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Clinical and Radiologic Manifestations: (a) coarse facial features, flat nasal bridge, stubby nose, and protuberant upper lip; (b) thickened palms and soles with an abnormal dermatoglyphic pattern, short digits, palmar flexion contracture, and hypoplastic fingernails; (c) hydronephrosis resulting from ureteral stenosis; bicornuate uterus; (d) inguinal hernia; (e) low-pitched hoarse voice; (f) failure to develop motor control, bifid uvula, and so forth.

Reference

Rüdiger RA et al: Severe developmental failure with coarse facial features, distal limb hypoplasia, thickened palmar creases, bifid uvula, and ureteral stenosis: a previously unidentified familial disorder with lethal outcome, *J Pediatr* 79:977, 1971.

SAETHRE-CHOTZEN SYNDROME

MIM#: 101400.

Synonyms: Acrocephalosyndactyly, Saethre-Chotzen type (ACS3); SCS.

Mode of Inheritance: Autosomal dominant with marked penetrance and variable expressivity; locus: 7p21, mutations in *TWIST* gene (also *FGFR2*, 3), mutations in *TWIST* NEIGHBOR: distinct learning disability (Chun et al, 2002; Kosan et al, 2002).

Clinical Manifestations: (a) craniofacial dysmorphism: *brachycephaly* and/or *acrocephaly*; facial asymmetry; visual defects; esotropia, exotropia; ptosis of the eyelids; lacrimal duct abnormalities; malformed ears; impaired hearing (Lee et al, 2003); flattened nasofrontal angle; beaked nose; cleft palate; highly arched palate; low-set frontal hairline; labial pits at the corners of the mouth; deviation of nasal septum; low-set ears; hypertelorism; strabismus; (b) mental subnormality in some cases; (c) *syndactyly* (*partial*; *soft tissue*); (d) other reported abnormalities: (1) head and neck: epicanthic folds; downslanting palpebral fissures; abnormal eyebrows (sparse medially; heavy laterally); irregular eyelid margins; optic atrophy; blepharophimosis; dacryostenosis; dental anomalies (malocclusion; supernumerary teeth; enamel hypoplasia) (Goho, 1998); (2) skeletal: short arms; short and broad hands; brachydactyly; fingerlike thumbs; clinodactyly; hypoplastic distal phalanges of the hands, shortened fourth metacarpals; short feet and toes; hallux valgus; broad great toes; dorsiflexion of the fourth toes; partially bifid distal phalanges of the great toes; (3) miscellaneous: short stature; renal anomalies (incomplete renal Fanconi syndrome) (Oktenli et al, 2002); congenital heart disease; cryptorchidism; simian palmar creases; dermatoglyphic alterations; imperforate anus; recurrent infections; seizures; neoplasm; defective neutrophil chemotaxis; hyper IgE syndrome (Boeck et al, 2001); congenital adrenal hyperplasia; familial translocation at chromosome 7p22; mirror image unilateral coronal synostosis in twins.

Radiologic Manifestations: (a) *variable degrees of craniosynostosis associated with plagiocephaly and facial asymmetry*;

maxillary hypoplasia; microcephaly; absent or underdeveloped frontal sinuses and mastoids; abnormal cephalometric findings; dilatation of lateral ventricles; increased intracranial pressure; (b) *partial cutaneous syndactyly of fingers and toes*; *brachyphalangy* (21/28), *clinodactyly* (17/28), *carpal fusions*—usually trapezium trapezoid (8/24), *cone-shaped epiphyses* (9/17) (Tresen et al, 2003); (c) other reported abnormalities: (1) skull: large sella turcica; parietal foramina; metopic suture synostosis; large fontanels; delayed closure of fontanels; calvarial ossification defect; (2) skeletal system: *cervical vertebral fusion* (9/20) (Anderson et al, 1997; Tresen et al, 2003); vertebral anomalies; small ilia and large ischia; coxa valga; short clavicles with distal hypoplasia; radioulnar synostosis.

Note: (1) Auralcephalosyndactyly has been used in describing familial cases of craniosynostosis of coronal sutures, syndactyly (third, fourth and fifth toes), and small pinnae. This may represent a variant of Saethre-Chotzen syndrome or a separate entity (Legius et al, 1989); (2) *Muenke craniosynostosis syndrome*: very similar to SCS phenotype, *FGFR3* mutation (*Pro250Arg*), with coronal craniosynostosis, calcaneo-cuboid fusion, carpal coalition, brachydactyly, Klippel Feil (Graham et al, 1998; Lowry et al, 2001; Muenke et al, 1997; Tresen et al, 2003); (3) Fountaine-Farriaux craniosynostosis syndrome (two cases): craniosynostosis with gray matter nodular heterotopia (Priolo et al, 2001).

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 Tresen A et al: The pattern of skeletal anomalies in the cervical spine, hands, and feet in SCS and Meunke-type mutation, *Pediatr Radiol* 33:168, 2003.

SAKATI SYNDROME

MIM#: 101120.

Synonyms: Acrocephalopolysyndactyly, Sakati type; ACPS III.

Clinical and Radiologic Manifestations: (a) acrocephaly; *craniosynostosis*; (b) unusual facies; dysplastic ears; (c) brachydactyly of the hands; *polydactyly* and *syndactyly* of the feet; (d) an unusual malformation of the knee region consisting of bowed femora, *hypoplastic tibias*, and posterior displacement of the fibulas on the femora; (e) other abnormalities: alopecia; skin atrophy; congenital heart disease; small penis; cryptorchidism; inguinal hernia.

Reference

Sakati N, Nyhan WL: A new syndrome with acrocephalopolysyndactyly, cardiac disease, and distinctive defects of the ear, skin, and lower limbs, *J Pediatr* 79:104, 1971.

SALLA DISEASE

MIM#: 604369.

Synonym: Sialuria, Finnish type.

Mode of Inheritance: Autosomal recessive; locus: 6q14-15; mutation in SLC17A5 gene.

Frequency: High incidence in Finland; Sweden: 23 patients (2002), mostly Finnish origin (Erickson et al, 2002).

Clinical Manifestations: Onset in infancy or early childhood (a) *mental and physical retardation*; (b) *ataxia, athetosis, abnormal deep tendon reflexes, inability to walk, impaired speech, and epileptic fits*; (c) *moderate to marked increase in the excretion of free N-acetylneuraminic acid (sialic acid) in urine*; prenatal detection (increased free sialic acid in amniocytes, mutational analysis); (d) other reported abnormalities: exotropia; slight corneal opacities; pale optic disc; hypertelorism; inguinal hernia; abnormal electroencephalographic findings; congenital ascites; (e) phenotypic spectrum (Varho et al, 2002).

Radiologic Manifestations: Thick calvarium in adult patients; brain atrophy in some; MRI: hypomyelination of cerebral white matter (rarely cerebellar), T2: higher signal intensity white > gray matter (Linnankivi et al, 2003; Sonninen et al, 1999); MRS: increased N-acetyl, creatine,

decreased choline (Varho et al, 1999); PET: increased glucose utilization (Suhonen-Polvi et al, 1999).

Note: The eponym *Salla disease* refers to the geographic area in northern Finland from which the patients originated; an adult form of sialic acid storage disease; allelic to infantile sialic acid storage disease.

References

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SAMS SYNDROME

MIM#: 602471.

Mode of Inheritance: AR.

Frequency: Two cases to 2002.

Clinical and Radiologic Manifestations: (1) acronym: Short stature, Auditory canal atresia, Mandibular hypoplasia, Skeletal abnormalities; (2) *scapulo-humeral synostosis*; humeral hypoplasia; radial head dislocation; *delayed pubic ossification*; (3) other reported abnormalities: genitourinary (GU) anomalies, DDH, club feet.

References

Lemire EG et al: SAMS: provisionally unique, *Am J Med Genet* 75:256, 1998.
 Ter Heide H et al: Auditory canal atresia, humeroscapular synostosis and other skeletal abnormalities: "SAMS" syndrome, *Am J Med Genet* 110:359, 2002.

SANDIFER SYNDROME

Frequency: About 50 published cases to 2003 (Bruckheimer et al, 1991).

Clinical Manifestations: (a) *abnormal movement or positioning of the head, neck, and upper part of trunk during or after eating*: sudden extension, continual movement from side to side, and flexion of the upper portion of the trunk and neck; (b) other reported abnormalities: vomiting; abdominal pain; *gastroesophageal reflux with or without hiatus hernia*;

esophagitis; manometric demonstration of low amplitude and slow propagation of esophageal peristalsis (improved when head tilted to one side); occurrence in children with brain damage or metabolic defects; association with Brachmann-de Lange syndrome; good response to medical or surgical antireflux treatment (subsidence of the abnormal movements); rare in breast-fed infants.

Radiologic Manifestations: *With the clinically described contortions, the gastroesophageal junction rises, and the upper portion of the stomach enters the thoracic cavity (hiatal hernia); delayed gastric emptying (US) (Fig. SYME-S-1).*

Note: (a) Torticollis has been reported in association with gastroesophageal reflux without a hiatal hernia; (b) two of the original patients reported by Kinsbourne were the cases of the neurologist Paul Sandifer whose name is associated with the syndrome.

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Figure SYME-S-1 ■ Sandifer syndrome. Dystonic neck movements associated with severe gastroesophageal reflux in a 5-year-old girl. (From Puntis JW, Smith HL, Buick RG, Booth IW: Effect of dystonic movements on oesophageal peristalsis in Sandifer's syndrome, *Arch Dis Child* 64:1311, 1989. Used by permission.)

SARCOIDOSIS

MIM#: 181000 (rare familial cases, AD).

Clinical Manifestations:

(A) General Symptoms: Fever, weight loss.

(B) Respiratory Manifestations: Dyspnea; productive or nonproductive cough; chest pain; wheezing; abnormal pulmonary function tests (impaired dynamic lung compliance and lung transfer factor for CO; etc.); abnormal cell on bronchoalveolar lavage (Chadelat et al, 1993; Sharma, 1985).

(C) Extrathoracic Manifestations: (a) skin, eyes (orbital pseudotumor), central nervous system (5%–16%), kidney, testicles, breast, salivary glands, nose, paranasal sinuses, larynx, liver, and lymph node involvement; (b) abdominal pain; nausea; vomiting; skeletal pain; muscular pain; arthralgia; arthritis (Besnier, 1889; Boeck, 1889; Campo et al, 1984; Friedman et al, 1983; Fye et al, 1991; Haas et al, 1986; Otake, 2001; Patel et al, 1991; Pattishall et al, 1986; Schaumann, 1917; Shaikh et al, 2000; Sharma, 1985; Torralba et al, 2003).

(D) Immunologic Changes: Depression of delayed-type hypersensitivity; hyperactive circulating antibody response; serum KL-6 monitoring; (Finke et al, 1986; Kondo et al, 2001; Sharma, 1985).

(E) Cardiac Manifestations: Arrhythmias; conduction disturbances; cardiomyopathy (Sharma, 1985).

(F) Laboratory Findings: Low-grade anemia; hypercalcemia; hypercalciuria; high levels of serum alkaline phosphatase and cholesterol; elevated serum globulin levels, particularly the g fraction; elevation of the serum angiotensin-converting enzyme level; chronic thrombocytopenia (Field et al, 1987; Sharma, 1985).

(G) Other Reported Abnormalities: Muscular sarcoidosis (nodular and myopathic types); association with liver cirrhosis; splenomegaly; protein-losing enteropathy; simultaneously occurring sarcoidosis and scleroderma; positive Kveim test (some false positives; safety questioned); interferon-induced sarcoidosis; isolated cavernous sinus syndrome; necrotizing sarcoid granulomatosis is rare in childhood (four cases), pulmonary sarcoid in infancy is rare; (du Bois et al, 1993; Finke et al, 1986; Groen et al, 1993; Heinrich et al, 2003; Maddrey, 1983; Popović et al, 1980; Rubinowitz et al, 2003; Rudzki et al, 1975; Sharma, 1985; Tsagris et al, 1999; Zarei et al, 2002).

Radiologic Manifestations:

(A) Respiratory System: (a) airways: laryngeal obstruction (laryngeal infiltration; epiglottic enlargement; epiglottic and subglottic polypoid masses; tracheal stenosis); extrinsic tracheal compression; cystic bronchial dilatation; (b) lungs: hilar haze; pulmonary infiltrates; ground-glass opacities; lung distortion; “crazy paving” pattern (CT); spherical (alveolar) masslike opacities, “sarcoid galaxy” sign; granulomatous nodules; irregularly thickened bronchovascular bundles (CT); small nodules along vessels (CT); granulomas adjacent

to the visceral pleura (CT); bullae; thick wall cavities; atelectasis; peripheral pulmonary infiltrates; fibrosis and end-stage lung disease; (c) mediastinum: eggshell calcification in the hilar and mediastinal lymph nodes; MRI of lymphadenopathy variable (high or low intensity on T2-weighted images); mediastinal emphysema; (d) pleura: granulomas in the pleural; pleural thickening; fibrothorax; pleural effusion; chylothorax; pneumothorax (Bergin et al, 1989; Brauner et al, 1989; Johnson et al, 1984; Judson et al, 1993; McHugh et al, 1993; Mendelson et al, 1992; Merten et al, 1980; Miller, 1981; Nakatsu et al, 2002; Nishimura et al, 1993; Rockoff et al, 1985; Rossi et al, 2003; Visco et al, 1979).

(B) Central Nervous System (CNS): cerebral hemispheres, cerebellar and mesencephalic structures, cranial nerves, particularly II and VII, and pituitary gland most common sites; brainstem and spinal cord less common sites: (a) meningeal lesions causing nodular granulomatous masses; adhesive meningitis causing obstructive hydrocephalus; communicating hydrocephalus with sarcoid arachnoiditis; (b) intraparenchymal CNS lesions: CT demonstration of a contrast-enhanced mass or masses; hypodense white matter lesions (CT); great variability on magnetic resonance imaging (isointense or hypointense relative to the cerebral cortex on T1- and T2-weighted images or hyperintense on T2-weighted images); enhancement of sensitivity of MR imaging by the use of gadopentetate dimeglumine; MRI: *nonspecific findings*, periventricular/white matter mimics multiple sclerosis (MS) (46%), supra/infratentorial lesion mimics metastases (36%), solitary intraaxial mass mimics astrocytoma (9%), leptomeningeal enhancement (36%) (Pickuth et al, 2000); (c) spinal cord lesions: intramedullary expansion; areas of patchy, multifocal, parenchymal enhancement and areas of linear peripheral enhancement on MR imaging (Christoforidis et al, 1999; Lexa et al, 1994; Nesbit et al, 1989; Seltzer et al, 1992).

(C) Osteoarticular Manifestations: Oval or spheroid lytic lesion of the phalanges; “lace work” type of destructive lesions of the phalanges; lytic lesion and subperiosteal new bone formation of the long bones; radiolucent calvarial defects; scattered radiodense lesions (low signal intensity on T1-weighted images; low central signal zone surrounded by a high signal rim on T2-weighted images); arthritis; osseous lesions (5%); calcaneal involvement (rare); cervical spine sclerotic lesions; (Allanore et al, 2001; Dally et al, 1987; Godin et al, 1977; Goltzarian et al, 1994; Grossman et al, 1985; Guilford et al, 1982; Hall et al, 1992; Jelinek et al, 1998; Otake, 2001; Oven et al, 1986; Patel et al, 1991; Sartosis et al, 1985).

(D) Cardiovascular System: Cardiomegaly; cardiac failure; pericardial effusion; cardiomyopathy; left ventricular aneurysm; pulmonary artery narrowing; cardiac MRI: nodular increased signal intensity on T2, contrast enhanced images (Vignaux et al, 2002).

(E) Digestive System: Nodular lymphoid hyperplasia of the small intestine; antral and pyloric stiffening and narrowing; gastric and duodenal ulcers; abnormal mucosal pattern; sacculi (Britt et al, 1991; Davis et al, 1970; Levine et al, 1989).

(F) Genitourinary: Enlargement of the kidneys resulting from sarcoid granulomas; nephrocalcinosis; poor concentration of contrast medium on excretory urography; ureteral obstruction (Duszlak et al, 1982; Nocton et al, 1992; Schoenfeld et al, 1985; Tammela et al, 1989).

(G) Liver and Spleen: (a) hepatomegaly; splenomegaly; (b) US: normal or increased hepatic parenchymal echogenicity; coarsening of the liver parenchyma with or without discrete nodules; splenic nodules; focal calcifications; (c) CT: heterogeneous enhancement with hypodense areas; (d) MR: hepatic and splenic contour irregularity; abnormal signal intensity; spiculation of small hepatic vascular branches; high periportal signal intensity; (e) granulomatous biliary tract obstruction; (f) portal hypertension (Bloom et al, 1978; Britt et al, 1991; Iko et al, 1982; Kessler et al, 1993; Le Verger et al, 1977; Mathieu et al, 1986).

(H) Skeletal Muscles: Muscular sarcoid: 4 types (nodular, chronic myopathy, acute myositis, asymptomatic) (a) US: hyperechoic center with hypoechoic periphery; (b) MRI: star-shaped central structure of decreased signal intensity; enhancement of the peripheral in post-contrast images; (c) ⁶⁷Ga scintigraphy: increased uptake in the nodules (Otake, 2001).

(I) Eyes: Lacrimal glands, optic nerve and its sheath, and ocular bulb involvement; anterior uveitis; choroid involvement with subretinal fluid collection (Frohman et al, 2001; Signorini et al, 1984; Som et al, 1982).

(J) Salivary Glands: Ectasia; spreading apart of the ducts in the early phase; displacement of the ducts resulting from swelling in the later phase; destruction of the duct system (Iko et al, 1986; Som et al, 1981).

(K) Radioisotope Scanning: (a) ^{99m}Tc pyrophosphate or pyrodiphosphate compounds: uptake in the involved regions: bones, lacrimal glands, salivary glands, paranasal sinuses, mediastinum, lung, and inguinal areas; (b) ⁶⁷Ga citrate: uptake in pulmonary and extrapulmonary foci; (c) a distinctive intrathoracic lymph node ⁶⁷Ga uptake pattern, resembling the Greek letter lambda; (d) symmetrical lacrimal and parotid gland ⁶⁷Ga uptake (panda appearance); (e) positive scintigraphy with J001 macrophage targeting glycolipopeptide; somatostatin receptor imaging (¹¹¹In-pentetreotide) (Diot et al, 1992; Iko et al, 1982, 1986; Johnson et al, 1984; Kwekkeboom et al, 1998; Patel et al, 1991; Sohn et al, 2001; Sulavik et al, 1990).

(L) Other Reported Abnormalities: Empty sella turcica; association with tumoral calcinosis; abdominal adenopathy; pancreatic lesions; female pelvic visceral involvement; subcutaneous imaging: striped/mesh pattern; thymic carcinoma (rare) (Britt et al, 1991; Chiang et al, 1984; Friedman et al, 1983; Ohmichi et al, 1997; Shinozaki et al, 1998; Wolpe et al, 1987) (Fig. SYME-S-2).

Therapy: Corticosteroids effective (Paramothayan et al, 2002).



Figure SYME-S-2 ■ Sarcoidosis in a 15-year-old girl with an oval lytic lesion of the proximal phalanx of the fourth digit (arrows).

Note: (1) MRI findings (musculoskeletal): early, but nonspecific (Moore et al, 2003); (2) mimics metastatic disease (Ludvig et al, 2003), cardiac sarcoid mimick right ventricular dysplasia (Shiraishi et al, 2003); MRI useful in all areas of involvement (Mana, 2002).

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SARS

Synonym: Severe acute respiratory syndrome.

Frequency: More than 8000 cases worldwide to 2004; first cases in China, November 2002.

Clinical Manifestations: (1) similar to many other acute respiratory infections; often rapid deterioration at end of second week; (2) etiology: SARS-coronavirus (Christian et al, 2004; Vijayanand et al, 2004).

Radiologic Manifestations: (1) plain film: (a) early: air-space opacification (78%), peripheral/lower lung fields; (b) later: clearing (1–2 weeks) or deterioration, multifocal opacification with confluence consistent with acute respiratory distress syndrome (ARDS) pattern; (c) other reported abnormalities: round pneumonia (Bitar et al, 2004); (2) CT: ground-glass opacification (thickened interstitium), “crazy paving pattern,” consolidation; (precede plain-film findings by 2 days) (Antonio et al, 2003; Chan et al, 2004; Hsieh et al, 2004; Hui et al, 2003; Müller et al, 2004); (3) pediatric findings: similar to adult but less extensive (Babyn et al, 2004; Tsou et al, 2004).

Differential Diagnosis (radiographically): (1) atypical pneumonias (*Mycoplasma*, *Chlamydia*); (2) ARDS.

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SATOYOSHI SYNDROME

MIM#: 600705.

Synonym: *Komuragaeri disease* (calf-spasm).

Frequency: Approximately 50 reported cases to 2003 (Kamat).

Clinical Manifestations: (a) *painful muscle spasms with onset in childhood*; slowly progressive course; involving masticatory muscles and the muscles of neck, trunk, and limbs; (b) *alopecia*; (c) *diarrhea*; malabsorption(d) *short stature*.

Radiologic Manifestation: Irregularity and widening of the physes and a mixture of translucent and sclerotic areas in the metaphyses (*mimicking metaphyseal chondrodysplasia*); *slipping of the epiphyses* (proximal humerus; distal radius; phalanges of the hands; proximal femur; distal femur), and patellae (Wisuthsarewong et al, 2001); *acroosteolysis*; *osteolysis* (clavicle; trochlea); *cystic bone lesions*; bone fragmentation at tendinous insertion sites; fatigue fracture; osteoarthritis; (Haymon et al, 1997).

Therapy: (1) IVIG (Kamat et al, 2003); (2) corticoid steroids (Cecchin et al, 2003; Wisuthsarewong et al, 1967); (3) botulinum toxin (Merello et al, 1994).

Note: (1) Bone lesions may be resulting from repeated injuries to the growth plates, associated with recurrent vigorous muscle spasms (Ikegawa et al, 1993); (2) unilateral presentation (Uddin et al, 2002); (3) hyperthermia, acute renal/respiratory failure, rhabdomyolysis, cardiac arrest following midazolam therapy (Adachi et al, 1998); (4) adult-onset: milder with just muscle spasm and alopecia (Ikeda et al, 1998).

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SCAPULOILIAC DYSOSTOSIS (DYSPLASIA)

MIM#: 169550, 260660.

Synonyms: *Pelvis-shoulder dysplasia*; *Kosenow syndrome*; *pelvis-scapular dysplasia*.

Mode of inheritance: AD (milder cases); AR (severe cases) (Amor et al, 2000; Elliott et al, 2000).

Frequency: 13 cases reported to 2003.

Clinical Manifestations: Varied, not consistent; *eyes*: epicanthic folds/narrow palpebral fissures (6/11); microphthalmos (4/11); ectopic pupils; coloboma of the retina (3/11); corneal opacification; *ears*: small, malformed and low-set ears (7/11); central nervous system (CNS): hydranencephaly, cerebral atrophy (4/11); *craniofacial*: micrognathia, microglossia, cleft palate (4/11); genitourinary (GU): ambiguous genitalia, hydronephrosis (3/11); (Elliott et al, 2000).

Radiologic Manifestations: (a) *extreme hypoplasia of the scapula and ilium*; (b) hypoplasia of the clavicle; (c) lordosis of lumbosacral spine; rounded appearance of the lumbar vertebral bodies in infancy; (d) faulty development of ribs; overconstriction of the shaft of the femora and tibiae; (e) other reported abnormalities: *absent fibulae* (3/11); cranium bifidum; micrognathia, radio-ulnar synostosis; synostosis

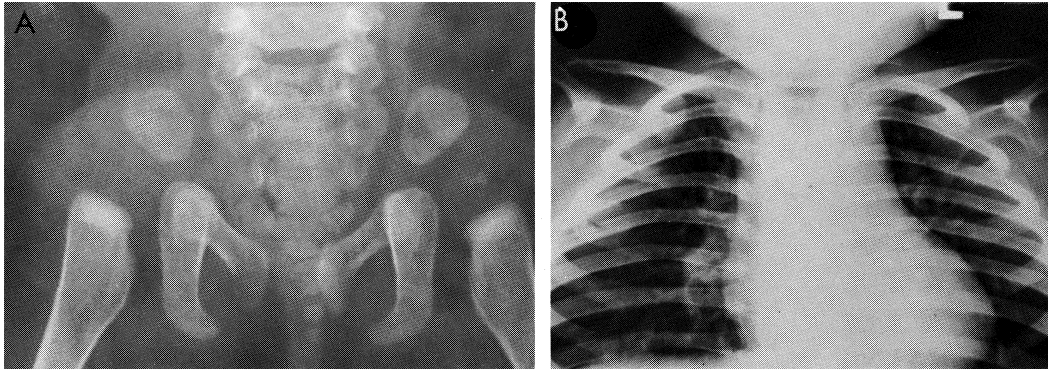


Figure SYME-S-3 ■ Scapuloiliac dysostosis. **A**, Extreme hypoplasia of the ilium in a 5-month-old girl. **B**, Bilateral cervical ribs, straight clavicles, and scapular dysplasia in the same patient at 20 months of age. (From Kosenow W, Niederle J, Sinios A: Becken-Schulter dysplasia, *Fortschr Rontgenstr* 113:39, 1970. Used by permission.)

of the distal portions of the clavicles to the scapulae; clinodactyly of the fingers; simple partial syndactyly (Fig. SYME-S-3).

Note: (1) *Emx2* gene knockout mouse: similar phenotype (Williams, 2003); spectrum of disorder(s) (Elliott et al, 2000).

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SCHILDER DISEASE

MIM#: 272100.

Synonyms: Inflammatory myelinoclastic diffuse sclerosis; *sudanophilic cerebral sclerosis*; myelinoclastic diffuse sclerosis; encephalitis periaxialis diffusa.

Clinical Manifestations: Slowly progressive or episodic course: (a) *pyramidal tract signs, blindness, deafness, extraocular muscle paralysis, nystagmus, and dysarthria*; (b) *psychiatric disturbances; mental retardation*; (c) other reported abnormalities/associations: Turner syndrome (one case) (Stachniak et al, 1995).

Radiologic Manifestations: (a) *CT: decreased density in the periventricular white matter; ventricular dilatation; rim-enhancing at the border of the cerebral white matter lesions; cavitory white matter lesions; fluctuating contrast enhancement in the zones of active inflammation; mass effects*; (b) *MR: course*

of demyelination from the periventricular white matter distally (increased signal intensity on T2-weighted images; multiple mass lesions mimic neoplasms, abscess: extensive perilesional edema (Kotil et al, 2002; Kurul et al, 2003; Nejat et al, 2002); (c) spinal cord involvement (demyelination), recurrences (Fitzgerald et al, 2000).

Differential Diagnosis: (a) adrenoleukodystrophy (presence of abnormal very-long-chain fatty acids; lesions in the occipital lobes more symmetrical); (b) progressive multifocal leukoencephalopathy; (c) Pelizaeus-Merzbacher disease; (d) *childhood multiple sclerosis*; cerebral sclerosis, Scholtz type, X-linked (MIM# 302700).

Note: (a) The criteria established by Poser et al. for the diagnosis of Schilder disease are (1) *a subacute or chronic demyelinating disorder involving the centrum semiovale of the cerebral hemispheres with one or two symmetric bilateral plaques measuring at least 2 × 3 cm*; (2) *there should be no involvement of the peripheral nervous system or the adrenal glands*; (3) *absence of very-long-chain fatty acids of cholesterol esters*; (4) *histologic findings identical to those of multiple sclerosis*; (b) a variant of multiple sclerosis (Fitzgerald et al, 2000; Gallucci et al, 2001).

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SCHINZEL-GIEDION SYNDROME

MIM#: 269150.

Synonym: SGS.

Mode of Inheritance: Probably autosomal recessive.

Frequency: More than 30 cases reported to 2003 (Grosso et al, 2003).

Clinical Manifestations: (a) *coarse facial features*, gingival hyperplasia (Kondoh et al, 2001); frontal bossing, wide sutures and anterior fontanelle, midfacial hypoplasia, orbital hypertelorism, alacrima, corneal hypoesthesia (Manouvrier-Hanu, 2003; Minn et al, 2002); short and upturned nose, and low-set ears; deafness; (b) *seizures* (33%); *profound motor and intellectual retardation*; infantile spasms (West syndrome 25%) (Grosso et al, 2003); (c) *genitourinary anomalies: hydronephrosis; hypospadias*; hypoplastic scrotum; short penis; *deep interlabial sulcus; hypoplasia of the labia majora or minora*; hymeneal atresia; (d) *clubfeet*; (e) *hypertrichosis*; hypoplasia of the dermal ridges; hyperconvex nails; (f) cardiac abnormalities (4/13); (g) other abnormalities: failure to thrive; choanal stenosis; microcornea; corneal opacity; postaxial hexadactyly; mesomelic brachymelia; facial hemangiomas; malignant *sacrococcygeal teratoma* (Robin et al, 1993; Sandri et al, 2003); hepatoblastoma.

Radiologic Manifestations: (a) *short and sclerotic base of the skull*; poor skull vault mineralization; *steep base of the skull*; *wide supraoccipital "synchronrosis"*; multiple wormian bones; orbital hypertelorism; wide cranial sutures and fontanelles; brain MRI: neurodegeneration (Alembik et al, 1999; Shah et al, 1999); temporal bone CT: "tuning fork" stapes (Minn); (b) increased density of long tubular bones and vertebrae; *broad ribs*; long clavicles; *thick long-bone diaphyses*; wide distal metaphysis of femurs; *hypoplastic or aplastic pubic bones*; moderate mesomelic brachymelia; short first metacarpals; hypoplasia of the distal phalanges in the hands and feet; (c) urinary system anomalies: *hydronephrosis; megacalyces* (US, prenatal) (Rittinger et al, 1999); low position of the kidneys; hydroureter; ureteric stenosis; duplication of the collecting system; (d) other reported abnormalities: ventriculomegaly; echogenic bands within the lateral ventricles; brain atrophy; thin corpus callosum.

Differential Diagnosis: (a) Rüdiger syndrome; (b) hypothyroidism; (c) *mucopolysaccharidoses*; (d) gangliosidosis; (e) SGS-like syndrome: milder phenotype, no cardiac renal abnormalities (Joss et al, 2002).

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SCHNITZLER SYNDROME

Frequency: About 50 cases reported to 2004.

Clinical Manifestations: *Urticarial eruption; monoclonal IgM gammopathy*; intermittent fever; *joint/bone pain*; adenopathy, hepato/splenomegaly; malignancy risk: lymphoplasma-cytic (15%) (Lipsker et al, 2001).

Radiologic Manifestations: (1) plain film: *paracortical osteosclerosis*, periosteal reaction, joint swelling; osteolysis; (2) bone scan: increased uptake (early: bone/joint areas, late dimetaphyseal region uptake); (3) MRI: long bones (low signal-T1, high signal T2 in marrow); (4) US: liver (dense lesions [nodular regenerative hyperplasia]) (Lauwers et al, 1999); (5) CT: hyperostosis both cortical and cancellous bone (De Waele et al, 2000; Ferrando et al, 1994; Lecompte et al, 1998).

Differential Diagnosis: (1) lymphoma; (2) rheumatoid arthritis; (3) lupus, CINCA, Muckle-Wells syndrome, Waldenstrom disease, POEMS syndrome.

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SCHWARTZ-JAMPEL SYNDROME

MIM#: 255800.

Synonyms: *Chondrodystrophic myotonia*; osteochondromuscular dystrophy; Aberfeld syndrome; SJS.

Mode of Inheritance: Autosomal recessive, variable expressivity; SJS 1 locus: 1p36.1, mutations in perlecan gene (Arikawa-Hirasawa et al, 2002).

Frequency: More than 120 cases to 2003.

Clinical Manifestations: Progressive disease with an onset of symptoms in infancy: (a) “masklike” facies, blepharophimosis, microstomia, recessed chin, and full cheeks; (b) short stature; stiff posture; crouched stance; short neck; short trunk; waddling gait; pectus carinatum; kyphosis or kyphoscoliosis; (c) prolonged myotonic responses; firm hypertrophic muscles; muscular weakness and wasting; depressed tendon reflexes; (d) large-joint stiffness and contracture; carpal tunnel syndrome (Cruz Martinez et al, 1998); (e) high-pitched voice; (f) immunologic abnormalities (humoral and cellular); (g) manifestations in neonates: short stature; contractures; myotonia (electromyographic; clinical); muscle hypertrophy, muscle rigidity; choking; respiratory difficulty; apnea, abnormal facies (blepharophimosis; microstomia; etc.); death resulting from asphyxia; (h) other reported abnormalities: compression myopathy; abnormal electromyogram (non-specific); central nervous system (CNS) dysfunction (Paradis et al, 1997; Singh et al, 1997); some degree of mental retardation; facial expression of crying when asked to smile; *malignant hyperthermia* (a potentially lethal complication during anesthesia); sleep apnea (Cook et al, 1997); orodental complications (Stephen et al, 2002).

Radiologic Manifestations: (a) triangular deformity of the pelvis; flared iliac wings; (b) *hip disorders*: coxa vara or

coxa valga; delay in appearance of femoral head ossification; fragmentation of the femoral head; flat femoral head; slipped capital femoral epiphysis; (c) slender diaphysis of the long bones; anterior bowing of the long bones; irregularity of the femoral and tibial epiphyses in the knee region; (d) spine and skull: scoliosis; kyphoscoliosis; marked platyspondyly; coronally cleft vertebral bodies; failure of ossification of the anterior half of some vertebral bodies; basilar invagination, platybasia, Chiari 1 malformation (CT, MRI) (Samimi et al, 2003); (e) pectus carinatum; (f) increased bone density in neonates; (g) ultrasound: increased echogenicity of muscle; computed tomography: high and low attenuation in varying muscle groups, increased muscle bulk with normal attenuation (Iwata et al, 2000); (h) prenatal ultrasonography in at risk fetus: constant flexion of the fingers, decreased fetal activity, and shortening and bowing of the femora (Fig. SYME-S-4).

Therapy: (1) mexiletine (Yang et al, 2002); increased doses of rocuronium (Eikermann et al, 2002).

Differential Diagnosis: (a) Freeman-Sheldon syndrome; (b) Marden-Walker syndrome; (c) urofacial syndrome (facial expression when laughing); (d) blepharophimosis-ptosis-epicanthus inversus MIM# 110100; (e) myotonia with skeletal abnormalities and MR MIM# 255710.

Note: (1) *Giedion classification*: type 1A: childhood presentation, moderate bone dysplasia; type 1b: newborn presentation, resembles Kniest dysplasia; type 2: newborn presentation, high mortality, metaphyseal widening (Stuve-Wiedemann-like (Di Rocco et al, 2003; Giedion et al, 1997); SJS 2 and Stuve-Wiedemann dysplasia are identical (or allelic) (Superti-Furga

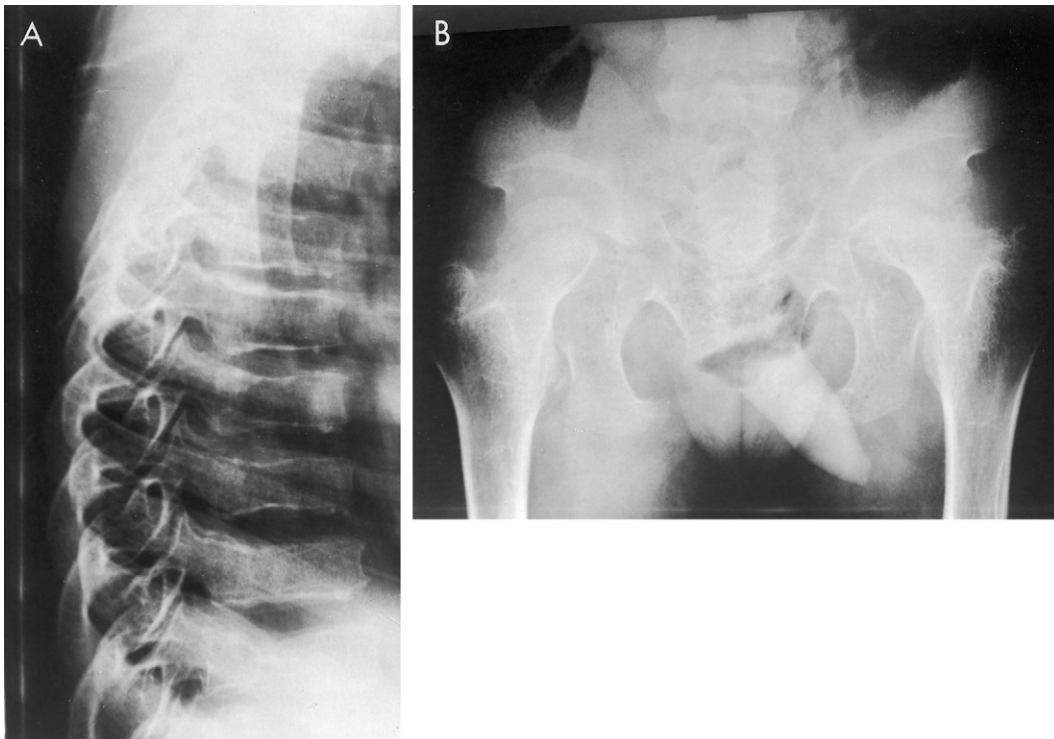


Figure SYME-S-4 ■ Schwartz-Jampel syndrome. **A**, Platyspondyly. **B**, Pelvic dysplasia, coxa vara, flattening of the capital femoral epiphysis. (From Horan F, Beighton P: Orthopedic aspects of Schwartz syndrome, *J Bone Joint Surg Am* 57:542, 1974. Used by permission.)

et al, 1998); (2) Spranger SJS spectrum (later onset of myotonia): kyphomelic dysplasia, Kniest-like (Burton) dysplasia with whistling face, micromelic chondrodysplasia (shortened bowed femurs/tibiae) (Spranger et al, 2000); (3) perlecan gene disorders: SJS, dyssegmental dysplasia-Silverman/Handmaker.

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SCIMITAR SYNDROME

MIM#: 106700.

Synonyms: Venolobar syndrome; Halarz syndrome.

Mode of Inheritance: Some familial cases have been reported (AD, AR).

Pathology: (a) hypoplasia of the right lung and right pulmonary artery; absent pulmonary artery (five cases) (Saltik et al, 1999); (b) dextroposition of the heart; (c) anomalous systemic vessels to an abnormal segment originating totally or in part from the thoracic aorta, abdominal aorta, or even the celiac axis; (d) anomalous venous drainage of part or all of the right lung usually into the inferior vena cava, portal vein, hepatic vein, or rarely the lower right atrium; drainage

into left atrium (milder phenotype; ± 12 cases) (Holt et al, 2004); anomalous pulmonary venous connection at the supracardiac, cardiac and infracardiac levels in a single case (Geggel, 1993); (e) anomalies of the diaphragm on the affected side (accessory diaphragm; hernia; cyst); (f) extrapleural soft tissues replacing missing lobe(s); (g) associated congenital heart defects (atrial septal defect; coarctation of the aorta; ventricular septal defect; patent ductus arteriosus; tetralogy of Fallot (three cases) (Azhari et al, 2000); and so forth; (h) other reported abnormalities: horseshoe lung deformity (Takahashi et al, 1997); absent right pulmonary artery, the "inverse scimitar" (all the pulmonary veins joining behind the heart, forming a long, tortuous channel at the base of the right lung, and then coursing through the lung in a cranial direction, emptying into the superior vena cava); left-sided scimitar syndrome (Rutledge et al, 2001); secondary pulmonary hemosiderosis (Cannon et al, 2001); pulmonary arteriovenous (AV) fistulas (Le Rochais et al, 1999); Knobloch syndrome (two cases); Langer-Giedion syndrome (Sinzig et al, 1999); scimitar syndrome plus: iris coloboma, enlarged cysterna magna, myelination abnormality (Ruggieri et al, 2003).

Clinical Manifestations: May be asymptomatic or symptomatic: (a) recurrent respiratory infection; (b) decrease in breath sounds on the right side of the chest; (c) small right hemithorax.

Radiologic Manifestations: (a) *shift of the heart and mediastinum to the right*; (b) unsharp right cardiac border (resulting from a strong rotation of the heart into the right hemithorax), and right hemidiaphragm; (c) *scimitar-shaped vein located in the right supradiaphragmatic region and draining into the inferior vena cava* (partial or total anomalous drainage); other forms of anomalous venous drainage: "double-scimitar" venous drainage into the inferior vena cava; simultaneous venous return from the right lung to both the inferior vena cava and the left atrium or scimitar-type vein draining into the left atrium without connection to the inferior vena cava or dual connection to both (Tortoriello et al, 2002); association with a crossover lung segment; left-sided scimitar syndrome (anomalous left pulmonary venous drainage to the inferior vena cava and through the pericardiophrenic vein to the innominate vein); meandering right pulmonary vein (Salazar-Mena et al, 1999); (d) CT, 3D CT: hyparterial relationship of the right bronchus to the pulmonary artery; the course and drainage site of the scimitar vein; mediastinal shift; unusual fissures; abnormal bronchial tree, and pulmonary lobation, horseshoe lung (Inoue et al, 2002); gadolinium-enhanced, velocity-encoded cine MRI (Gilkeson et al, 2000; Henk et al, 1997; Marco de Lucas et al, 2003; Puvaneswary et al, 2003); (e) bronchiectasis of the right lung; (f) *fetal diagnosis*, 2D, 3D Doppler: cardiac dextraposition (Abdullah et al, 2000; Michailidis et al, 2001; Valsangiacomo et al, 2003); (g) other reported abnormalities: stenosis of the anomalous vein draining into the inferior vena cava; pulmonary hypertension; scimitar sign with partially hypoplastic right lung; systemic arterial supply and pulmonary vein drainage into the left atrium (Cukier et al, 1994) (Figs. SYME-S-5 and SYME-S-6).



Figure SYME-S-5 ■ Scimitar syndrome in a 5-year-old girl. Note the slightly smaller right hemithorax as compared with the left, the minimal shift of the heart to the right, the indistinct right cardiac border, and the scimitar-shape anomalous vein. (From Gwinn JL, Barnes GR Jr: Radiological case of the month, *Am J Dis Child* 114:585, 1967. Copyright American Medical Association. Used by permission.)

Differential Diagnosis: (1) nonsyndromic total anomalous pulmonary venous return (TAPVR); bronchial stenosis (Hsieh et al, 1997); (2) *primary pulmonary hypoplasia* (familial) (Green et al, 1999).

Note: The following represent the major components of “congenital pulmonary venolobar syndrome” with the first two most constantly occurring components: (1) *lobar aplasia, or hypoplasia*; (2) *partial anomalous pulmonary venous drainage*; (3) absence of a pulmonary artery; (4) pulmonary sequestration; (5) systemic arterialization of the lung; (6) absence of the inferior vena cava; (7) accessory diaphragm (Woodring et al, 1994).

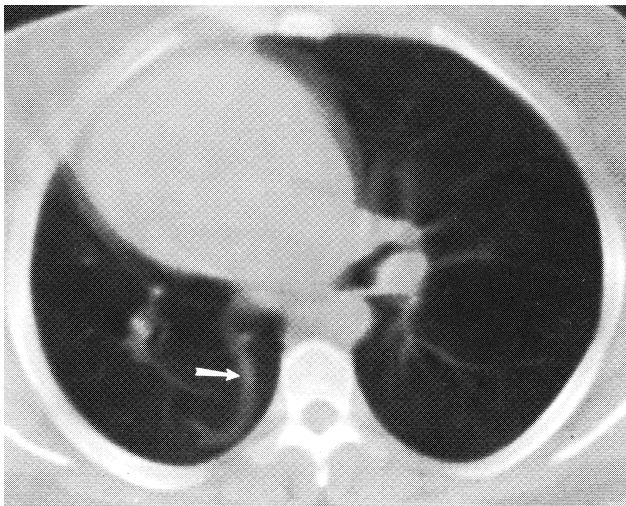


Figure SYME-S-6 ■ Scimitar syndrome. A CT scan at the level of the left lower bronchus shows a strong mediastinal shift to the right, abnormal lucency of the right lung, and disordered vascularity. The large scimitar vein (arrow) curving posteriorly is connected to the hilum (probably to the left atrium) at this level and on the lower section was shown to be connected to the inferior vena cava. (From Godwin JD, Traver RD: Scimitar syndrome: four new cases examined with CT, *Radiology* 159:15, 1986. Used by permission.)

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SCLERODERMA

MIM#: 181750.

Synonyms: Systemic sclerosis; progressive systemic sclerosis; systemic scleroderma; acrosclerosis syndromes.

Frequency: An incidence of about 12 new cases per million population per year (Maddison et al, 1993); approximately 100 reported cases in children and adolescents; rarely familial (AD).

Clinical Manifestations: Scleroderma includes a group of heterogeneous connective tissue diseases ranging from localized scleroderma to progressive systemic sclerosis involving skin and internal organs:

(A) Skin: *Edema, induration, and finally atrophy.*

(B) Alimentary System: Dysphagia; nausea and vomiting; constipation, or diarrhea; abdominal distension; intestinal pseudo-obstruction; secondary malabsorption (abnormal intraluminal bacterial flora); fecalith formation associated with constipation; acute abdominal manifestation (obstruction; bowel perforation; peritonitis; ischemia; bowel infarction; hemorrhage resulting from telangiectasia) (Campbell et al, 1986; Kaye et al, 1994).

(C) Cardiovascular System: Pericardial disease (acute process with chest pain, dyspnea; fever, and a pericardial friction rub or a chronic picture of pericardial effusion); myocardial fibrosis (diffuse and patchy distribution; abnormalities of myocardial perfusion); disorders of cardiac rhythm and conduction; decreased right ventricular ejection fraction; decreased left ventricular ejection fraction; stress-induced reversible myocardial perfusion abnormalities; hypoxic pulmonary vasoconstriction; cold-induced reversible myocardial ischemia; pulmonary hypertension; cor pulmonale (Arroliga et al, 1992; Follansbee et al, 1993); *Raynaud phenomenon* (in about 60%), gangrene of the extremities.

(D) Respiratory System: Abnormalities of pulmonary function (restrictive ventilatory defect; air flow obstruction; depressed diffusing capacity for carbon monoxide); pulmonary hypertension (Morgan et al, 1991); severe restrictive lung disease (15%) (White, 2003).

(E) Neurologic Manifestations: Autonomic dysfunction (parasympathetic impairment and sympathetic overactivity); peripheral nerve dysfunction; necrotizing encephalitis;

brain abnormalities adjacent to the cutaneous manifestations (Dessein et al, 1992; Lüer et al, 1990; Schady et al, 1991).

(F) Antinuclear Antibodies: Association of different types of sclerodermas with specific immunologic markers (Blaszczyk et al, 1991; Kahaleh, 1993; Maddison et al, 1993).

(G) Other Reported Abnormalities: Joint pain; skeletal myopathy; abnormal renal physiology (renovascular disease; elevated plasma renin activity; reduced para-aminohippurate); association of linear scleroderma and melorheostosis; scleroderma renal crisis; association with hypothyroidism or hyperthyroidism, impotence, malignancies (Clements et al, 1994; Follansbee et al, 1993; Nicholson et al, 1986; Nowlin et al, 1986; Wenzel, 2002).

(H) Overlap syndromes: (1) lupus (SLE); (2) rheumatoid arthritis; (3) Sjogren syndrome; (4) polymyositis; portal hypertension (10 cases) (Pope, 2002; Tsuneyama et al, 2002).

Radiologic Manifestations:

(A) Skeletal System: (a) *absorption of the distal phalanges*; absorption of carpal bones and the distal portions of the radius and ulna (rare); foot involvement less common than hand (La Montagna et al, 2002); (b) periarticular soft tissue swelling; *joint destruction*; (c) *soft tissue calcification*; paraspinal calcinosis (van de Perre et al, 2003); (d) generalized osteoporosis; (e) carpal synostosis; (f) periosteal new bone formation of the long bones; (g) thickening of the skin (ultrasonographic measurement of the finger: 3.3 +/- 0.7 mm as compared with normal control subjects of 2.5 +/- 0.2 mm); (h) other manifestations: ankylosis of the interphalangeal joints; intra-articular calcification associated with bone erosion; osteolysis of the calcaneus in a child with localized scleroderma; rib erosion; resorption of ribs and the medial ends of the clavicles (Bassett et al, 1981; Doyle et al, 1990; Greenberg et al, 1991; Resnick et al, 1978; Shanks et al, 1983).

(B) Alimentary Tract: (a) *wide and atonic esophagus with decreased peristalsis*; stricture; Barrett esophagus; wide-mouth sacculations (Coggins et al, 2001); (b) atonic dilated stomach; (c) gastroesophageal reflux; (d) *dilatation and sacculation of the small bowel* with decreased motility and peristaltic activity; prolonged transit time; increased fluid; diverticula; packed valvulae; (e) *areas of sacculation and narrowing of the colon* and thickened longitudinal folds in the narrowed segment; increased fluid; postevacuation residua; increased length; lack of haustrations; megacolon; thin section endo anal MRI: incontinence (deSouza et al, 1998); (f) other manifestations: corrugated mucosal pattern of the esophagus; atypical wide-mouthed esophageal diverticula (Agha et al, 1985; Bhalla et al, 1993; Campbell et al, 1986; Drane et al, 1986; Horowitz et al, 1973; Shamberger et al, 1983).

(C) Heart: Cardiomegaly; pericardial effusion (2/18) (Anvari et al, 1992; Thompson et al, 1998).

(D) Respiratory System: *Small cystic areas in the lung; diffuse lung fibrosis; detection of interstitial lung disease by*

high-resolution computed tomography (subpleural lines; honeycombing; parenchymal bands); pleural effusions (7%); *lymphadenopathy* with diffuse lung disease (75%) (Arroliga et al, 1992; Remy-Jardine et al, 1993; Schurwitzki et al, 1990; Seely et al, 1998; Singen, 1986; Thompson et al, 1998; Wechsler et al, 1996).

(E) Other Reported Abnormalities: Widening of the peridontal membrane; dilatation of the pulmonary artery and main branches in patients with pulmonary arterial hypertension; diffuse spotty lucencies on the nephrogram phase of renal arteriography; MRI: hyperintense areas adjacent to cutaneous and bony lesions; intraspinous calcifications; pneumoperitoneum; mediastinal lymphadenopathy; asymptomatic cerebral hypoperfusion (CT SPECT); 13 megahertz US skin: “flattened yo-yo” appearance; In-antimyosin scintigraphy: cardiac involvement (Bhalla et al, 1993; Cosnes et al, 2003; Cutolo et al, 2000; Lekakis et al, 1999; Singen, 1986; von Reinbold et al, 1986; Walden et al, 1990; Winograd et al, 1976) (Fig. SYME–S–7).

Therapy: Vasodilators, immunosuppressants, antifibrotics, new therapies (Sapadin et al, 2002; Sule et al, 2003).

Differential Diagnosis: (a) childhood scleromyositis; (b) mixed connective tissue disease; dermatomyositis; (c) *scleroderma-like cutaneous syndromes* (Mori et al, 2002) including Shulman syndrome (eosinophilic fasciitis): a scleroderma-like lesion, flexion contractures, limitation of joint movements, and firm taut skin (Hirai et al, 1992).

Note: (a) Focal scleroderma (fibrosis of the skin and subcutaneous tissues with frequent extension into underlying muscle and bone) is more common in children: morphea or linear scleroderma, joint contracture, limb deformity, leg length discrepancy, functional abnormalities, and cerebral abnormalities (Buckley et al, 1993; Liu et al, 1994); (b) scleroderma in childhood (rare): tuft resorption and soft tissue calcification in the fingers are more common in child scleroderma; small-bowel involvement, hand contractures, and erosive arthropathy are less frequent in children as compared with adults (Blaszczyk et al, 1991; Foeldvari, 2002; Shanks et al, 1983;

Singen, 1986); (c) soft tissue calcification is more common in females and in patients with extensive skin changes; the hands are the most common sites of calcification; other reported sites: knees, elbows, paraspinous, intraspinous, intervertebral disks, and so forth; (d) linear scleroderma and brain calcifications (Flores-Alvarado et al, 2003).

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Figure SYME–S–7 ■ Scleroderma. Osseous resorption (arrows) as transverse bands across the shafts of the distal phalanges. (From Bassett LW et al: Skeletal findings in progressive systemic sclerosis (scleroderma), *AJR* 136:1121, 1981. Copyright © by American Roentgen Ray Society. Used by permission.)

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SCURVY

Synonyms: Vitamin C (ascorbic acid) deficiency; Barlow disease.

Clinical Manifestations:

(A) Children: Onset of symptoms usually between 3 months and 2 years of age: (a) irritability; (b) pain, swelling, tenderness, pseudoparalysis of the legs, frog-leg position, and external hemorrhage (skin; mucous membranes); painful limp; (c) swelling of the gums; (d) costal rosaries; limb deformities; (e) anemia.

(B) Adults: (a) muscle fatigue; (b) petechiae, purpura, ecchymoses, and subcutaneous and mucosal bleeding; (c) swelling, pain, and discoloration of the lower limbs; decreased range of motion of the ankle and knee joints; (d) enlargement and hyperkeratosis of the hair follicles with a red hemorrhagic halo; corkscrew deformity and swan neck deformity of hair; (e) anemia; (f) death in 16-18 century; (g) contributing factors: elderly, alcoholism, restricted diets,

multiple inoculations (Clemetson), anorexia nervosa (Christopher).

Radiologic Manifestations: (a) *generalized osteoporosis*; ground-glass appearance; thickening of the provisional zone of calcification (*Fränkel sign*); white rim about the epiphyseal center (*Wimberger sign*); metaphyseal zone of demineralization; "corner sign" (subepiphyseal infraction); (b) fracture with epiphyseal slipping; subperiosteal hemorrhage; subperiosteal calcifying hematoma; (c) metaphyseal cupping; ball-in-socket deformity of the epiphyseal-metaphyseal junction; improvement of the deformity in a long-range follow-up; premature closure of central epiphyseal growth plate (*cone epiphysis*) (Hoeffel et al, 1993).

Differential Diagnosis: (a) child abuse; (b) syphilis; (c) copper deficiency; (d) Menkes syndrome; (e) tyrosinosis.

Note: (1) Humans, unlike most mammals, cannot synthesize ascorbic acid.

Historical Note: (1) Scurvy in 10% of Egyptian mummy skeletons (Nerlich et al, 2000); (2) 1535, Canadian Indians exhibited cure for scurvy (tree extract) (Martini, 2002); (3) 1768, "Captain Cook's beer" (beer/malt) for sailors to prevent scurvy (Stubbs, 2003).

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SEA-BLUE HISTIOCYTE SYNDROME

MIM#: 269600.

Mode of Inheritance: AR; locus:19q13.2, mutations in APOE gene (Nguyen et al, 2000).

Clinical Manifestations: (a) *abnormal cells (histiocytes) containing large blue cytoplasmic granules in the bone marrow, skin, lung, gastrointestinal tract, nervous system, and spleen*; (b) *splenomegaly; hepatomegaly*; progressive hepatic cirrhosis; lymphadenopathies; (c) periodic hemorrhagic diathesis associated with thrombocytopenia; (d) other reported abnormalities: retinal involvement; nervous system involvement; (e) associations: cholesterol ester storage disease, Niemann-Pick disease (type B) and liver lesion (Strigaris et al, 1993),

parenteral nutrition (Bigorgne et al, 1998), myelofibrosis (Yamauchi et al, 1995), myelodysplastic syndromes (Howard et al, 1993).

Radiologic Manifestations: (a) pulmonary nodular densities, hilar adenopathy; (b) *hepatosplenomegaly*.

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SECKEL SYNDROME

MIM#: 210600.

Synonyms: Bird-headed dwarfism; Virchow-Seckel dwarfism; microcephalic primordial dwarfism I.

Mode of Inheritance: Probably *autosomal recessive; clinically and genetically heterogeneous*; loci: 3q22.1-q24, 18p11.31-.2, 14q23 (Borglum et al, 2001; Faivre et al, 2002; Goodship et al, 2000; Kilinc et al, 2003), splicing mutation (O'Driscoll et al, 2003).

Clinical Manifestations: (a) *low birth weight; dwarfism*; (b) *mental retardation*; (c) “*bird-headed appearance*”: microcephaly; beaklike protrusion of the nose; hypoplasia of the cheek bones; prominent eyes; ocular hypertelorism; pigmentary retinopathy (Guirgis et al, 2001); micrognathia; (d) other reported abnormalities: low-set ears; lobeless ears; high-arched or cleft palate; cryptorchidism; various urogenital anomalies; cardiac anomalies; flexion contracture of the elbows; malignant hypertension (Sorof et al, 1999); *hematologic abnormalities* (25%): myelodysplasia (Chanan-Khan et al, 2003); hypoplastic anemia; aplastic anemia; pancytopenia; chromosomal instability (Bobabilla-Morales et al, 2003); acute myeloid leukemia.

Radiologic Manifestations: (a) *microcrania; ocular hypertelorism; hypoplasia of the maxillae and mandible*; (b) hand and wrist: ivory epiphyses; cone-shaped epiphyses in the proximal phalanges; disharmonic skeletal maturation

(carpals; phalanges); alteration in tubular bone length; small carpal bones; angular carpal bone configuration; normal or increased cortical thickness of the metacarpals; incurving of the distal phalanges; clubbing of fingers; hypoplastic thumb; (c) other reported abnormalities: premature closure of cranial sutures; MRI: Chiari I malformation (Hopkins et al, 2003), agenesis corpus callosum, neuronal migration disorder, cerebral dysgenesis (three cases) (Shanske et al, 1998), normal brain (Carfagnini et al, 1999); intracranial aneurysms (D'Angelo et al, 1998); missing or atrophic teeth; kyphoscoliosis; sternal anomalies; absence of patellae; absence of tibiofibular joints; short fibulas; dislocations (hip; knee; elbow); rhizomelic shortening of the humeri and femora; (d) prenatal US: downslanting palpebral fissures (Mielke et al, 1997).

Differential Diagnosis: (a) osteodysplastic primordial dwarfism, other types; (b) cephaloskeletal dysplasia; (c) Seckel-like syndrome: microphthalmos, coloboma, cloudy cornea, genitourinary (GU) anomalies, cardiac defects, anal stenosis (Fryns et al, 1997); (d) *Kennerknecht syndrome*: ambiguous/normal genitalia, GU anomalies, diaphragmatic defect, Seckel-like dwarfism (AR, 3 sibships) (Silengo et al, 2001); (e) Seckel-like syndrome: severe hydrocephalus (Arnold et al, 1999); (f) ring chromosome 4 mosaicism (Anderson et al, 1997).

Note: Also see: Microcephalic osteodysplastic primordial dwarfism (types).

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SENIOR SYNDROME

MIM#: 113477.

Synonyms: *Brachymorphism-onychodysplasia-dysphalangism syndrome*; BOD.

Frequency: About 12 reported cases to 2003.

Clinical and Radiologic Manifestations: (a) short stature at birth; (b) minute toenails (one or more small toes bilaterally); (c) *dysphalangism: brachydactyly*; hypoplasia/aplasia or fusion of the distal phalanges of the fifth finger and toe; brachymesophalangism V; incurving of the fifth fingers; (d) other reported abnormalities: mild intellectual impairment; microcephaly; sparse hair; *facial dysmorphism*: broad nose; wide mouth; cardiac defects (Ounap et al, 1998).

Differential Diagnoses: (1) Coffin-Siris syndrome; (2) BOD-like (AD): large boxy head, hypertelorism, no MR (Elliott et al, 2000).

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SHAPIRO SYNDROME

Synonym: Spontaneous periodic hypothermia.

Frequency: About 21 reported cases to 2003.

Clinical Manifestations: (a) *episodic hyperhidrosis and hypothermia* (a central defect in temperature regulation); (b) abnormal electroencephalographic findings; (c) other reported abnormalities: seizures; primary organic polydipsia; insufficient antidiuretic hormone secretion; pituitary dwarfism; precocious puberty; behavioral disturbances during attack; altered norepinephrine (NE) metabolism (increased NE release rate into the extravascular compartment and decreases in NE clearance and volume of distribution of NE in the intravascular compartment); "*reverse Shapiro syndrome*" (agenesis of corpus callosum associated with periodic hyperthermia).

Radiologic Manifestations: *Agenesis of the corpus callosum* (Fig. SYME-S-8).

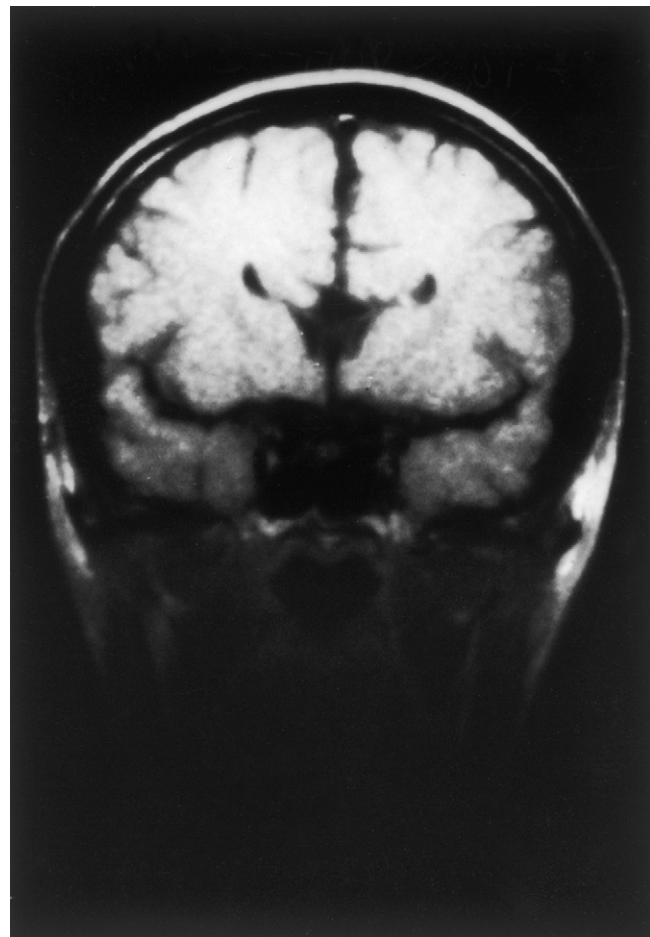


Figure SYME-S-8 ■ Shapiro syndrome. A 25-year-old man with a central defect in temperature regulation. Magnetic resonance imaging showing absence of corpus callosum. (From Walker BR, Anderson J, Edwards CRW: Clonidine therapy for Shapiro's syndrome, *Q J Med* 82:235, 1992. By permission of Oxford University Press.)

Differential Diagnosis: (1) paroxysmal episodic central thermoregulatory failure (Magnifico et al, 2002); (2) Shapiro syndrome-like disorder: forebrain abnormality (Klein et al, 2001); (3) ectodermal dysplasia, hypohydrosis, hypothyroidism, agenesis of corpus callosum (MIM# 225040).

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SHEEHAN SYNDROME

Pathology: Necrosis of the pituitary during the postpartum period; secondary atrophy of thyroid, adrenal cortex, and ovaries.

Clinical Manifestations: (a) acute postpartum shock followed by asthenia; failure of lactation; amenorrhea or menstrual irregularity; pallor; anorexia; brachycardia; hypotension; weight loss; cachexia; clinical manifestations of hypothyroidism, adrenal insufficiency, diabetes insipidus (Kan et al, 1998), and gonadal insufficiency; (b) lower than normal response to provoked combined pituitary stimulation (Dash et al, 1993).

Radiologic Manifestations: (a) small sella turcica; (b) empty sella turcica (partial or complete); visible pituitary stalk; pituitary residue usually less than one third normal size; hypodense (CT) residual pituitary gland; (c) MR imaging in pituitary apoplexy (sudden degeneration of pituitary gland): enhancement of adjacent dura after injection of contrast medium has been observed (Koenigsberg et al, 1994), empty sella/optic chiasma invagination (Scheller et al, 1997); *MRI, gad-enhanced:* enlarged pituitary, rim of increased signal, isointense central area (Vaphiades et al, 2003).

Note: In Burma, a bite by a Russell's viper has been reported to be a common cause of anterior pituitary failure in long-term survivors.

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SHONE COMPLEX

Frequency: About 50 cases reported to 2003 (children, few adults) (Prunier et al, 2001).

Clinical and Radiologic Manifestations: (1) components: (a) "parachute mitral valve" (all the mitral chords insert into one papillary muscle or muscle group); (b) supravulvar ring of the left atrium; (c) subaortic stenosis; (d) coarctation of the aorta; (e) pulmonary vein atresia (Cheng et al, 1999); (2) MRI characterization: (a) regurg/stenotic mitral flow; (b) abnormal valve motion/papillary muscle; (c) narrow/abnormal flow subaortic region; (d) coarctation (Roche et al, 1998).

Associations: (1) Adams-Oliver syndrome (Lin et al, 1998); (2) CHILD syndrome (Hebert et al, 1987).

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SHORT-BOWEL SYNDROME

Etiology: (a) congenital (rare); familial cases (Sabharwal et al, 2004); (b) acquired: (1) postsurgical: atresia; volvulus; gastroschisis (Ramsden); total intestinal aganglionosis; necrotizing enterocolitis, particularly in cases with an absence of the distal portion of the ileum and ileocecal valve or resection of more than two thirds of the small bowel

(Davenport et al, 2001); (2) mesenteric thrombosis, various etiologies (Oguzkurt et al, 2000).

Pathology: *Adaptation changes in the bowel wall:* increased diameter of the intestine; increase in villus height; increase in crypt depth; hyperplasia-increased cell proliferation and migration rate; increased rate of DNA synthesis and total DNA, RNA, and protein concentrations; increase in water, electrolyte, and nutrient transport per centimeter of small intestine; increase in mucosal enzymes per centimeter of small intestine; changes in tissue metabolism accompanied by regeneration and growth.

Clinical Manifestations: (a) *diarrhea; steatorrhea; dehydration; malnutrition; failure to thrive; vomiting; gastric hypersecretion;* metabolic acidosis resulting from D-lactic acidosis related to abnormal intestinal bacterial flora; encephalopathy resulting from D-lactic acidosis; oxaluria; (b) noninfectious colitis associated with short gut syndrome and parenteral nutrition; (c) complications: gallstones, kidney stones; synovial lipomatosis (Siva et al, 2002); pneumatosis intestinalis (Kurbegov et al, 2001).

Radiologic Manifestations: *increased diameter of the small intestine; thickening and hypertrophy of the bowel wall, plain films: multiple air/fluid levels; prenatal diagnosis (US): dilated short loops of bowel (Aviram et al, 1998).*

Therapy: (1) electrical stimulation (Lin et al, 2002); (2) dietary management (Ukleja et al, 2002), pharmacotherapy/growth factors (Schwartz et al, 2001); (3) intestinal transplantation (Pirenne et al, 2001; Reyes, 2001); (4) serial transverse enteroplasty-bowel lengthening (STEP) (Kim et al, 2003), serosal matching (Freud et al, 2001).

Note: A syndrome with autosomal recessive inheritance and a congenitally short small bowel in association with malrotation, functional intestinal obstruction, and in a high percentage of cases, hypertrophic pyloric stenosis has been reported (Kern et al, 1990); *pseudo-short bowel syndrome* radiographically: gastroschisis without infarction, bowel dilatation/air-fluid levels secondary to amniotic fluid bathing (Lachman).

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SHOULDER IMPINGEMENT SYNDROME

Synonyms: Rotator cuff impingement syndrome; SIS.

Clinical Manifestations: Because of pressure on the supraspinatus tendon by the anterior portion of the acromion with the arm in abduction and/or forward flexion, resulting in edema and hemorrhage into the rotator cuff in the early stage followed by fibrosis, tendinitis, tears of the rotator cuff, and biceps tendon rupture: *pain during abduction and external rotation of the arm; neck pain (Gorski et al, 2003); bursoscopy with normal histology of undersurface acromion: impingement at coracoacromial ligament (Suenaga et al, 2002).*

Associations and Etiologies: (1) familial agenesis of acromion (Hermans et al, 1999); (2) os acromiale (Swain et al, 1996).

Radiologic Manifestations: (a) *subacromial proliferation of bone, spurring of the interior aspect of the acromioclavicular joint, degenerative changes in the humeral tuberosities, and decreased coraco-humeral distance; scapular rotational tilt impaired on AP view (Endo et al, 2001); (b) magnetic resonance imaging: increased signal intensity in the tendinous portion of the rotator cuff (resulting from degeneration and inflammation); supraspinatus tear; arm elevation position acromiohumeral distance: decreased (discriminant) (Hebert et al, 2003); after therapeutic injection (<24 hours); fluid may not be pathologic (Major, 1999); (c) dynamic sonography (lateral and anterior elevation of the arm): fluid collection in subacromial-subdeltoid bursal system, with gradual distension of the bursa and lateral pooling of fluid to the subdeltoid portion while the arm is elevated; (d) arthro-MR (Lee et al, 2000), arthro-CT: for tendon tears (Beltran et al, 1986; Godefroy et al, 2001); cine-MR (Allmann et al, 1997).*

Note: (1) *drooping shoulder syndrome:* inferior subluxation of glenohumeral joint (fracture, brachial plexus injury, hemiplegia, arthropathy, calcific tendonitis-rotator cuff) (Prato et al, 2003).

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SHPRINTZEN-GOLDBERG SYNDROME

MIM#: 182212.

Mode of Inheritance: AD; locus 15q21.1, mutation in fibrillin-1 gene.

Frequency: About 17 cases to 2003.

Clinical and Radiologic Manifestations: *Marfanoid features:* (a) *craniosynostosis*; *hydrocephalus*; abnormal C1, C2; Chiari 1 malformation; (Greally et al, 1998); (b) *exophthalmos*; (c) *maxillary and mandibular hypoplasia*; (d) *soft tissue hypertrophy of the palatal shelves*; (e) *low-set, pliable auricles*; (f) *arachnodactyly*; *camptodactyly*; *marfanoid habitus*; (g) *abdominal hernias*; (h) *obstructive apnea*; (i) *mental retardation, development delay*; (j) *joint contractures*; *osteopenia* (Hassad et al, 1997), *thin* (slightly twisted) *ribs*, tall vertebrae, overmodeled diaphyses (Nishimura et al, 1996); (k) *cardiovascular: aortic root dilatation, mitral valve prolapse* (Fukunaga et al, 1997).

Differential Diagnosis: (1) *Marfan syndrome*; (2) *fronto-metaphyseal dysplasia*.

Note: (1) *Shprintzen omphalocele syndrome:* *dysmorphic facies, pharyngeal/laryngeal hypoplasia, scoliosis* MIM# 182210; (2) *Shprintzen/Goldberg-like:* *web neck, aortic dilatation, pneumothoraces* (Lee et al, 2000); (3) *Shprintzen-Goldberg plus:* *glucocorticoid deficiency (17OH deficiency)* (Adachi et al, 1999); *contiguous gene ? (tetrasomy 15q25-qter): also bilateral Wilms tumor* (Hu et al, 2002).

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SHY-DRAGER SYNDROME

MIM#: 146500.

Synonyms: *Progressive autonomic nervous system failure; multiple system atrophy.*

Mode of Inheritance: Possibly autosomal dominant.

Pathology: *Symmetrical degeneration in the tractus intermediolateralis, hypothalamus, caudate nuclei, Onuf nucleus of the sacral cord* (Lu et al, 1997); *? complete autonomic failure* (Parikh et al, 2002).

Clinical Manifestations: (a) *orthostatic hypotension* without acceleration of the pulse; *supine hypertension* (50%) (Biaggione et al, 2002); (b) *urinary and fecal incontinence*; abnormal urodynamic study results (*detrusor areflexia; detrusor hyperreflexia; lower neuron lesion involving periurethral striated muscle*); (c) *erectile impotence*; (d) *anhidrosis*; (e) other reported abnormalities: *paralysis of the laryngeal abductor muscles (vocal cords); association with: pheochromocytoma; iris atrophy; external ocular palsies; rigidity; tremor; fasciculations; myasthenia; anterior horn cell neuropathy; olfactory dysfunction (anosmia or microsmia); bullous pemphigoid* (Okazaki et al, 1998); *Ménière disease.*

Radiologic Manifestations: (a) *magnetic resonance imaging: a decrease in signal intensity of the putamina, particularly along their lateral and posterior portions (T2-weighted sequences and T1-weighted spin-echo sequences); loss of signal intensity in the pallidum of moderate to marked degree; loss of signal intensity in the substantia nigra and, to a lesser degree in the red nucleus* (Lu et al, 1997); *high signal rim-putamen* (Naka et al, 2002); PET: *cerebral blood flow regulation is spared* (Ogawa et al, 1998); (b) *open vesical neck at rest*; (c) other reported abnormalities: *duplication (fenestration) basilar artery* (Tsutsumi et al, 2002).

Therapy: (1) *vasopressin* (Vallejo et al, 2002).

Note: (1) autonomic dysfunction (not as severe) common in Parkinson disease (Koike et al, 1997); (2) multiple system atrophy subtypes: Shy-Drager, olivopontocerebellar atrophy, striatonigral degeneration (Naka et al, 2002).

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SIALIC ACID STORAGE DISEASES

Classification and Manifestations:

1. Sialidosis (neuraminidase deficiency).
2. Salla disease.
3. Sialuria (MIM# 269921): Hepatosplenomegaly, developmental delay, difficulty with fine motor skills, etc.; urinary excretion of free sialic acid.
4. Infantile sialic acid storage disease (MIM# 269920) locus: 6q14-15, mutations in SLC17A5 (Salla) gene (Kleta et al, 2003): A rapidly progressive neurovisceral storage disorder with onset of symptoms in early infancy: unusually fair complexion, coarse facial features, severe mental and motor retardation, dystonia, hepatosplenomegaly, nephrosis, vacuolization of peripheral lymphocytes, short life span.
5. Nephrosialidosis (MIM# 256150): early glomerulonephropathy, dysostosis multiplex, early death.
6. Galactosialidosis (MIM# 256540): dysostosis multiplex, combination of neuraminidase and beta-galactosidase deficiency.

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SIALIDOSIS

MIM#: 256550.

Definition: A group of inborn errors of metabolism caused by the intracellular accumulation of sialic acid-containing oligosaccharides; two clinical forms (a) type I: no dysmorphism, late onset; type II: dysmorphism, dysostosis multiplex, variable onset (see forms) (Rodriguez-Criado et al, 2003).

Mode of Inheritance: Autosomal recessive; locus: 6p21.3, mutations in sialidase gene NEU1 (Seyrantepe et al, 2003); clinical severity related to mutation type (Bonten et al, 2000).

Enzyme Deficiency: Glycoprotein-specific N-acetylneuraminidase.

Frequency: 1:4.2 million live births (Meikle et al, 1999).

Clinical Manifestations:

(A) Early Infantile Form (Congenital Sialidosis): Nonimmune hydrops fetalis, ascites, hepatosplenomegaly, failure to thrive, and recurrent infections; death usually occurs within the first year of life; refractory ascites (Sergi et al, 1999); prenatal diagnosis (cultured amniotic cells).

(B) Late Infantile Form: Motor retardation, progressive neurologic deterioration, axial hypotonia, limb hypertonicity, hepatosplenomegaly, coarse facial features, and recurrent infections; death in early childhood.

(C) Juvenile Form (previously known as "mucopolipidosis I"): Progressive neurologic deterioration, impaired hearing, impaired speech, Hurler-like appearance in early childhood, hernias, myoclonus, ataxia, cherry-red macular spot, mental retardation, and hepatosplenomegaly; survival into early adulthood.

(D) Adult Form (cherry-red spot-myoclonus syndrome): Onset in adolescence, progressive myoclonus, bilateral macular cherry-red spots, gradual visual loss, and normal or near normal intelligence; death in the fourth decade of life.

(E) Other Reported Abnormalities: Coincident neuraminidase and aspartoacylase deficiency associated with

chromosome 9q paracentric inversion in a family; nephrosis in infantile sialic acid storage disease.

Radiologic Manifestations:

(A) Infantile Form: Coarsened bony trabecular pattern mainly in the long bones; metaphyseal irregularity and increased density; stripelike intracranial echogenicities in the region of the basal ganglia with color Doppler demonstrating blood flow within the echogenicities (vasculopathy).

(B) Juvenile Form: (a) *mild to moderate dysostosis multiplex*: flat vertebral bodies; beaking of vertebral bodies; irregular vertebral end plates; small and flared iliac wings; shallow acetabular roofs; flat capital femoral epiphyses; coxa valga; thickened calvaria; mandibular prognathism; osteopenia; thin cortex of the tubular bones; cystic-type changes of the phalanges; bifid ossification of the calcaneus; (b) skeletal maturation retardation; (c) cardiomegaly; (d) persistent pulmonary infiltrates.

(C) Type I: (a) MRI: cerebellar/ pontine atrophy cerebrum/ corpus callosum, early 4th ventricular dilatation (Palmeri et al, 2000); (b) SPECT: decreased blood flow occipital lobes; PET: decreased glucose metabolism occipital lobes (Nishiyama et al, 1997) (Fig. SYME-S-9).

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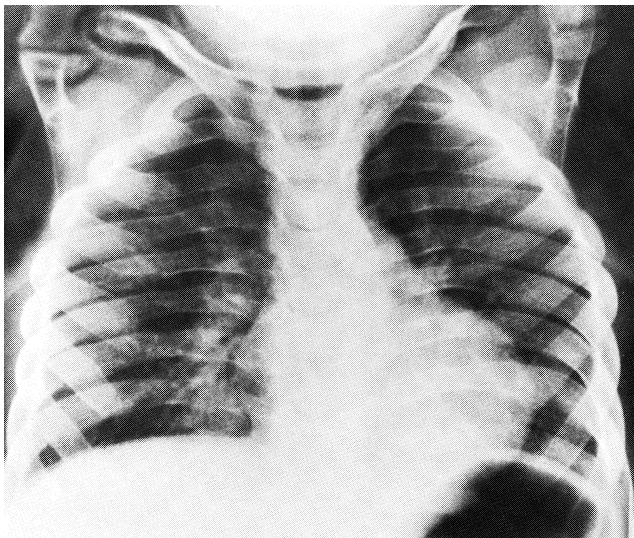


Figure SYME-S-9 ■ Sialidosis in a 2-year-old girl with wide ribs and mild cardiomegaly. (From Kelly TE et al: Mucopolipidosis I (acid neuroaminidase deficiency), *Am J Dis Child* 135:703, 1981. Used by permission.)

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SICKLE CELL ANEMIA

MIM#: 603903.

Mode of Inheritance: Autosomal recessive.

Frequency: Sickle cell hemoglobin present in 8% of the black population of the United States; 1 in 625 has sickle cell disease (homozygous for hemoglobin S).

Etiology: The presence of abnormal β -chain in HbS (valine substituted for glutamic acid) results in erythrocyte sickling at a reduced oxygen tension; the deformed and fragmented erythrocyte associated with an increase in blood viscosity leads to occlusion of small blood vessels and infarct (Herrick, 1910); mutation in beta globulin; genetic modifiers (Chui et al, 2001).

Classification: (a) *homozygous sickle cell disease (SS disease)*, severe anemia; (b) *sickle cell-hemoglobin C disease (SC disease)*, mild anemia; (c) *sickle cell- α thalassemia (SS- α thalassemia)*, severe anemia; (d) *sickle cell- β thalassemia*, mild to severe anemia (Sebes, 1989).

Clinical Manifestations:

(A) General Manifestations: (a) *anemia*; (b) jaundice; liver and biliary tract dysfunction; *hepatomegaly*; *splenomegaly* in the early stage; splenic fibrosis in a later stage; (c) abdominal crisis (intravascular thrombosis; infarcts): pain; vomiting; distension; splenic sequestration crises (Gage et al, 1983); (d) chronic leg ulcer; "ulcer osteoma" (Norris et al, 1993; Wiggins et al, 1986).

(B) Skeletal System: (a) painful limbs: *bone infarcts*; *hand-foot syndrome* (swelling; tenderness; fever; leukocytosis); orbital infarction (two cases) (Naran et al, 2001); *osteomyelitis* (*Salmonella* or staphylococcal infections); (b) arthralgia; arthritis; hemarthrosis; *osteonecrosis* capital femoral epiphysis (CFE) (37%); (Mukisi-Mukaza et al, 2000; Sebes, 1989).

(C) Respiratory System: *Pulmonary infarcts* (especially after hypertransfusion and DFO therapy [Sheth et al, 1997]); *recurrent pneumonias*; *acute chest syndrome: etiologies*,

infection/fat embolism (10%)/hypoxia-driven adhesion-related vascular occlusion (Stuart et al, 2001); rbc exchange is therapeutic (Lombardo et al, 2003), 51% associated with Mycoplasma disease (Neumayr et al, 2003); restrictive ventilatory defect characterized by low vital capacity and total lung capacity; sleep-related upper airway obstruction and baseline hypoxemia; abnormally small lungs (particularly in those with SS hemoglobin); diffuse lung fibrosis and cor pulmonale (rare) (Ballas et al, 1991; Bowen et al, 1990; Pianosi et al, 1993; Samuels et al, 1992; Siddiqui et al, 2003).

(D) Cardiovascular System: *Cardiomegaly; congestive heart failure; abnormal septal Q waves; ventricular dysfunction (cardiomyopathy), mitral valve prolapse; pulmonary hypertension; cor pulmonale* (Lester et al, 1990; Lippman et al, 1985).

(E) Nervous System: Stroke in 6 to 16% of children with sickle cell anemia, (several candidate genes associated [Hoppe et al, 2003]); seizures; hemiplegia; stupor; coma; cerebral infarction; intracranial hemorrhage; spinal cord infarction; isolated neuropathies resulting from anatomic proximity to infarcted bones; ocular manifestations; recurrent cerebral ischemia during hypertransfusion therapy; neuropsychologic impairment in school-aged children; sensorineural hearing loss in sickle cell crisis; high leukocyte count and an acute decrease of hemoglobin reported as risk factors for stroke in patients with homozygous sickle cell disease; severe hypoxemia secondary to acute sternal infarction; moyamoya effectively treated with EDAS procedure (Elwany et al, 1988; Fryer et al, 2003; Wang et al, 1992; Wasserman et al, 1991).

(F) Genitourinary System: *Focal glomerular sclerosis; urinary concentration defect; impaired renal acidification and potassium excretion; proteinuria; supranormal proximal tubular function (increased reabsorption of phosphate and increased secretion of creatinine); hematuria; papillary necrosis; renal failure; renal medullary carcinoma; testicular infarction* (Allon, 1990; Bruno et al, 2001; Falk et al, 1992; Kontessis et al, 1992; Noguera-Irizarry et al, 2003).

(G) Prenatal Diagnosis: First-trimester diagnosis with chorionic villus sampling (enzymatic DNA test); amniocentesis in the second trimester (Embury, 1987).

(H) Other Reported Abnormalities: (a) painful crises (acute chest syndrome, abdominal crises); (b) growth disturbances; abnormal body shape: reduction in weight, height, sitting height, limb length, interacromial and intercrystal diameters, and skinfold thickness; increased anteroposterior chest diameter; (c) retinopathy; exophthalmos associated with bone infarction; (d) fat embolism (bone marrow necrosis); ischemic colitis; myonecrosis secondary to muscle infarction; myofibrosis; (e) priapism (indication of severe disease in adults); (f) bacteremia; liver abscess; (g) miscellaneous: lymphadenopathy; mitral valve prolapse; vitamin C deficiency; hypothyroidism in adults receiving multiple blood transfusions (iron overload); association with sarcoidosis; aortic thrombus (one case) (Chiu et al, 1990; Chong et al, 1993; Filipek et al, 2000; Gage et al, 1983; Lippman et al, 1985; Phillips et al, 1992; Sharpsteen et al,

1993; Valeriano-Marcet et al, 1991; Zwerdling et al, 1993); anesthetic management (general rather than local) (Frietsch et al, 2001).

Radiologic Manifestations: General imaging (Crowley et al, 1999; Papadaki et al, 2003).

(A) Skeletal system:

1. Skull: *granular pattern; widening of diploic space; decreased width of the outer table; hair-on-end appearance; decreased calvarial density; focal radiolucent areas; focal or diffuse osteosclerosis; radiolucency and coarsening of the bony trabeculae of the mandible/maxilla; prominent lamina dura; orbital bone infarction; labyrinthine hemorrhage; calvarial infarction; iron deposition in cranial bone marrow (transfusion therapy)* (Faber et al, 2002; Kaneko et al, 1993; Rebsamen et al, 1993; Reynolds, 1987; Rothchild et al, 1981; Whitehead et al, 1998).
2. Spine and pelvis: osteoporosis (“codfish vertebrae”); depression of end plates with a squared-off appearance of the indentation (“Reynold spine sign”); prominent vertical bony trabeculae; secondary “tower (high) vertebrae” (Marlow et al, 1998); increased thoracic kyphosis and lumbar lordosis; prominence and persistence of anterior vascular foramina of the thoracic vertebral bodies in children; pelvic osteomyelitis; osteitis pubis; protrusio acetabuli; infarction of the ilia (Frush et al, 1991; Mandell et al, 1993; Martinez et al, 1984; Reynolds, 1987).
3. Thorax: sternal infarction; sternal cupping; patchy areas of rarefaction and/or sclerosis of the ribs; rib infarction (demonstrated by ^{99m}Tc-diphosphonate bone scan) in patient with acute chest syndrome (Ballas et al, 1991; BenDridi et al, 1987; Gelfand et al, 1993; Levine et al, 1982; Rucknagel et al, 1991).
4. Long bones: (a) *diaphyseal infarction* (mottled and strandy medullary sclerotic densities; cortex-within-cortex pattern; cortical fissuring; massive infarct of the entire shaft in children; scintigraphic demonstration of infarcted segment); soft tissue abnormalities with marrow infarcts (MRI, US) (Frush; William et al, 2000); (b) *epiphyseal infarction* (proximal humeral and femoral epiphyses most common sites; *osteonecrosis*; commonly collapse and disintegration; osteosclerosis); (c) *osteomyelitis (Salmonella; Staphylococcus aureus; etc.)*; (d) infection versus infarction (gd-enhanced MRI) (Umans et al, 2000); (e) miscellaneous: pathologic fractures; “ulcer osteoma” (chronic ulcer in the superficial tissues adjacent to the involved bone); tibiotalar slant (BenDridi et al, 1987; David et al, 1993; Frush et al, 1999; Hernigou et al, 2003; Piehl et al, 1993; Sadat-Ali, 1993; Sebes et al, 1983; Shaub et al, 1975; Skaggs et al, 2001; Stark et al, 1991; Weinberg, 1982; Wiggins et al, 1986).
5. Hands and feet: *hand-foot syndrome* in infancy (most frequent between 6 months and 2 years of age; “dactylitis”); soft tissue swelling; bone resorption in infarcted or infected areas; periosteal elevation and subperiosteal new bone formation); slender marfanoid fingers or brachydactyly associated with cone-shaped epiphyses

and concave metaphyses of the metacarpal bones and phalanges; terminal phalangeal sclerosis; erosive disease of the calcaneus (loss of definition of the cortical margin in the superior aspect of the bone) (Bennett, 1992; Sebes, 1989; Silver et al, 1984).

6. Retarded skeletal maturation.
7. Arthropathy: joint effusion (noninflammatory); septic arthritis; hemarthrosis (Sebes).
8. *Bone infarction* (Frush et al, 1991, 1999; Lanzer et al, 1984; Rebsamen et al, 1993; Rucknagel et al, 1991; Sebes, 1989): (a) radionuclide scintigraphy: photopenic defect in the femoral or humeral head as an earliest manifestation of avascular necrosis; cortical bone-seeking radiopharmaceuticals (^{99m}Tc phosphate compounds) may show a similar picture to that of osteomyelitis in cases with medullary osteonecrosis; bone marrow scanning with ^{99m}Tc -sulfur colloid demonstrating decreased marrow activity in bone infarction; Ga-citrate imaging very useful in differentiating bone marrow infarction and osteomyelitis (Frush et al, 1991; Sebes, 1989); (b) MR: various patterns in avascular necrosis: T1-weighted images: low signal intensity (homogeneous, heterogeneous, or ringlike pattern of decreased signal surrounding the high signal intensity of fatty marrow); T2-weighted images: double-line ring (high signal bordering the ring); edema in acute infarction; cystic lesions; MRI helpful in differentiating between acute and chronic marrow infarcts; significant inhomogeneity of bone marrow in asymptomatic patients; MRI not helpful in differentiating acute infarct and acute osteomyelitis (Bonnerot et al, 1994; Rebsamen et al, 1993; Sebes, 1989); (c) CT: "asterisk sign" of femoral head (normal central density with star-shaped appearance): loss of rays of asterisk, increased peripheral density, sclerosis, deformity, and intraosseous cyst; CT not useful for early detection of avascular necrosis of epiphyses (Sebes, 1989).

(B) Chest: (a) *acute chest syndrome* resulting from pneumonia or infarction (or idiopathic) (chest radiography and ventilation-perfusion scintigraphy are not diagnostic in differentiating pneumonia and pulmonary infarct; if new infiltrate on admission-infectious etiology likely, if normal/unchanged film—idiopathic); 3-mm chest CT helpful in differential diagnosis by demonstrating a ground-glass attenuation in microvascular occlusion); pleural effusion; rib infarction (Bhalla et al, 1993; Gelfand et al, 1993; Martin et al, 1997); (b) pulmonary hypertension and cor pulmonale following repeated episodes of pulmonary vascular occlusion; cardiomegaly; congestive heart failure; increased left atrial, left ventricular, and aortic root dimensions; increased left ventricular wall thickness (Lester et al, 1990); (c) *extramedullary hematopoiesis* (masses in the paravertebral region) (Gumbs et al, 1987; Papavasiliou et al, 1990).

(C) Urinary System (Allon, 1990): (a) renal enlargement; thickening of the renal medulla; focal cortical hypertrophy; caliceal clubbing; *papillary necrosis*; (b) pyelonephritis; (c) perirenal hematoma; (d) renal arteriography: focal cortical hypertrophy; "pseudobrain" nephrogram resulting from a mixture of hypertrophy and scar formation; thinning of

the cortex; medullary hypertrophy; pruning of the arterial tree; (e) MRI of sickle-cell nephropathy: decreased relative cortical signals, most evident on T2-weighted images; (f) *renal vein thrombosis*; (g) unusual renal accumulation of ^{99m}Tc phytate and ^{99m}Tc HMDP (Binnur et al, 1992); (h) focal and diffuse increased echogenicity in the renal parenchyma (Zinn et al, 1993).

(D) Central Nervous System:

1. *Vascular occlusion* of major arteries or distal branches (partial or complete) (Partington et al, 1994): (a) MRI, MRA: cerebrovascular disease (Gillams et al, 1998; Wiznitzer et al, 1990); (b) ultrasonography: cerebral vascular stenosis resulting in elevated flow velocity shown by transcranial and extracranial Doppler ultrasonography; increased velocity in ophthalmic artery and middle cerebral artery; decreased resistive index secondary to increased diastolic flow; reversal of flow especially in ophthalmic artery; absence of detectable flow in the middle cerebral artery or anterior cerebral artery when good flow is detected in posterior cerebral artery; increased velocity in posterior cerebral and/or increased velocity in vertebral and basilar circulation; decreased velocity in vessel supplying infarcted area, TCDI lower velocities than just duplex imaging; transcranial color doppler (Bulas et al, 2000; Jones et al, 2001; Kogutt et al, 1994; Mohr, 1992; Seibert et al, 1993); (c) abnormalities on localized proton resonance spectroscopy in stroke (Wang et al, 1993); PET for ischemia (Reed); (d) stable Xenon-enhanced CT: decreased cerebral blood flow (total, hemispherical, or regional) (Numaguchi); (e) MRI: CNS parenchymal changes, particularly in the general regions of arterial border zones between the major cerebral arteries and adjacent deep white matter (distal small-vessel disease), screening valuable; MRI, MRA, transcranial Doppler can all be negative with significant symptomatology; MRA abnormalities in asymptomatic patients, silent infarcts (Gillams et al, 1998; Kirkham et al, 2001; Pegelow et al, 2001; Seibert et al, 1993; Steen et al, 2003; Wiznitzer et al, 1990).
2. *Extramedullary hemopoiesis*: extradural mass within the spinal canal, displacing the cord (Papavasiliou et al, 1990).
3. Other reported abnormalities: intracranial hemorrhage (intracerebral; subarachnoid); intracranial aneurysm(s); retro-orbital and epidural hematoma (associated with bone infarct); postangiographic blindness; vein of Galen and straight sinus thrombosis (Anson et al, 1991; Balkaran et al, 1992; Banna et al, 1992; Oguz et al, 1994; Oyesiku et al, 1991).

(E) Abdomen: (a) spleen: infarcts; rupture; hemorrhage; calcification; acute splenic sequestration crisis (patent splenic vein; enlarged spleen; hypoechoic lesions; low attenuation on CT; hyperintense lesions on both T1- and T2-weighted MR images suggestive of subacute hemorrhage); rounded intrasplenic masses (preserved tissue) (Levin et al, 1996; Roshkow et al, 1990; Sheth et al, 2000); (b) liver: infarcts; hepatic vein thrombosis; abscess (Chong et al, 1993); (c) biliary tract: cholelithiasis (calcium bicarbonate);



Figure SYME-S-10 ■ Sickle cell anemia. Excretory urography in an 18-year-old woman with homozygous sickle cell disease. Note the blunting of the calices, in particular, on the right side, and papillary necrosis of one of the calices of the upper pole of the right kidney. (From Taybi H: Urinary tract manifestations of multisystem diseases in children. In Margulis AR, Goodling CA, editors: *Diagnostic radiology*, San Francisco, 1979, University of California.

biliary sludge; gallbladder wall thickening; abnormal biliary scintigraphy (delayed gallbladder visualization consistent with chronic cholecystitis (D'Alonzo et al, 1985; Nzeh et al, 1989); (d) bowel distension (related to vascular occlusion; (e) other reported abnormalities: appendicitis; focal hepatic nodular hyperplasia; focal echogenic lesions in the spleen in patients with no symptoms related to the spleen; transfusional hemosiderosis of liver and pancreas (shown by ultrasonography and MR imaging, hepatic magnetic susceptibility by superconducting or MR); retroperitoneal fibrosis (in sickle cell trait) (Brittenham et al, 2001; Flyer et al, 1993; Heaton et al, 1991; Siegelman et al, 1994; Walker et al, 1993).

(F) Soft Tissues: Soft tissue changes (edema; inflammation; and ischemia) with or without adjacent bone marrow abnormalities; myonecrosis (Feldman et al, 1993; Mani et al, 1993); altered muscle metabolism shown by magnetic resonance spectroscopy in patients with leg ulcers (Norris et al, 1993) (Figs. SYME-S-10 and SYME-S-11).

Therapy (recent): (1) bone marrow transplantation (Hoppe et al, 2001).

Note: (a) in vitro studies have shown that nonionic contrast medium causes significantly less sickling than ionic contrast agent does (Visipaque) (Losco et al, 2001); (b) magnetic fields and radiofrequency (RH) energy affect sickle erythrocytes in vitro; no changes in sickle blood cell flow have been shown during MRI in vivo; (c) post-transfusion hypertension in association with seizures and intracranial hemorrhage has been reported as a characteristic syndrome in sickle cell disease; the association of sickle cell disease, priapism, exchange transfusion, and neurologic events is referred to as "ASPEN syndrome" (Siegel et al, 1993).

Historical Note: Herrick's interesting discovery (Haller et al, 2001).

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Figure SYME-S-11 ■ Sickle cell anemia (hand-foot syndrome) in a 19-month-old black boy with sickle cell anemia (hemoglobin SS) and swelling and tenderness of both hands and feet. Note the periosteal elevation and subperiosteal new bone formation of the metatarsals.

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SILENT SINUS SYNDROME

Clinical and Radiologic Manifestations: (1) painless, spontaneous enophthalmos; maxillary sinus disease and hypoplasia (maxillary collapse, imploding antrum); (2) other associated abnormalities: nasogastric tube intubation (Burroughs et al, 2003) iatrogenic (postsurgical) (Rose et al, 2003); (3) *imaging features:* CT, complete/almost complete opacification, lateral uncinat process retraction with sinus obstruction, inward retraction of sinus walls, osteopenia sinus walls; MRI, same findings plus downward retraction of orbital floor into sinus; (Illner et al, 2002; Vander Meer et al, 2001).

Differential Diagnosis: (1) tumor, trauma, congenital facial asymmetry, lipodystrophy; (2) Parry-Romberg syndrome, scleroderma; (Burroughs et al, 2003).

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SILVER-RUSSELL SYNDROME

MIM#: 180860.

Synonyms: Silver syndrome; *Russell-Silver syndrome*; SRS.

Mode of Inheritance: The majority of the reported cases sporadic; familial cases (25 families); twins, discordant monozygotic (Samn et al, 1990); locus: 7p12-14; 7% to 10% show *maternal uniparental disomy* (UPD 7) (Meyer et al, 2003).

Frequency: Approximately 200 reported cases (Ramírez-Dunñas et al, 1992).

Clinical Manifestations: (a) *low birth weight at full term; short stature* (Russel, 1954; Silver et al, 1953); (b) *partial or*

total asymmetry (face; trunk; limbs) in about two thirds of the cases (Russell, 1954; Silver et al, 1953); (c) *craniofacial morphology* (Bergman et al, 2003): *pseudohydrocephalic appearance; frontal bossing; small triangular face; small mandible; downturned corners of the mouth* (Russell, 1954; Silver et al, 1953); (d) *short and/or incurved fifth fingers*; (e) *mental retardation in some cases*; (f) *metabolic-endocrine dysfunctions: hypoglycemia; ketoaciduria and dicarboxylic aciduria; abnormal pattern of sexual development (increased serum or urinary gonadotropin levels in the prepubertal age; precocious sexual development; premature mucosal esterogenesis; sexual ambiguity); growth hormone deficiency; corticotropin deficiency; panhypopituitarism* (Cazgan et al, 1994; Nishi et al, 1982); (g) *genitourinary system: cryptorchidism; male with ambiguous genitalia; clitoromegaly; urinary tract infections; testicular cancer* (Arai et al, 1988; Haslam et al, 1973; Weiss et al, 1981); (h) *chromosome abnormalities* (Midro et al, 1993; Ramírez-Dunñas et al, 1992); (i) *gastrointestinal (GI) abnormalities (77%): reflux, esophagitis* (Anderson); (j) *other reported abnormalities: large anterior fontanelle; poor muscular development; feeding problems* (Blissett et al, 2001); *café-au-lait spots, achromatic patch* (Perkins et al, 2002); *hand syndactyly; syndactyly of the feet; disproportionately short arms, optic nerve asymmetry* (Siegel et al, 1998); *difficult pregnancy; blue sclerae in infancy; cardiac defects.*

Radiologic Manifestations: (a) *clinodactyly; fifth digit phalangeal hypoplasia (middle or distal); camptodactyly (22%)* (Price et al, 1999); *syndactyly, Kirner deformity; ivory epiphysis; second metacarpal pseudoepiphysis* (Herman et al, 1987; Moseley et al, 1966); (b) *asymmetry; (c) skeletal maturation retardation; difference in skeletal maturation of the two sides* (Herman et al, 1987; Moseley et al, 1966); (d) *urinary system anomalies: horseshoe kidney deformity; hydronephrosis; enlarged kidneys; posterior urethral valve; anterior urethral valve; multiple polypoid bladder masses (US)* (Arai et al, 1988; Haslam et al, 1973; Ortiz et al, 1991; Steele et al, 2003); (e) *other reported abnormalities: slender long bones; hypoplasia or absence of phalanges; elbow dislocation; hip dislocation; irregularities of the end plates of the vertebrae; hypoplasia of the sacrum and coccyx; Legg-Calve-Perthes disease* (Hotokebuchi et al, 1994; Moseley et al, 1966).

Therapy: (1) *growth hormone (not alter limb asymmetry)* (Rizzo et al, 2001); (2) *mandibular distraction osteogenesis* (Kisnisci et al, 1999).

Differential Diagnosis: (a) *SRS phenotype in chromosomal abnormalities: (18p-; 18 trisomy/normal mosaicism; triploid/normal mosaicism; interstitial deletion of proximal 8q; small deletion on chromosome 13; 1q32-42; partial trisomy 7q/monosomy 15q with glaucoma)* (Kato et al, 2001; Schinzel et al, 1994; van Haelst et al, 2002; Wahlström et al, 1993); (b) *Mulibrey nanism*; (c) *Noonan syndrome*; (d) *3-M syndrome*; (e) *McCune-Albright syndrome*; (f) *hemihypertrophy*; (g) *polyostotic fibrous dysplasia.*

Note: (1) The diversity and the nonspecificity of the diagnostic criteria for the "syndrome" are responsible for the inclusion of heterogeneous conditions with overlapping clinical features under the title of Silver-Russell

syndrome/phenotype; (2) *UPD7 cases clinically indistinguishable* (Bernard et al, 1999); (3) *associated with Mayer-Rokitansky syndrome* (Bellver-Pradas et al, 2001).

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SIMPSON-GOLABI-BEHMEL SYNDROME

MIM#: 312870 (type 1); 300209 (type 2).

Synonyms: Golabi-Rosen syndrome; gigantism-dysplasia syndrome; bulldog syndrome; SGBS.

Mode of Inheritance: X-linked recessive; carrier females may show partial expression of the phenotype; locus: Xq26 (type 1); mutation in glypican 3 gene (40%) (Li et al, 2001).

Frequency: More than 30 reported cases (Garganta et al, 1992).

Clinical Manifestations: (a) *prenatal and postnatal overgrowth*; (b) *psychomotor development ranging from normal to mildly retarded*; (c) *macrocephaly, "coarse, bulldog" facial appearance, short and broad upturned nose, large mouth, macroglossia, submucous cleft lip and/or cleft palate, hypertelorism, grooved lower lip/tongue/gingiva, and malposition of teeth; odontogenic keratocysts*; (Krimmel et al, 2000; Taniyama et al, 2003); (d) highly arched palate; preauricular fistulas/pits; deafness; (e) cardiac abnormalities (36%): conduction defects; congenital heart defect; (Lin et al, 1999); (f) embryonal tumors: Wilms, nephroblastomatosis, nephrogenic rests, hepatoblastoma (one case) all with GPC 3 mutation (Li et al, 2001); (g) other reported abnormalities: short neck; hepatosplenomegaly; choledochal cyst (Kim et al, 1999); coccygeal skin tag; ruptured cystic skin lesion; supernumerary nipples; absent or hypoplastic finger nails; splayed fingertips; redundant skin; hemangiomas (Poetke et al, 2002); hypotonia, clumsiness; umbilical hernia; inguinal hernia; genital abnormalities (cryptorchidism; chordee; hypospadias; ambiguous genitalia).

Radiologic Manifestations: (a) skeletal abnormalities: (1) hypoplasia of the distal phalanges; syndactyly of the second and third fingers and toes; tibial clinodactyly of the second toes; ulnar clinodactyly of the second fingers; postaxial polydactyly; (2) presence of two carpal ossification center at birth; (3) rib anomalies; pectus excavatum; vertebral anomalies, a tail bone; flared iliac wings and narrow sacroiliac notches in infancy; (b) other reported abnormalities: congenital diaphragmatic hernia; bowel obstruction, Meckel diverticulum; large and/or cystic kidneys; renal dysplasia and embryonal tumor.

Differential Diagnosis: (a) Beckwith-Wiedemann syndrome; (b) Fryns syndrome; (c) Pallister-Killian syndrome; (d) infant of diabetic mother; (e) Perlman syndrome; (f) storage disorders.

Note: (1) early lethal form: fetal hydrops (Terespolsky et al, 1995).

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SINGLETON-MERTEN SYNDROME

MIM#: 182250.

Mode of Inheritance: Possibly autosomal dominant (Feigenbaum et al, 1988).

Clinical Manifestations: Onset of symptoms in childhood: (a) *history of fever of unknown origin in early infancy, muscular weakness, and poor development*; (b) *abnormal dentition*; (c) normal serum calcium, phosphorus, and alkaline phosphatase levels; (d) other reported abnormalities: chronic psoriasiform skin lesions; glaucoma; photosensitivity; hypertension; heart block; foot deformities.

Radiologic Manifestations: (a) skeletal demineralization; (b) *expanded shafts of metacarpals and phalanges with widened medullary cavities*; (c) *cardiomegaly*; (d) *intramural calcification of the proximal segment of the aorta with extension into the descending aorta, aortic and mitral valve calcification*; (e) other reported abnormalities: shallow acetabular fossa; subluxation of the femoral head; coxa valga; soft tissue calcification between the radius and ulna; hypoplastic distal radial epiphysis; constriction of the proximal part of the shaft of the radius; acro-osteolysis; equinovarus foot deformity (Fig. SYME-S-12).

Note: ? animal model lacking GLA protein (Luo et al, 1997).

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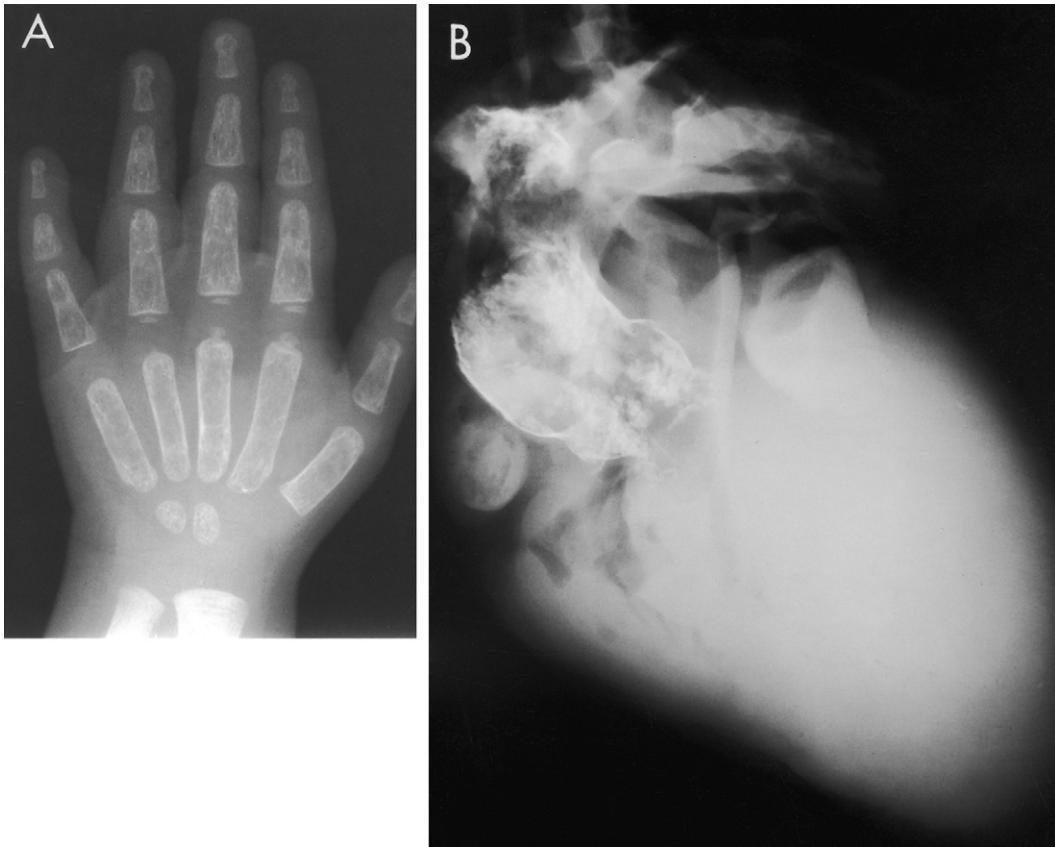


Figure SYME-S-12 ■ Singleton-Merten syndrome in a 2-year-old child with a clinical history of increasing fatigability and intermittent fever. **A**, Diffuse osteoporosis was found in a bone survey. Note the thinned cortices and hyperlucent expansion of the medullary space. **B**, Gross cardiomegaly, extensive calcification of the aorta involving the aortic root and ascending aorta, and pulmonary edema were present at 4 years of age. A radiogram of a postmortem specimen shows aortic calcification including calcification of the aortic valve. (From Singleton EB, Merten DF: An unusual syndrome of widened medullary cavities of the metacarpals and phalanges, aortic calcification and abnormal dentition, *Pediatr Radiol* 1:2, 1973. Used by permission.)

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SIRENOMELIA

Synonyms: Mermaid syndrome; symplus apus.

Frequency: 1.5-4.2 per 100,000.

Etiology and Pathogenetic Mechanisms: (1) caudal and medial iliac displacement correlates with severity of limb defects (iliac-sacral distance) (Kjaer et al, 2003); (2) lack of fission of lower limb progenitor fields; (3) regression of mid-line structures secondary to abnormal blood supply.

Clinical Manifestations: (a) rotation and fusion of the lower limbs; (b) absence of anus; imperforate anus; (c) defective or absent external genitalia; (d) surviving infants (four cases) (Stanton et al, 2003); (e) other reported abnormalities: association with Potter syndrome; single umbilical artery; association with twinning in 5% of the reported cases (most often monozygotic); association with limb-body-wall

complex; combined pentalogy of Cantrell and sirenomelia; esophageal atresia; hydrocephalus (Onyeije et al, 1998); cyclopia, cebocephaly (Chen et al, 1998a; Martínez-Frías et al, 1998); neural tube defect (Chen et al, 1998b); association with a “vanishing twin”; four successive offspring with sirenomelia associated with bilateral renal dysplasia and megacystitis secondary to urethral obstruction; history of cocaine exposure during the first trimester of pregnancy; retinoic acid-induced in mouse (Padmanabhan, 1998).

Radiologic Manifestations: (a) skeletal anomalies: contracted lesser pelvis (small pelvic outlet syndrome); sacral dysplasia; medial position, fusion, or absence of fibulas; (b) genitourinary anomalies, in particular renal agenesis; absent bladder (Stanton et al, 2003); (c) gastrointestinal anomalies: blind ending colon, imperforate anus, etc.; (d) oligohydramnios; (e) prenatal diagnosis first trimester (US): “froglike” position lower extremities (Monteagudo et al, 2002; Schiesser et al, 2003) (Fig. SYME-S-13).

Note: (a) According to the number of feet, sirenomelia is divided into three types: symplus apus, symplus monopus, and symplus dipus; (b) sirenomelia is considered to represent an extreme form of “caudal regression syndrome” (diabetic embryopathy) (Akbiyik et al, 2000); (c) overlap with two other entities: (1) small pelvic outlet syndrome: association of contracted lesser pelvis, imperforate anus, absent or severely dysplastic kidneys, and absent or severely hypoplastic ureters, bladder, and urethra; (2) limb body-wall complex:



Figure SYME-S-13 ■ Sirenomelia. Note fusion of the lower limbs and pelvic anomalies. (From Raabe RD et al: Ultrasonographic antenatal diagnosis of “mermaid syndrome.” Fusion of fetal lower extremities, *J Ultrasound Med* 2:463, 1983. Used by permission.)

cerebral and facial malformations; thoracoschisis; cardiovascular anomalies; pulmonary dysplasia; diaphragmatic defects; agenesis of gallbladder; abnormal kidneys; absence of genitalia; scoliosis; limb defects; *amniotic rupture and bands*; oligohydramnios; small placenta; short umbilical cord; (d) a relationship between sirenomelia and VACTERL association has been suggested (Schüler et al, 1994).

Historical Note: Medieval manuscript (1270 AD) depicts “Antipodes” sirenomelia (Bos et al, 1999).

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SJÖGREN-LARSSON SYNDROME

MIM#: 270200.

Mode of Inheritance: Autosomal recessive; locus: 17p11.2; mutation FALDH gene (Willemsen et al, 2001).

Frequency: More than 200 reported cases; more prevalent in Sweden than in any other country (Carney et al, 1993; Iselius et al, 1989).

Enzyme Deficiency: Fatty alcohol: NAD⁺ oxidoreductase.

Clinical Manifestations: Preterm birth: (a) *congenital ichthyosis*; (b) *spastic diplegia or tetraplegia*; (c) *mental retardation*; *speech defects*; (d) *retinopathy* (retinal “glistening dots”), *macular dystrophy* (Willemsen et al, 2000); superficial punctate epithelial erosions of the cornea; conjunctivitis; blepharitis; photophobia; (e) short stature; (f) *reduced activity of the fatty alcohol: NAD⁺ oxidoreductase activity in cultured skin fibroblasts and peripheral leukocytes*; carrier detection by measurement of fatty alcohol: NAD⁺ oxidoreductase complex (FAO) and fatty aldehyde dehydrogenase component of FAO in cultured skin fibroblasts; (g) prenatal diagnosis: skin biopsy (hyperkeratosis), mutation analysis (Sillen et al, 1997); (h) other reported abnormalities: seizures; joint hyperextensibility (Levisohn et al, 1991); increased muscle tone; increased deep tendon reflexes; kyphoscoliosis; defective sweating; enamel hypoplasia; dermatoglyphic anomalies; (i) therapy: more effective if begun in early infancy (Auada et al, 2002).

Radiologic Manifestations: (a) *demyelination in the cerebral white matter*; corticospinal and vestibulospinal

tracts; internal hydrocephalus (Di Rocco et al, 1994); MRI: diffuse white matter abnormality (periventricular, sparing of overlying cortex, most prominent in frontal region (Altinok et al, 1999; van Miegheem et al, 1997); proton MRS: abnormal accumulation of fatty acids/lipids (even in heterozygotes) (Kaminaga et al, 2001); (b) short metacarpals and metatarsals; epiphyseal–metaphyseal dysplasia; foot deformities and flexion contractures; widening of the symphysis pubis; nonossified pubis; hypoplasia of the femoral heads; retarded skeletal maturation (c) other reported abnormalities: dental dysplasia; hypertelorism; basilar impression; Dandy-Walker malformation.

Differential Diagnosis: (1) Sjögren-Larsson like, without central nervous system (CNS)/eye involvement (MIM# 270220); (2) syndrome of congenital ichthyosis, *hypogonadism*, short stature, *facial dysmorphism*, *myogenic dystrophy* (Stoll et al, 1999); (3) “Rud” syndrome (Kaufman, 1998).

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SJÖGREN SYNDROME

MIM#: 270150, 109092.

Synonyms: Sicca syndrome; Gougerot-Sjögren syndrome; Gougerot-Houwer-Sjögren syndrome; Gougerot-Mikulicz-Sjögren syndrome.

Definition and Classification: An autoimmune exocrinopathy with production of multiple antibodies, lymphocytic infiltration of glandular and extraglandular organs, and polyclonal B-cell proliferation: (a) primary; (b) secondary: rheumatoid arthritis, systemic lupus erythematosus, and so forth (Vitali et al, 1993); increase in caspase cascade (Hayashi et al, 2003).

Clinical Manifestations: Onset of symptoms usually in middle age (women in particular); childhood (rare) (Nikitakis et al, 2003):

(A) Skin and Mucous Membranes: (a) *xerostomia*; *painless swelling of the parotid glands*; *pharyngolaryngitis sicca*; *rapid destruction of the teeth*; *rhinitis sicca*; *inflammation of labial salivary glands* (Daniels et al, 1994; Gougerot, 1925; Tabbara et al, 2000); (b) *keratoconjunctivitis*; (c) *dry skin and vagina* (Sjögren, 1933).

(B) Polyarthritis (in 50% to 60%).

(C) Respiratory System: Chronic bronchitis; recurrent pneumonitis; interstitial lymphocytic pneumonia; restrictive ventilatory impairment; interstitial fibrosis; small-airway disease; desiccation of the upper respiratory tract; large-airway obstruction; pleuritic pain; pulmonary lymphoma (Kelly et al, 1991).

(D) Nervous System Disease (in approximately 20% of patients with primary Sjögren syndrome): The clinical picture resembling multiple sclerosis; aseptic meningoencephalitis; vasculitic neuropathy; progressive transverse myelopathy (17 cases) (Williams et al, 2001); psychiatric abnormalities (affective disturbances; etc.); hemiparesis; transient aphasia; chronic progressive sensory ataxic neuropathy; peripheral neuropathy; concurrent cerebral venous sinus thrombosis and myeloradiculopathy; segmental anhidrosis in the spinal dermatomes (Kumazawa et al, 1993; Pou Serradell et al, 1993; Sobue et al, 1993; Tanaka et al, 1985).

(E) Immune Disorders: *Antibodies to Ro/SS-A or La/SS-B antigens*; *antinuclear antibodies*; *rheumatoid factor*; immune thrombocytopenia; autoimmune hemolytic anemia in sisters (Boling et al, 1983; Ramakrishna et al, 1992; Vitali et al, 1993).

(F) Endocrine and Exocrine: Recurrent parotid gland enlargement as an initial manifestation in children; exocrine pancreatic impairment; sclerosing cholangitis in association with pancreatitis; hypothyroidism; atherosclerosis associated with telangiectasis and myxedema.

(G) Syndromes Association: CREST syndrome; myelodysplastic syndrome; Raynaud phenomenon (Albert et al, 1982).

(H) Tumor Association: *Lymphoproliferative neoplasms* (lymphoma, 6%); pseudolymphoma (Tonami et al, 2002a).

(I) Other Reported Abnormalities: Renal tubular acidosis (in 20%); association of primary Sjögren syndrome with multiple sclerosis; lymphoproliferative neoplasms; familial Sjögren syndrome and salivary gland lymphoma; inclusion body myositis; retroperitoneal fibrosis; adherence of “lipstick to the teeth” sign; infrequent familial occurrence; combination of *Sjogren syndrome with HIV disease* (Ramos-Casals et al, 2001); association with HLA-DR3; increased HLA-B8 in primary sicca syndrome; mastitis; temporomandibular abnormalities (Gentric et al, 1987; Gregoir et al, 1991; Gutmann et al, 1985; List et al, 1999; Miro et al, 1990; Ruiz-Arguelles et al, 1986).

Radiologic Manifestations:

(A) Salivary Glands: *sialectasia* (punctate; globular; cavitary; destructive); atrophy of the salivary ducts; bilateral cystic lesions; parotid pseudotumors: (a) CT: salivary gland enlargement; heterogeneous attenuation having a multilocular appearance; salivary gland calcification; (b) MR: multiple hypointense mixed with hyperintense foci on T1- and T2-weighted images; good accuracy (Izumi et al, 1998; Tonami et al, 2002b); (c) ultrasonography: hypoechoic areas 2 to 5 mm in diameter within the gland (homogeneous or nonhomogeneous) representing parotid lobules replaced by lymphocytic infiltration; (d) parotid sialography (imaging procedure of choice (Kalk et al, 2002); (e) salivary SPECT (single-photon emission computed tomography) useful in diagnosing the syndrome by evaluating the uptake ratio of the submandibular gland to parotid gland (Bradus et al, 1988; March et al, 1989; Nakamura et al, 1991; Takashima et al, 1992; Takashima et al, 1992; Tonami 1998, 2002b).

(B) Chest: Reticular-nodular infiltrate, bilateral; patchy infiltrate; hilar lymph node enlargement; bronchiectasis; enlarged mediastinal nodes; CT: *interstitial* and bronchopulmonary (Franquet et al, 1997; Meyer et al, 1997).

(C) Lymphatic System: Enlarged nodes with a foamy reticular pattern (lymphography); MALT lymphoma (Tonami et al, 2002b).

(D) Skeletal System: Destructive juxta-articular changes; renal rickets.

(E) Digestive System: Mucosal atrophy of the esophagus, achalasia of the cardia, gastric hypersecretion (Hradsky et al, 1967).

(F) Central Nervous System (CNS): Nonenhancing (CT) lucencies in the brain in patients with clinical manifestations in the central nervous system; the lesions best detected by magnetic resonance imaging (predominantly within the subcortical and periventricular white matter) (Tanaka et al, 1985; Urban et al, 1994).

(G) Other Reported Abnormalities: Nephrocalcinosis; distended gallbladder (Tanaka et al, 1985); decreased thyroid uptake of ^{99m}Tc (Taura et al, 2002) (Fig. SYME-S-14).



Figure SYME-S-14 ■ Sjögren syndrome. A parotid sialogram shows peripheral cylindrical and punctate sialectases. (From Gonzalez L, Mackenzie AH, Tarar RA: Parotid sialography in Sjögren's syndrome, *Radiology* 97:91, 1970. Used by permission.)

Differential Diagnosis: (1) *TINU syndrome* (tubulo-interstitial nephritis/uveitis) (Sessa et al, 2000); (2) hepatitis C infection (Ramos-Casals et al, 2001).

Note: The diagnosis of the syndrome requires the presence of at least two of the following major manifestations: (a) *keratoconjunctivitis sicca*; (b) *xerostomia*; (c) *evidence of systemic autoimmune disease* (Vitali et al, 1993).

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SLEEP APNEA SYNDROME

MIM#: 107650, 207720 (with glaucoma) 137763.

Clinical Manifestations:

(A) Diagnostic Criteria for Obstructive Sleep Apnea Syndrome (Carroll et al, 1992): (a) the patient has a

complaint of excessive sleepiness or insomnia. Occasionally the patient may be unaware of clinical features that are observed by others; (b) frequent episodes of obstructive breathing during sleep; (c) associated features: loud snoring, morning headaches, a dry mouth on waking, chest retraction during sleep in young children; (d) polysomnographic monitoring: (1) more than five obstructive apneas, greater than 10 seconds in duration, per hour of sleep, and one or more of the following: frequent arousal from sleep associated with apneas, brachytachycardia, arterial oxygen desaturation in association with the apneic episodes, with or without an MSLT that demonstrates a mean sleep latency of less than 10 minutes; (e) can be associated with other medical disorders: tonsillar enlargement, and so forth; (f) other sleep disorders may be present: periodic limb movement disorder or narcolepsy, and so forth.

(B) Other Reported Abnormalities: Increase in blood pressure associated with a decrease in heart rate and cardiac output during apneic episodes; nocturnal angina associated with heart failure and near-miss sudden death; nocturnal oxyhemoglobin desaturation; association with chronic renal disease; neuroendocrine dysfunction and reversal by continuous positive airways pressure therapy, depression; cognitive impairment; associated with craniocervical junction (Chiari I, etc.) malformations (Hershberger et al, 2003; Reybet-Degat, 2001).

Radiologic Manifestations: (a) airway obstruction (somnofluoroscopy): type 1, obstruction at the level of the soft palate only; type 2, obstruction occurs initially at the level of the soft palate followed by closure of the more distal part of the airway; type 3, obstruction initially occurs distal to the soft palate; airway at the soft-palate level may close or remain open; (b) computed tomography: measurement of tongue size to evaluate its predictive value for the result of corrective surgery (uvulopalatopharyngoplasty); "hooked soft palate" (Pepin et al, 1999); (c) pulmonary edema; (d) ultrafast spoiled GRASS MR imaging of the pharyngeal airway: occlusion or narrowing; cine MRI (Donnelly; Jager et al, 1998); volumetric MRI: volume of tongue and lateral walls increase risk, continuous narrowing anterior 2/3 of pharyngeal airway (Arens et al, 2003; Schwab et al, 2003); (e) altered intracranial hemodynamics shown by transcranial Doppler ultrasonography (increased cerebral blood flow velocity during apnea, followed by a rapid decrease during snoring); (f) functional MRI: aberrant response in multiple brain areas (Macey et al, 2003); (g) sedation precautions (Donnelly et al, 2001).

Therapy: (1) Distraction osteogenesis (Li et al, 2002; Petit et al, 2002); (2) postobstructive pulmonary edema (Burke et al, 2001).

Note: (1) obstructive apnea syndrome features in children (Carroll et al, 1992): snoring often continuous; excessive daytime sleepiness and obesity present in minority of the cases; daytime mouth breathing commonly present; enlarged tonsils and adenoids common etiologic factor; obstructive hypoventilation present; complications (cardiopulmonary; growth; behavior; developmental); (2) relationship to *sudden infant death syndrome (SIDS)* MIM# 272120.

Historical Note: (1) Morgagni (1750s) described sleep apnea with obesity (Enzi et al, 2003); (2) Dormouse disease (as in Alice in Wonderland—Lewis Carroll) (Williams, 1983).

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SLIT VENTRICLE SYNDROME

Synonym: Noncompliant ventricle syndrome.

Clinical and Radiologic Manifestations: (1) impairment (excessive drainage) in shunted hydrocephalic patients; the

recommended diagnostic triad (Rekate, 1993): (a) intermittent headaches lasting 10 to 30 minutes; (b) smaller than normal ventricles on imaging studies ("slit-ventricles"); (c) slow refill of shunt-pumping devices; (2) neuropathologic findings: glial adhesions, aqueduct obstruction, periventricular astrogliosis (Del Bigio, 2002); (3) therapy: shunt removal (Baskin et al, 1998), lumboperitoneal shunt (Le et al, 2002), subtemporal decompression (Buxton et al, 1999); (4) other reported abnormalities and associations: ophthalmologic leading to blindness (Nguyen et al, 2002); arachnoid cyst-peritoneal shunt (Sunami et al, 2002); suture closure (Albright et al, 2001).

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SMALL LEFT COLON SYNDROME

Clinical Manifestations: (a) symptoms of intestinal obstruction within the first 2 days of life; (b) high incidence of an association with maternal diabetes; (c) other associated conditions: hypoglycemic cardiomyopathy; persistent fetal circulation, meconium plug; maternal ingestion of psychotropic drugs; association with neonatal intussusception; association with cystic fibrosis; occurrence in twins.

Radiologic Manifestations: (a) intestinal distension; (b) significant narrowing of the colon extending from the splenic flexure to the anus; repeat enemas show normalization (Lachman); (c) intestinal perforation (small bowel; colon); (d) association with meconium plug syndrome; (e) increased subcutaneous fat thickness in infants of diabetic or gestational diabetic mothers (Fig. SYME–S–15).

Differential Diagnosis: Hirschsprung disease.

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Figure SYME-S-15 ■ Small left colon syndrome in a male newborn with clinical symptoms of intestinal obstruction. Narrowing of the sigmoid and descending colon is present. The meconium plug is outlined by contrast material.

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SMITH-LEMLI-OPITZ SYNDROME TYPE I

MIM#: 270400.

Synonyms: RSH syndrome; SLO syndrome, SLOS.

Mode of Inheritance: Autosomal recessive; chromosomal males in the majority of the reported cases; affected sibling in more than 40% of the cases; reported in twins; locus: 11q12-13; mutations in *sterol* delta-7-reductase gene (DRCH7).

Frequency: More than 120 reported cases to 1991 (Tzouveleakis et al, 1991); estimated incidence of 1 in 10,000 to 1 in 60,000 births.

Clinical Manifestations (Goldenberg et al, 2003; Nowaczyk et al, 2001c): A metabolic-multiple congenital

anomalies—mental retardation syndrome: (a) low birth weight; failure to thrive; (b) hypotonia at birth; progressive spasticity in childhood; (c) moderate to severe mental retardation; (d) typical facies: microcephaly, blepharoptosis, inner epicanthal folds, strabismus, short nose with a broad bridge, anteverted nostrils, broad maxillary anterior alveolar ridge, micrognathia, and slanted auricles or low-set ears; (e) short neck; (f) short and narrow shoulders, postaxial polydactyly, syndactyly of the second and third toes; (g) urogenital anomalies: hypospadias; cryptorchidism; cleft scrotum; pseudohermaphroditism; micropenis; microurethra; hypoplastic scrotum, 46,XY with female external genitalia; renal agenesis (Nowaczyk et al, 2003); (h) ocular abnormalities: cataracts; absence of lacrimal punctae; posterior synechiae; ptosis; epicanthal folds; choroidal hemangioma; pale disks; neuronal atrophy; abnormal rod/photoreceptor responses (Elias et al, 2003); (i) defect in biosynthesis of cholesterol: low level of blood cholesterol; high concentration of 7-dehydrocholesterol (cholesterol precursor); deficiency in normal bile acids in urine and presence of abnormal species (Irons et al, 1994; Nwokoro et al, 1994); (j) hepatomegaly; pancreatic anomalies; adrenal enlargement, adrenal insufficiency (Irons et al, 1994; Nowaczyk et al, 1994); (k) other reported abnormalities: high arch or cleft palate; long tapered fingers; sacral dimple; cardiovascular abnormalities (atrioventricular [AV] canal, TAPVR) (Lin et al, 1997); abnormal electroencephalographic and electrocardiographic findings; acrocyanosis of the hands and feet; skin photosensitivity (Anstey et al, 1999); hypoplasia of the thymus; irritability; typical shrill screaming; frequent vomiting and regurgitation; abnormal dermatoglyphics; *Hirschsprung disease*; prematurity; few cases reported in adults; early death.

Radiologic Manifestations: (a) *microcephaly*; scaphocephaly; holoprosencephaly (Nowaczyk et al, 2001a); micrognathia; (b) mild to moderate hydrocephalus involving one or more ventricles; hypoplasia of the frontal lobes, the corpus callosum, the cerebellum, and the brainstem; paucity of white matter in cerebellum; periventricular gray matter heterotopias, irregular frontal gyri; pachygyria; MRI/MRS: abnormal 5/18, callosal abnormalities, Dandy-Walker variant, arachnoid cyst (Caruso et al, 2003); hippocampal malrotation (Fitoz et al, 2003); (c) *soft tissue syndactyly of the second and third toes*; (d) swallowing mechanism dysfunction in early infancy; gastroesophageal regurgitation and recurrent pneumonia; (e) urinary tract anomalies: ureteropelvic junction obstruction; vesicoureteral reflux; hydronephrosis; collecting system duplication; positional renal abnormalities; renal cystic dysplasia; renal agenesis; etc.; (f) prenatal diagnosis: (US) *IUGR*, *nuchal edema*, cardiac/renal anomalies, polydactyly, genital anomalies (Goldenberg et al, 2004); (g) other reported abnormalities: congenital heart disease; pyloric stenosis; polydactyly; brachydactyly; clinodactyly; hypoplasia of the thumbs, which are low-set on the hands; clubfoot; stippled epiphyses (Fig. SYME-S-16).

Differential Diagnosis: (a) Pallister-Hall syndrome; (b) Meckel syndrome; (c) Smith-Lemli-Opitz syndrome type II; (d) SLO-like with cerebellar vermis aplasia and Meckel syndrome features (MIM# 213010); (e) desmosterolosis: macrocephaly, thick alveolar ridges, gingival nodules, short

limbs, ambiguous genitalia, osteosclerosis (MIM# 602398); (f) Faciothoracicgenital syndrome: SLO and Aarskog-like (MIM# 227320); (g) SLO-like with intrauterine growth retardation (IUGR), feeding difficulties, hypotonia, psychomotor delay, toe syndactyly 2/3 (Nguyen et al, 2003); (h) chromosomal disorder (unbalanced translocation 3q;5p) (Rossi et al, 2002).

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SMITH-LEMLI-OPITZ SYNDROME TYPE II

MIM#: 268670.

Synonyms: *Acrodysgenital dwarfism; Lowry-Miller-MacLean syndrome; Rutledge lethal MCA syndrome.*

Mode of Inheritance: Autosomal recessive; locus: 11q12-13; mutations in DRCH7; allelic with or same as SLOS I (Rakheja et al, 2003).

Clinical Manifestations: *More severe than SLO I:* (a) *intrauterine growth retardation;* oligohydramnios; birth asphyxia; (b) *distinctive face* (round face, ptosis, epicanthal folds, broad nasal bridge, and anteverted nares); facial hemangiomas; *microcephaly; micrognathia; cleft palate;* small tongue; tongue cysts; redundant sublingual tissues; (c) short neck with redundant skin folds; (d) *postaxial polydactyly* (hands and/or feet); soft tissue syndactyly of second and third toes; (e) *genital ambiguity or pseudohermaphroditism in XY males;* (f) *congenital heart defect;* (g) internal organ abnormalities: pulmonary hypoplasia; unilobated lungs; large adrenals; pancreatic islet cell hyperplasia; *Hirschsprung disease;* pyloric stenosis; renal agenesis; *renal cystic dysplasia;* (h) other reported abnormalities: cataracts; developmental delay; maternal estradiol levels unrecordable during the late stage of pregnancy and suppression of maternal adrenal function; poor suck and feeding; vomiting, abdominal distension; recurrent respiratory infections; short limbs; joint contractures; de novo balanced translocation involving 7q32; abnormalities of cholesterol and bile acid biosynthesis (Cunniff et al, 1994).

Radiologic Manifestations: (a) prenatal ultrasonographic findings: growth retardation, heart defect, limb shortening, finger anomalies, renal anomaly, breech presentation, decreased fetal movement, and so forth; (b) central nervous system (CNS): microcephaly, hydrocephaly, absent corpus callosum, polymicrogyria, cerebellar hypoplasia, holoprosencephaly, cerebral atrophy, lipoma of the sella turcica, lumbar meningocele (Herman et al, 1993); (c) other reported abnormalities: persistent open posterolateral fontanelle, thin ribs, hypoplastic thumb metacarpals, high ovoid lumbar bodies, increased number of sternal ossification centers (Herman et al, 1993) (see Fig. SYME-S-16).

Differential Diagnosis: (a) Meckel syndrome; (b) Pallister-Hall syndrome; (c) Smith-Lemli-Opitz syndrome type I.

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Figure SYME-S-16 ■ Smith-Lemli-Opitz syndrome (Type II) in a patient shortly after birth. Note the micrognathia, large low-set ears (*upper row*), postaxial polydactyly of the left hand (*bottom left*), bilateral syndactyly between the second and third toes, and postaxial polydactyly of the right foot. (From Bialer MG et al: Female external genitalia and müllerian duct derivatives in a 46,XY infant with the Smith-Lemli-Opitz syndrome, *Am J Med Genet* 28:723, 1987. Used by permission.)



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SMITH-MAGENIS SYNDROME

MIM#: 182290.

Synonyms: SMS; 17p interstitial deletion syndrome.

Mode of Inheritance: locus: 17p11.2 deletion; variable size deletions; also ? contiguous gene syndrome.

Frequency: More than 50 reported cases to 1994 (Fan et al, 1994).

Clinical and Radiologic Manifestations: Variable phenotype, no pathognomonic features (Potocki et al, 2003); (a) *growth failure*; (b) brachycephaly; midfacial hypoplasia; microcephaly; upward slant of palpebral fissures, upper lip turned at corner, prognathism (Allanson et al, 1999); (c) *mental retardation*; *hyperactivity*; infant spasms (Roccella et al, 1999); self-mutilation (Finucane et al, 2001); speech delay; *sleep disturbance* (inverted circadian rhythm-melatonin) (De Leersnyder et al, 2001); seizures; (d) *short and broad hands*; brachydactyly (especially of distal bones), nonspecific pattern profile, enlarged proximal phalanx of thumb and middle phalanx of fifth digit (Schlesinger et al, 2003); clinodactyly of fifth fingers; abnormal palmar creases; finger

pads; (e) *eye abnormalities*: strabismus; Brushfield spots; high myopia; retinal detachment; macular scars (Babovic-Vuksanovic et al, 1998); (f) prenatal diagnosis (two cases) (Thomas et al, 2000); (g) other reported abnormalities: cardiac defect (45%); genital/renal anomalies (19%), vesicoureteral reflux (Chou et al, 2002); delayed dentition; malpositioned ears; hearing loss; hoarse/deep voice; scoliosis, flat feet (Spilsbury et al, 2003); hypercholesterolemia (Smith et al, 2002); mosaicism for deletion 17p11.2; infant born to a mother having a mosaic 17p11.2p12 deletion and minimal findings of Smith-Magenis syndrome.

Note: (1) large deletion presenting with both SMS and Joubert syndrome phenotype (Natacci et al, 2000).

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SNAPPING HIP SYNDROME

Synonym: Coxa saltans, *snapping tendon syndrome*; *iliopsoas syndrome*.

Clinical and Radiologic Manifestations: (1) **definition and etiologies:** 3 types; external: thick iliotibial band (gluteus maximus) over greater trochanter, internal: slip of iliopsoas tendon over iliopectineal eminence, intra-articular: joint lesions (Allen et al, 1995; Tatu et al, 2001); consequent to Perthes disease (Yamamoto et al, 2004); idiopathic hip instability (Bellabarba et al, 1998); (2) **imaging:** plain film, *dynamic US*, CT, MRI; findings: hypoechoic band, thickened band; fluid collections; jerky/abnormal movement (Choi et al, 2002; Janzen et al, 1996; Pelsser et al, 2001; Vaccaro et al, 1995; Wunderbaldinger et al, 2001).

Note: (1) *snapping scapula syndrome* (Carlson et al, 1997; Mozes et al, 1999).

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SNEDDON SYNDROME

MIM#: 182410.

Mode of Inheritance: Autosomal dominant; commonly sporadic.

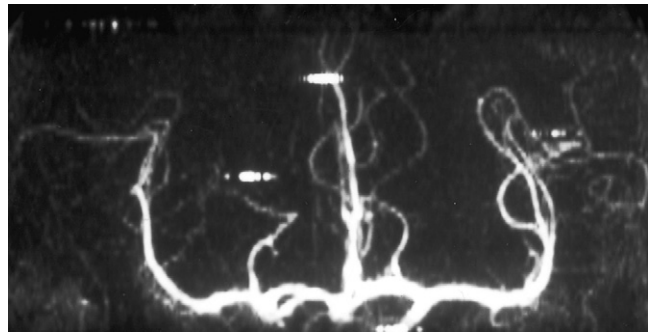


Figure SYME-S-17 ■ Sneddon syndrome. Anteroposterior, maximum-intensity projection MRA (three-dimensional time of flight with magnetization transfer contrast; TR = 38, TE = 8), demonstrating a relatively low signal intensity of the right pericallosal artery, consistent with slow flow or a narrowed vessel lumen. (From Pettee AD et al: Familial Sneddon's syndrome: clinical, hematologic, and radiographic findings in two brothers, *Neurology* 44:399, 1994. Used by permission.)

Clinical Manifestations: Onset of symptoms in early adulthood; more common in females: (a) *generalized livedo reticularis* (skin changes often precede central nervous symptoms by a number of years); most commonly occurring at the trunk and the proximal part of the limbs; (b) *recurrent strokes*; long symptom-free intervals; most symptoms related to medium-sized cerebral artery occlusions; epileptic fits; (c) mental deficiency associated with cerebral atrophy; (d) *migraine* (Tietjen et al, 2002); (e) other reported abnormalities: systemic hypertension; Raynaud phenomenon; ischemic heart disease; disturbed sexual function in men; complicated pregnancies; *multifactorial*, association with: *antiphospholipid antibodies* (in about one third of the cases) (Charles et al, 1994; Frances et al, 1999), high concentration of anticardiolipin antibodies, factor V Leiden mutation, platelet abnormalities (Matsumura et al, 2001), arylsulphatase A pseudodeficiency (Parmeggiani et al, 2000).

Radiologic Manifestations: (a) *vascular occlusion*; irregularities of the vessel walls in the periphery, atypical moyamoya; (b) cerebral blood flow study (HMPAO- brain SPECT): disturbed regional cerebral flow shown before irreversible ischemic insults occur; (c) MRI: progressive white matter lesions, brain atrophy (Tourbah et al, 1997) (Fig. SYME-S-17).

Differential Diagnosis: (1) *Divry-van Bogaert syndrome* (Sneddon-like but no antibodies) (Stone et al, 2001).

Note: (1) relationship with Lupus (SLE) (Frances et al, 2000).

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SOLITARY RECTAL ULCER SYNDROME

Synonym: Rectal ulcer syndrome.

Frequency: More than 15 cases reported in children (De la Rubia et al, 1993; Ertem et al, 2002; Godbole et al, 2000; Kiristioğlu et al, 2000).

Clinical Manifestations: (a) *rectal bleeding; mucus discharge; (b) anorectal pain; chronic constipation; prolonged straining; rectal prolapse* (Gopal et al, 2001); (c) *benign mucosal lesion in the distal wall of the rectum:* fibrous obliteration of the lamina propria; disruption of the lamina muscularis mucosae; extension of muscle fibers into the lamina propria; (d) *associations:* nonspecific colitis (Haboubi et al, 2001); rectal stricture (Baskonus et al, 2001); hemophilia (Bishop et al, 2001); spinal cord injury (Wang et al, 2001); rectal malignancy simulation (Li et al, 1998; Tsuchida et al, 1998).

Radiologic Manifestations: (a) *granularity of the rectal mucosa, thickened rectal folds; rectal stricture;* (b) *defecography: intussusception of the rectal wall; rectocele; rectal prolapse; failure of relaxation of the puborectalis that prevents passage of a bolus, abnormal perineal descent;* (c) *transrectal sonography: thick hypoechoic growth disrupting the echogenic margin of the perirectal fat.*

Therapy: (1) surgical (Marchal et al, 2001); (2) nonsurgical (biofeedback) (Bishop et al, 2002; Malouf et al, 2001).

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SOMATOSTATINOMA SYNDROME

Etiology: Pancreatic tumor *producing somatostatinlike immunoreactivity and bioactivity;* carcinoid type (Fulfaro et al, 1998).

Clinical and Radiologic Manifestations: (a) *dry mouth, dyspepsia, postprandial fullness, steatorrhea, and diabetes mellitus;* (b) *normocytic, normochromic anemia;* (c) pancreatic tumor or extrapancreatic tumor (duodenum or papilla of Vater, resulting in chronic pancreatitis); diabetes (Sessa et al, 1997); (d) metastases relate to size (>2 cm) (Tanaka et al, 2000); (e) *MRI: heterogeneous, nonspecific* (Semelka et al, 2000); *CT* (Hamissa et al, 1999); *somatostatin receptor scintigraphy (111 In-pentetreotide)* (Schillaci et al, 1997); (f) other reported abnormalities: associations of somatostatinoma: with *neurofibromatosis type I* (Green et al, 2001); hypercalcemia (somatostatin increase) (Sugimoto et al, 1998); congenital pseudoarthrosis; cholelithiasis; multiple endocrine neoplasia (MEN) I (Lin et al, 2003); erythrocytosis and von Hippel-Landau disease (Karasawa et al, 2001); sprue (one case) (Frick et al, 2000); ectopic pancreas (Chetty et al, 1999).

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SORSBY SYNDROME

MIM#: 120400.

Mode of Inheritance: Autosomal dominant.

Frequency: 11 members of a single family (Thompson et al, 1988).

Clinical and Radiologic Manifestations: (a) *bilateral macular colobomas; horizontal pendular nystagmus; visual loss*; (b) *hand and foot anomalies: brachydactyly type B*, shortening of the middle and terminal phalanges of the second to fifth digits; absent or hypoplastic nails, broad or bifid thumbs and halluces; syndactyly; absence of the distal phalanges (in some); (c) other reported abnormalities: unilateral absence of a kidney; duplication of the uterus and vagina.

Note: Another Sorsby syndrome: fundus (eye) dystrophy MIM# 136900.

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SOTOS SYNDROME

MIM#: 117550.

Synonym: Cerebral gigantism.

Frequency: More than 200 reported cases to 1994 (Cole et al, 1994); many cases since to 2003.

Mode of Inheritance: Sporadic in the majority of the cases; autosomal dominant; mutations/microdeletions in NSD1 gene (60%–75%) (Nagai et al, 2003; Rio et al, 2003; Visser et al, 2003); allelic to Weaver syndrome.

Clinical Manifestations: (a) *acromegalic appearance* (Sotos et al, 1964, 1977); (b) *large head; dolichocephaly; prominent forehead and supraorbital ridges; downslant of palpebral fissures; ocular hypertelorism; prominent jaw; pointed chin; high-arched palate* (Cole et al, 1994; Sotos et al, 1964, 1977); (c) *birth weight above average; very rapid growth in height and weight (above the 90th percentile)* (Cole et al, 1994;

Sotos et al, 1964, 1977); (d) *long arm span; large hands and feet*; (e) *mental retardation; poor motor coordination; behavioral problems: tantrums; destructiveness; aggressive behavior; social withdrawal; autistic disorder; eating and sleeping difficulties* (Rutter et al, 1991); (f) *absence of precocious sexual development*; (g) *chromosomal aberrations: deletions (chromosome 15); duplication (chromosome 15); translocation (chromosomes 2, 3, 5, 6, 8, 12, and 15); pericentric inversion of chromosome Y; trisomy 20p*. (Faivre et al, 2000; Haeusler et al, 1993; Imaizumi et al, 2002; Maroun et al, 1994); (h) *neoplasms: hepatocarcinoma; epidermoid carcinoma; Wilms tumor; neuroblastoma; sacrococcygeal teratoma; leukemia; lymphoma; small cell carcinoma; vaginal carcinoma; gastric carcinoma; osteochondroma; pulmonary blastoma; cardiac fibroma*; (Cohen, 1999; Hersh et al, 1992; Le Marec et al, 1999; Leonard et al, 2000; Maldonado et al, 1984; Marci et al, 2001; Nance et al, 1990; Sugarman et al, 1977); (i) other reported abnormalities: (1) *skin: cutis laxa-like* (Robertson et al, 1999); *pigmented nevus; thin and brittle nails; enamel hypoplasia* (Inokuchi et al, 2001); (2) *metabolic/endocrine: thyrotoxicosis; Kocher-Debré-Sémélaigne syndrome; glucose intolerance; low somatomedin levels; increased urinary excretion of 17-ketosteroids and 17-hydroxysteroids; abnormal plasma amino acids*; (3) *neuromuscular: hypotonia; muscle weakness; increased tendon reflexes; abnormal electroencephalogram (nonspecific; diffuse); autonomic failure with persistent fever*; (4) *ocular manifestations: moderate to high refractive error (hyperopia); retinal degeneration* (Inoue et al, 2000); *glaucoma* (Yen et al, 2000); *nystagmus, strabismus*; (5) *congenital heart defects (8%–10%)* (Miyamoto et al, 2003); *cardiac conduction defects (Wolff-Parkinson-White)* (Sharma et al, 2003); (6) *miscellaneous: feeding difficulties in infancy; premature eruption of teeth; cavernous hemangioma; polycystic kidney disease (Cefle et al, 2002); ovarian fibromas* (Chen et al, 2002); *leg length asymmetry; growth hormone hypersecretion; carpal tunnel syndrome* (Ambler et al, 1993; Kaneko et al, 1987; Maino et al, 1994); (7) *anesthesia* (Adhami et al, 2003).

Radiologic Manifestations: (a) *large dolichocephalic skull, ocular hypertelorism, high-rising orbital roofs, normal-size sella turcica* (Poznanski et al, 1967); (b) *disproportionately large hands and feet; abnormal metacarpophalangeal pattern profile (a major peak in the proximal phalangeal area and a smaller peak in the metacarpal area, with the distal hand bones being relatively short; a relative short metacarpal one and long distal phalanx one; heterogeneity in the profile)* (Butler et al, 1988; Cole et al, 1994; Dijkstra et al, 1994; Poznanski et al, 1967); (c) *advanced skeletal maturation, disharmonic maturation of the phalanges and carpal bones* (the phalanges more advanced as compared with the carpals; delayed appearance of the scaphoid ossification) (Cole et al, 1994; Poznanski et al, 1971); (d) other reported abnormalities: (1) *central nervous system (CNS): megalencephaly, enlarged subarachnoid space, dilated cerebral ventricles, cavum septum pellucidum, cavum velum interpositum, absent corpus callosum* (al Rashed et al, 1999; Aoki et al, 1998; Poznanski et al, 1967; Schaefer et al, 1997); (2) *skeletal: posteriorly inclined dorsum sella turcica, presence of an anterior fontanelle bone, vertebra plana, intervertebral disk herniation, kyphosis or kyphoscoliosis* (Sweeney et al, 2002), *syndactyly,*

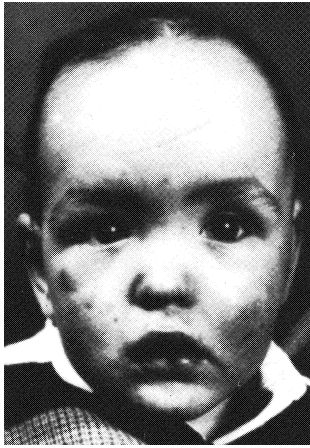


Figure SYME-S-18 ■ Sotos syndrome in a 2.75-year-old boy with a birth weight of 4 kg and a birth length of 56 cm. (From Wit JM et al: Cerebral gigantism (Sotos syndrome). Compiled data of 22 cases. Analysis of clinical features, growth and plasma somatomedin, *Eur J Pediatr* 144:131, 1985. Used by permission.)

unequal leg length, pes planus, genu valgus, genu varus, valgoid feet, congenital hip dislocation (Cole et al, 1994; Poznanski et al, 1967); (3) miscellaneous: hydronephrosis, functional megacolon (Adam et al, 1986) (Figs. SYME-S-18 and SYME-S-19).

Differential Diagnosis: *Macrocephaly-autism syndrome* (605309) (Cole, 1991); *Nevo syndrome* (MIM# 601451); Soto-like syndrome: dysmorphic, overgrowth, normal bone age, severe developmental delay (Amiel et al, 2002), probably NSD1 defect (Lachman); Bannayan-Smith-Ruvalcaba syndrome; Beckwith-Wiedemann syndrome; Fragile X syndrome; Klinefelter syndrome; Marfan syndrome; Marshall-Smith

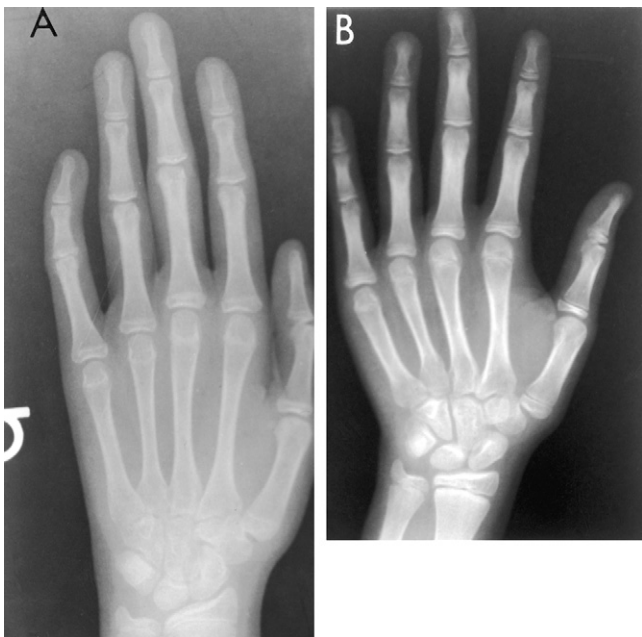


Figure SYME-S-19 ■ Sotos syndrome in a 12-year-old mentally retarded girl who is large for her age. Note the large size of her hand (A) compared with that of another patient of same age. B, Skeletal maturation is 13 years, 9 months when compared with the standards.

syndrome; Neurofibromatosis; Perlman syndrome; Proteus syndrome; San Filippo syndrome; Simpson-Golabi-Behmel syndrome; Trisomy 8 mosaicism; Weaver syndrome.

Note: (1) diagnostic *mandatory* criteria: *macrocephaly, facial dysmorphism*; less firm criteria: *overgrowth, advanced bone age* (Rio et al, 2003); (2) deletion causes greater mental retardation (Rio et al, 2003).

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SPHEROCYTOSIS

MIM#: 182900.

Synonym: Minkowski-Chauffard disease.

Mode of Inheritance: Autosomal dominant in about 75% of the cases; sporadic or autosomal recessive inheritance in other cases; AD: locus:8p11.2, many private mutations of 5 proteins in RBC membranes (Tse et al, 1999); AR: (MIM# 270970, mutation in alpha-spectrin gene).

Frequency: Approximately 1 in 5000 persons of northern European ancestry (Agre, 1989).

Pathophysiology: Deficiency of spectrin (a protein of the erythrocyte membrane skeleton) resulting in the formation of spherocytes that lack normal strength; the spherocytes trapped in the splenic red pulp have a short survival period and are destroyed.

Clinical Manifestations: Variable clinical severity: (a) *jaundice*; (b) *splenomegaly*; (c) *chronic hemolytic anemia* with an onset in childhood or adolescence; *spherocytes in the peripheral blood*; *increased osmotic fragility of erythrocytes*; *shortened life span of erythrocytes* from an affected person in a normal recipient; rapid hemolysis of spherocytes in the spleen; (d) diagnosis in newborn infants: increased osmotic fragility of fresh and incubated red blood cells, moderately increased autohemolysis, and partial reduction of autohemolysis by the addition of glucose; (e) other reported abnormalities: atypical hyperbilirubinemia in newborns; aplastic crisis; leg ulcerations; congestive heart failure; myeloproliferative disorders.

Radiologic Manifestations: (a) *bilirubin stones*; (b) *osteoporosis*; *widening of the medullary canal of tubular bone*; *widening of the diploic space*; *hair-on-end appearance of the calvaria*; (c) *extramedullary hematopoiesis (paravertebral)* (Granjo et al, 2002), adrenal (Calhoun et al, 2001); (d) secondary

hemochromatosis (related to repeated transfusions); (e) splenomegaly, usually with a homogeneous increased echogenicity; well-defined focal defects of high echogenicity relative to the normal spleen (soft areas composed of dilated sinuses and extramedullary hemopoiesis); splenic rupture; (f) ischemic cerebral accident, moyamoya (two cases) (Holtz et al, 1998; Tokunaga et al, 2001).

Therapy: (1) partial splenectomy (de Buys Roessingh et al, 2002); (2) laparoscopic surgery.

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SPLENIC FLEXURE SYNDROME

Synonyms: Acute flexura lienalis syndrome; Payr syndrome.

Clinical Manifestations: (a) left upper abdominal pain; (b) tenderness over the left upper portion of the abdomen; (c) abdominal distension in some.

Radiologic Manifestations: (a) *localized gaseous distension of the splenic flexure of the colon* with/without contrast studies demonstrating interposition of the splenic flexure of the colon between the diaphragm, stomach, and spleen.

Note: The existence of the syndrome is questionable.

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SPLENOGONADAL FUSION/ LIMB DEFORMITY

MIM#: 183300.

Synonym: SGFLD.

Classification and Pathology of Splenogonadal Fusion:

(a) types: (1) *continuous splenogonadal fusion*: spleen connected to the left gonad by a cord of splenic or fibrous tissue or by bandlike masses of splenic tissue; (2) *accessory splenic tissue attached to the gonad*; (b) other associated anomalies (usually continuous type): (1) limb defects, bifid vertebrae; (2) abdomen: diaphragmatic hernia; partial situs inversus microgastria; bowel obstruction; anal malformations; Meckel diverticulum; bilobed spleen; hepatolienal fusion; abnormal fissures of the liver; abnormal fissuring of the spleen; accessory spleen; adrenogonadal fusion; hypoplasia of the adrenals; hypospadias; double uterus; (3) chest: abnormal fissures of the lungs; hypoplastic lungs; congenital cardiovascular defects; (4) polymicrogyria.

Frequency and Mode of inheritance: Approximately 150 reported cases of splenogonadal fusion (McPherson et al,

2003); 33 reported cases of splenogonadal fusion in association with limb deformity/associated anomalies (McPherson et al, 2003); *high incidence* of occurrence in *males*; sporadic.

Clinical Manifestations: (a) *limb malformation* (amelia; peromelia; phocomelia; ectromelia; hemimelia; clubfoot); (b) *inguinal hernia*; *cryptorchidism* (31%) (Cortes et al, 1996); *scrotal "mass"*; (c) *micrognathia* (20/33); (d) other reported abnormalities: malformed ears; asymmetrical skull; Möbius syndrome; tumors: *germ cell testicular tumors* (three cases) (Imperial et al, 2002); laparoscopic diagnosis (Braga et al, 1999).

Radiologic Manifestations: (a) ^{99m}Tc sulfur colloid imaging for *ectopic splenic tissue localization* (Steinmetz et al, 1997); (b) demonstration of splenogonadal fusion by various imaging techniques: US, homogeneous mass adjacent to testes (Cirillo et al, 1999; Cochlin, 1992; Henderson et al, 1991; Lombay et al, 1999); CT, contiguous mass (Jequier et al, 1998); (c) *limb deformities*, hip dislocation (Fig. SYME-S-20).

Differential Diagnosis: (1) paratesticular neoplasms (Akbar et al, 2003); (2) translocation 46XX t(2;12) (p25.1;q24.1): pero/phocomelia without splenogonadal

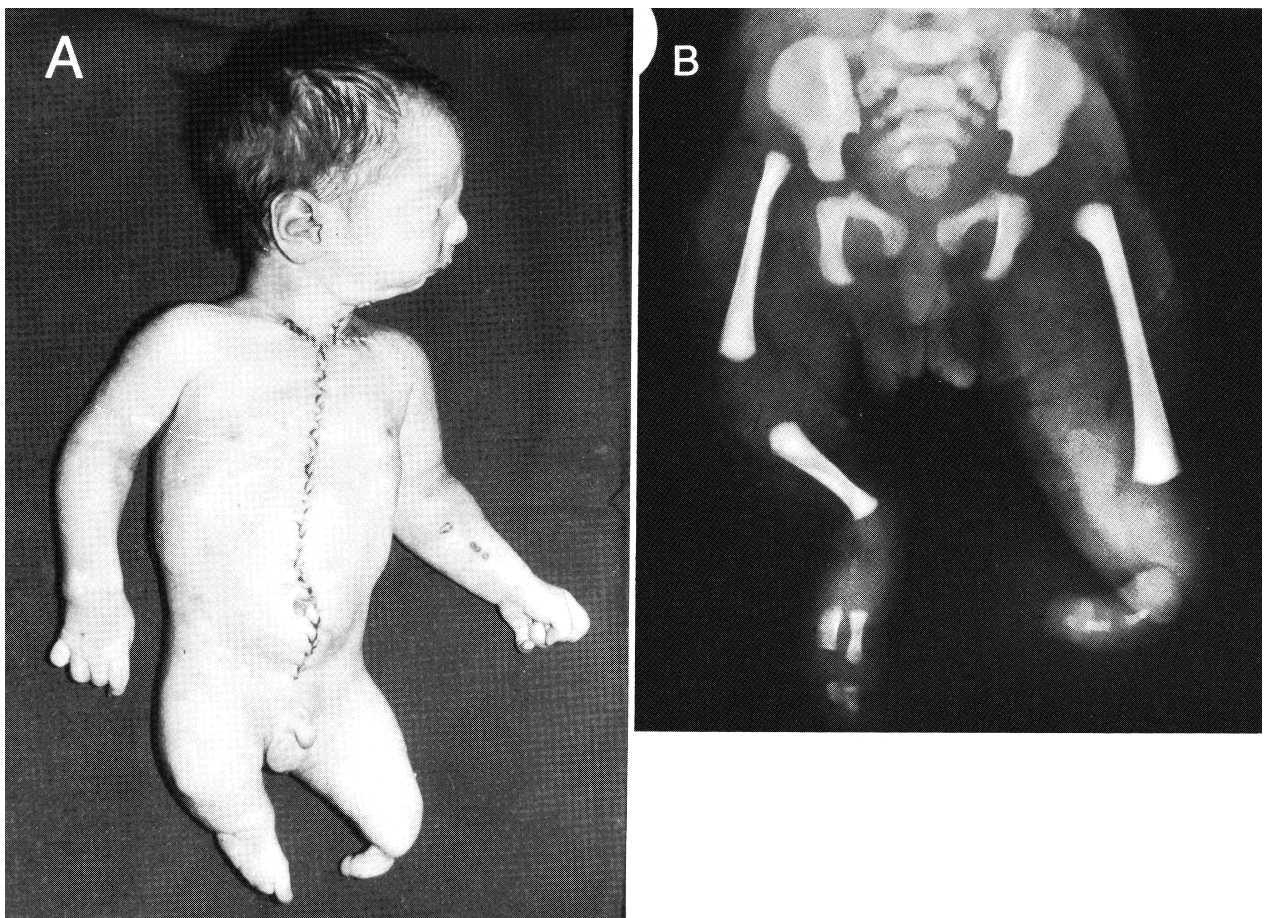


Figure SYME-S-20 ■ Splenogonadal fusion syndrome. **A**, Postmortem photograph of an infant with peromelia of the lower limbs and micrognathia. **B**, Roentgenogram of the lower limbs. The right femur is shorter than the left one is, and an absent left tibia and fibula, short right tibia and absent right fibula, and feet deformity are present. At postmortem examination fusion of a splenic mass and the left testicle ventral to the left kidney was found. (From Gouw ASH et al: The spectrum of splenogonadal fusion: case report and review of 84 reported cases, *Eur J Pediatr* 144:316, 1985. Used by permission.)

fusion nor micrognathia (Murray et al, 2002); (3) Roberts syndrome (De Ravel et al, 1997; Lipson, 1995).

Note: (1) ? relationship to Hanhart, femoral-facial syndromes (McPherson et al, 2003); (2) *hepatogonadal fusion* (one case) (Ferro et al, 1996).

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SPLIT-HAND/SPLIT-FOOT DEFORMITIES (SYNDROME)

Synonyms: Lobster-claw deformity; *ectrodactyly*; *SHFM*.

Definition: Defect in development of the central rays of the hands/feet; in the monodactylous type, the fifth digit is usually present.

Classification:

(A) Isolated Malformation: Type 1 (locus 7q21); Type 2 (locus xq26); Type 3 (10q24; dactylin gene [Basel et al, 2003]); Type 4 (mutation tp63 gene [Duijf et al, 2003]).

(B) Syndromic: More than 60 syndromes reported (also see *gamut: ectrodactyly*). (a) acrorenal syndrome (Dieker-Opitz syndrome; Curran syndrome); (b) *ADULT syndrome* (Acro-Dermato-Ungual-Lacrimal-Tooth syndrome): ectrodactyly, excessive freckling, onychodysplasia, obstruction of lacrimal ducts, and hypodontia and/or early loss of permanent teeth (TP63 gene mutation) (Amiel et al, 2001); (c) anonychia

with ectrodactyly; (d) ectrodactyly with cleft palate (MIM# 129830), without cleft lip/palate (MIM# 129810); (e) EEC syndrome (*Ectrodactyly*; *Ectodermal dysplasia*; *Cleft lip and/or cleft palate*); (f) Karsch-Neugebauer syndrome: split hand with congenital nystagmus, fundal changes, and cataract; (g) split hands and/or split feet associated with other limb reduction defects (absence of long bones of upper and/or lower limbs), SFHM with absent tibia (possibly AR (Witters et al, 2001), MIM# 119100), SFHM with fibular aplasia (47 cases) (Evans et al, 2002); autosomal dominant in most families with wide variability in expression; locus heterogeneity (Helal et al, 1993); (h) split hand and/or split foot with mandibulofacial dysostosis; (i) split hand/foot with perceptive deafness (contiguous gene, with type 1, MIM# 605617) (Fukushima et al, 2003); (j) SHFM with coloboma, hypospadias, sperm abnormalities (Giltay et al, 2002).

Imaging Abnormalities: (1) fetal US (Haak et al, 2001; Lepaire et al, 2002); (2) SFHM3: supernumerary ossicle-distal phalanx of thumb (Roscioli et al, 2004).

Note: (1) AR inheritance in SFHM (Gui et al, 2002); (2) p63 mutations in SFHM and many other limb deformity syndromes (Brunner et al, 2002).

Historical Note: SFHM nonsyndromic family members sterilized by Nazi eugenics law of 1933 (Busch et al, 2002).

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SPLIT NOTOCHORD SYNDROME

Frequency: Approximately 25 reported cases to 2003.

Pathology: (a) *vertebral anomalies: anterior and posterior spina bifida*; (b) *neural anomalies: split notochord; meningo-myelocele; meningocele; developmental anomalies of the hindbrain and cervical spinal cord*; (c) *intestinal anomalies: mediastinal cysts of foregut origin (neuroenteric cysts); enteric duplication, diverticulum; dorsal enteric fistula (passage of bowel through the spinal cleft) (Kanmaz et al, 2002); partial agenesis of the colon; malrotation of the bowel; intussuscepted cecum; enteric fistula opening into the rectum, sigmoid, closed colonic loop or lower part of the small intestine; imperforate anus (six cases); annular pancreas; meconium peritonitis*; (d) *genitourinary anomalies: malformed kidney; bicornuate uterus; bladder exstrophy; penoscrotal transposition*; (e) *miscellaneous: diaphragmatic hernia; wandering spleen (Dindar et al, 1999); common mesentery; spinal cord herniation into cyst (Aydin et al, 2003); intraabdominal leg (Fowler, 1998); (e) embryology, experimental: partial separation of notochord (Emura et al, 2003).*

Clinical Manifestations: (a) external deformities related to the anomalies listed under Pathology (spina bifida cystica, enteric fistula, etc.); (b) *neurologic deficit* associated with spinal cord anomalies.

Radiologic Manifestations: Well-demonstrated on MRI (a) *spina bifida (anterior and posterior)*; (b) *spinal cord and nerve defects; split cord*; (c) *intestinal anomalies* including intestinal herniation through the dorsal cleft; (d) *genitourinary anomalies*; (e) *neuroenteric cyst*; (f) *prenatal diagnosis: US, polyhydramnios, cyst vertebral anomalies (Almog et al, 2001) (Fig. SYME-S-21).*

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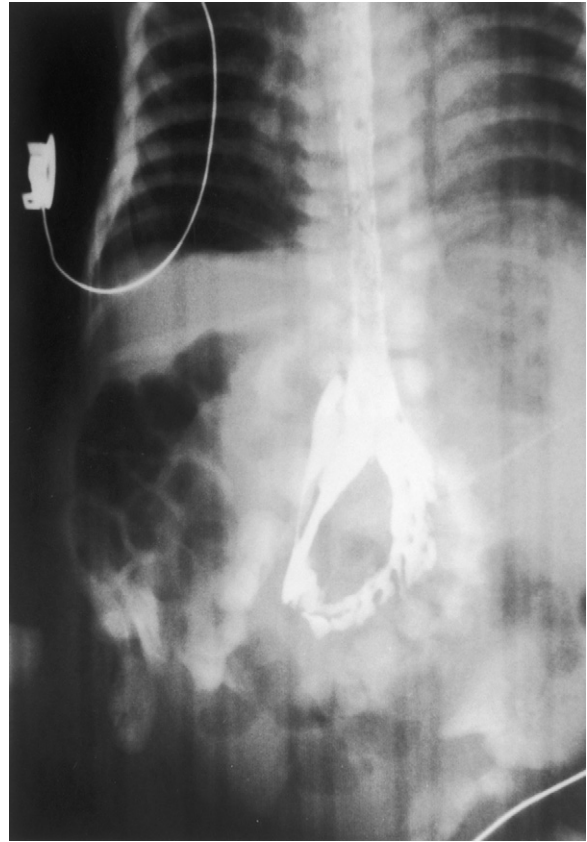


Figure SYME-S-21 ■ Split notochord syndrome in a newborn with exstrophy of the bladder and lumbar abnormalities with meconium draining through the dorsal fistula in the lumbar region. Myelography demonstrates total lumbar rachischisis.

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SPONDYLOCARPOTARSAL FUSION (SYNOSTOSIS) SYNDROME

Synonyms: Congenital synspondylism; *spondylocarpotarsal synostosis with/without unsegmented bar.*

Mode of Inheritance: *Autosomal recessive*; probably a NOG gene defect (Lachman).

Frequency: About 20 cases reported to 2002 (Honeywell et al, 2002).

Clinical Manifestations: (a) progressive *scoliosis*; (b) short stature; (c) other reported abnormalities: *hearing loss*; flat feet; clinodactyly of fifth fingers; cleft palate; enamel hypoplasia; *cervical instability* (odontoid hypoplasia, three cases) (Seaver et al, 2000).

Radiologic Manifestations: (a) *scoliosis*; vertebral fusion; *narrow intervertebral disks*; *unilateral unsegmented*

vertebral bar; (b) *carpal and tarsal fusion*; (c) generalized epiphyseal ossification delay (Honeywell et al, 2002). (Fig. SYME-S-22).

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SPONDYLO-COSTAL (SPONDYLO-THORACIC) DYSOSTOSES

MIM#: 122600, 277300.

Synonyms: *Spondylacarpotarsal synostosis; spondylacarpotarsal fusion syndrome; hereditary costovertebral dysplasia, Jarcho-Levin syndrome; SCDO; segmentation anomalies vertebrae/ribs.*



Figure SYME-S-22 ■ Spondylacarpotarsal fusion syndrome. **A**, AP hands: carpal fusions, bilateral. **B**, AP spine: vertebral body fusions, secondary scoliosis.

Frequency: More than 100 cases of Jarcho-Levin syndrome reported to 2002 (Rastogi et al, 2002).

Mode of Inheritance and Classification (Cornier et al, 2003, 2004; Martinez-Frias, 2004): A heterogeneous disorder of vertebral segmentation anomalies: (1) *Jarcho-Levin syndrome* (spondylocostal dysostosis type I); autosomal recessive inheritance; (severe phenotype) predominance in Hispanic families; reduced levels of PAX1, PAX9 in chondrocytes (Bannykh et al, 2003); (2) *autosomal dominant spondylocostal dysostosis*; variable gene expression; (milder phenotype); (3) *autosomal recessive*, most frequent type, (intermediate phenotype), variable gene expression; locus: 19q13.1-3, mutations in DLL3 (Notch signaling) (Dunwoodie et al, 2002; Sparrow et al, 2002), also mutations in MESP 2 (Turnpenny et al, 2003; Whittock et al, 2004).

Clinical Manifestations:

(A) Jarcho-Levin Syndrome: (a) *marked shortness of the neck and posterior aspect of the chest; increased anteroposterior diameter of the thoracic cage; protuberant abdomen;* (b) prominent occiput; broad forehead; wide nasal bridge; prominent philtrum; anteverted nares; inverted V-shaped mouth; (c) long, thin limbs with tapering digits; (d) often lethal; (e) other reported clinical and pathologic abnormalities (Duran et al, 2001): (1) limbs: soft tissue syndactyly; camptodactyly; hammertoes; (2) *genitourinary: hydronephrosis; bilobed bladder; urethral atresia; undescended testes; hydrocele; absent external genitalia; uterus didelphys; anal atresia;* (3) *central nervous system (CNS): cerebral polygyria; rachischisis; diastematomyelia; Arnold-Chiari malformation with thoracolumbar meningocele;* (4) *miscellaneous: lower airway deformity and obstruction; congenital heart disease* (Hatakeyama et al, 2003; McMahon et al, 2001; Shimizu et al, 1997); aortic root dilatation (Galguera et al, 1997); pulmonary hypoplasia; difficult delivery resulting from trunk deformity; single umbilical artery; inguinal hernia; abdominal wall hernias; (e) death often resulting from respiratory insufficiency, pulmonary hypertension; survival to childhood rare (66%) (Cornier, 2004; McCall et al, 1994; Rastogi et al, 2002).

(B) Benign Autosomal Dominant and Autosomal Recessive Types of Spondylocostal Dysostosis: (a) *short trunk and neck; wide anteroposterior diameter of the chest; limited rotatory movement of the spine;* (b) nerve root compression; (c) usually normal life expectancy.

Radiologic Manifestations: (a) *neurovertebral anomalies: block vertebrae; hemivertebrae; butterfly deformity; sagittal clefts; widely open neural arches; missing vertebral bodies; diastematomyelia; meningocele; spinal cord anomalies;* (b) *fan-shaped appearance of the ribs in the posteroanterior direction with posterior convergence of the ribs* (Jarcho and Levin, 1938); fused, hypoplastic, missing ribs (less severe forms); (c) prenatal diagnosis US (Eliyahu et al, 1997; Hull et al, 2001; Kauffmann et al, 2003; Lam et al, 1999; Wong et al, 1998) (Fig. SYME-S-23).

Differential Diagnosis: (1) COVESDEM syndrome (costovertebral segmentation defect with mesomelia) (Wadia et al, 1978); (2) SCDO-like with multiple pterygia and arthrogryposis (AR, six cases, MIM# 601809) (Johnson et al, 1997); (3) absent vertebral ossification, ribs (missing, posterior gaps), nephrogenic rests, AR (Prefumo et al, 2003); (4) SCDO phenotype with 46XX 6;15 translocation (Crow et al, 1997), with 18q22 deletion (Downton et al, 1997); (5) SCDO phenotype with malignant hyperthermia, central core disease (RYR1 gene abnormality) (Rueffert et al, 2004); (6) cerebrofaciothoracic dysplasia (MIM# 213980): MR, facial dysmorphism, SCDO vertebral/rib changes.

Note: (a) the distribution and severity of the costovertebral anomalies do not seem to be entirely helpful in the differential diagnosis of the various genetic types of the disease because mild and severe clinical manifestations have been reported in the same family (Lorenz et al, 1990); (b) *important genetic counseling information: SCDO with congenital malformations*, that is, genitourinary (GU), gastrointestinal (GI) external, and so forth are most commonly *sporadic* (Mortier et al, 1996); (c) associated abnormalities with severe spondylocostal dysostosis: *neural tube defects; central nervous system (CNS) anomalies; tracheal agenesis; diaphragmatic defect: hernia/agenesis; polydactyly, camptodactyly; caudal dysgenesis complex* (limb deficiencies; urinary tract anomalies including renal agenesis; genital anomalies; imperforate anus) (Day et al, 2003; Martínez-Frias et al, 1998, 2004; Shehata et al, 2000; Swietlinski et al, 2002); *Casamassina syndrome: SCDO with GU anomalies, anal atresia* (Casamassina et al, 1981; Martinez-Frias et al, 1998);

Figure SYME-S-23 ■ Spondylocostal dysostosis, dominant type, in a newborn female with truncal dwarfism, a prominent occiput, and normal limbs. Block vertebrae, hemivertebrae, butterfly vertebrae, and rib anomalies (dysplasia, fusion, and abnormal position) are present. Vertebral anomalies were also noted in the cervical and lumbosacral segments. The father (of Puerto Rican origin) had similar rib and vertebral anomalies in the cervical, thoracic, and lumbosacral regions. The cranium and limbs of the father appeared normal. (Courtesy Dr. Robert E. Sharkey, Hayward, Calif.)



(d) SCDO with anal atresia and GU anomalies (MIM# 271520); (e) molecular prenatal diagnosis (DLL3) (Whittock et al, 2003).

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STAGNANT SMALL-BOWEL SYNDROME

Synonyms: *Blind loop syndrome; blind pouch syndrome.*

Etiology: Small-bowel stenosis or stricture; gastrocolic fistula; ileocolic fistula; small-bowel diverticula; Crohn disease; blind loop (segment of the small intestine completely bypassed); blind pouch (side-to-side anastomosis associated with persistence of the residual afferent and efferent ends of the intestine).

Clinical Manifestations: (a) *weight loss; growth retardation; malnutrition;* (b) *abdominal cramp; abdominal distension;* (c) *malabsorption;* (d) *macrocytic anemia;* (e) *multiple vitamin deficiencies;* (f) *abnormal jejunal bile acid concentration resulting from abnormal bacterial flora;* (g) *hypertrophy of the bowel wall, edema, inflammation, and ulceration;* (h) *other reported abnormalities: bleeding; arthritis-dermatitis syndrome; spinocerebellar degeneration in the blind loop syndrome with vitamin E malabsorption.*

Radiologic Manifestations: (a) *spherical, tubular, or club-shaped gas-containing structures on plain films of the abdomen;* (b) *pseudotumor if filled with fluid or food debris; demonstration of distended bowel by a contrast study of the bowel;* (c) *diagnosis by scintigraphy (In-111 labeled leukocytes)* (Patel et al, 1999).

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STEELE-RICHARDSON-OLSZEWSKI SYNDROME

MIM#: 601104.

Synonym: *Progressive supranuclear palsy.*

Frequency: 1:100,000 (in UK) (Nath et al, 2001).

Clinical Manifestations: *Atypical parkinsonism* (Amar, 2003; Diroma et al, 2003), (a) *supranuclear ophthalmoplegia; pseudobulbar palsy; dystonia; axial rigidity; dementia* ("subcortical dementia"); (b) cerebellar and pyramidal signs and symptoms minor or absent; (c) absence of startle response to an unexpected auditory stimulus; (d) clinically difficult to differentiate from related disorders (Litvan et al, 1997); pathology: neurofibrillary tangles-brainstem striatum (Arnold et al, 2002a, 2002b).

Radiologic Manifestations: (1) positron-emission tomography: a global decrease in blood flow and oxygen utilization; more marked in the frontal region; (2) reduced dopamine receptor binding, MRI: *no multiple signal hyperintensities* (Arnold et al, 2002a, 2002b); MRS: "eye of the tiger" sign (high signal-globus pallidus/surrounding ring of low signal) (3/9 cases) (Davie et al, 1997).

Note: (1) most sporadic, familial cases, probably AD; (2) case with mutation in parkin gene (Morales et al, 2002).

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STERNAL-CARDIAC MALFORMATIONS ASSOCIATION

Clinical Manifestations: (a) *sternal deformity:* pectus carinatum; anterior sternal defect; etc.; (b) *congenital heart disease:* patent ductus arteriosus; ventricular septal defect; atrial septal defect; tetralogy of Fallot; transposition of the great arteries; and so forth; (c) other reported abnormalities: micrognathia; clubfeet; hemifacial microsomia; microphthalmos; tracheoesophageal fistula; congenital laryngeal stridor, dolichocephalic skull; and so forth.

Radiologic Manifestations: *Various sternal anomalies:* premature sternal fusion including chondromanubrial deformity (marked posterior angulation); delayed ossification of the mesosternum; multiple manubrial ossification centers; sternal defects (see Cantrell syndrome); and so forth.

Note: (a) the premature obliteration of the sternal sutures in association with pectus carinatum has been referred to as *Currarino-Silverman syndrome* (AD, MIM# 184800) (Chidambaram et al, 1992; Mehta, 1996; Shamberger et al, 1988); (b) the incidence of congenital heart disease in the patients with sternal anomalies has been reported to be 18% (Lees et al, 1975); (c) anterior/posterior sternal defects with pericardial/cardiac/diaphragmatic abnormalities (Cottrill et al, 1998).

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STERNAL MALFORMATION-ANGIODYSPLASIA ASSOCIATION

Clinical Manifestations: (a) *hemangiomas; telangiectasis* (face; scalp; neck; trunk; upper respiratory tract; abdominal); (b) other reported abnormalities: skin changes over the

sternal defect; absent pericardium; aortic aneurysm (Raas-Rothschild); cleft lip; micrognathia.

Radiologic Manifestation: *Sternal defects:* complete or partial, including the cleft to the xiphoid.

Note: (1) sternal cleft with *minor hemangiomas* (Tastekin et al, 2003); (2) Overlap with: PHACE syndrome (Posterior fossa abnormalities, Hemangioma, cranial Arterial anomalies, Cardiac defects, Eye abnormalities) (James et al, 2002), PHACE-like with aortic aneurysm, clefting, marfanoid features (Slavotinek et al, 2002) (see PHACE syndrome).

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STERNO-COSTO-CLAVICULAR HYPEROSTOSIS

Synonyms: Hyperostosis (multiple); Köhler disease; *Synovitis-Acne-Pustulosis Hyperostosis-Osteomyelitis syndrome*; *SAPHO syndrome*; *sternocostoclavicular hyperostosis*; (unifying concept; Boutin et al, 1998).

Clinical Manifestations: Presentation between 30 and 50 years of age: (a) *pain in the upper part of the chest and shoulder; limitation of motion; exacerbation and remission*; (b) *palmo-plantar pustulosis*: intermittent pustular, and exfoliative dermatitis of the palms and soles; (c) moderate elevation of the sedimentation rate and C-reactive protein concentration; elevated serum globulin levels (a1 and a2); polyclonal gammopathy; mildly elevated serum alkaline phosphatase concentration; (d) biopsy: nonsuppurative acute and chronic inflammation of bones, muscles, and entheses; ligamentous fibrosis; ligamentous ossification; lymphocytes, plasma cells, and polymorphonuclear leukocytes within the wall of small vessels; (e) other reported findings and associations: (1) Behçet disease (Caravatti et al, 2002); (2) transient hemiparesis (childhood) (Vanin et al, 2002); (3) *inflammatory bowel disease* (Girelli et al, 2001; Hayem et al, 1999).

Radiologic Manifestations (Davies et al, 1999; Earwaker et al, 2003; Hyodoh et al, 2001): (a) *hyperostosis and cortical thickening*, (clavicles; sternum; upper ribs; spondylodiscitis

(1/3) (Toussirost et al, 1997); sclerotic changes in the sacroiliac joint region; mandible: characteristic pattern, mixed osteolytic/osteoblastic, solid periosteal reaction, bone enlargement (Suei et al, 2003); (b) *increased uptake on skeletal scintigraphy* (especially with ^{99m}Tc MDP (Bhosale et al, 2001); “bullhead/bullhorn” sign (sternocostoclavicular region, manubrium = skull/sternal joints = horns) (Freyschmidt et al, 1998); (c) other imaging: MRI guided bone biopsy at CT (Kirchhoff et al, 2003); FDG PET (Kohl fuerst et al, 2003; Pichler et al, 2003); MRI spine: discitis/osteitis (Nachtigal et al, 1999); (d) other reported abnormalities: pleural effusion, pulmonary infiltrates; cervical spine (Tohme-Noun et al, 2003); iliac vein thrombosis (MRI) (Legoupil et al, 2001); calvarial lesion (one case) (DiMeco et al, 2000); tarsal bone involvement (Su et al, 1996) (Fig. SYME-S-24).

Therapy: (1) Pamidronate (Guignard et al, 2002).

Differential Diagnosis: (1) condensing osteitis of the clavicle (noninflammatory sclerosis of the sternal end of the clavicle) (Jurik, 1994); (2) psoriatic arthropathy.

Note: (1) *chronic recurrent multifocal osteomyelitis* (CRMO of childhood) possible continuum of SAPHO (Anderson et al, 2003; Azouz et al, 1998;

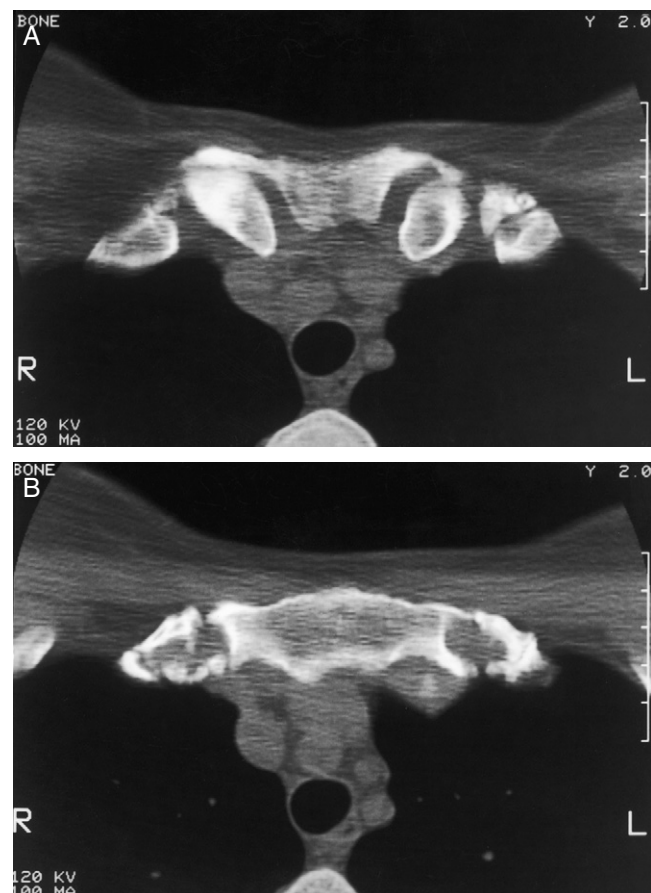


Figure SYME-S-24 ■ Sterno-costo-clavicular hyperostosis. CT: **A**, There is an ossified bridge over the sternoclavicular joints. The medial end of the right clavicle is sclerotic. The joint spaces are preserved. **B**, Lower level. Both cartilage surfaces are ossified (arrows). There is hyperostosis of the sternum. (From Economou G et al: Computed tomography in sternocostoclavicular hyperostosis, *Br J Radiol* 66:1118, 1993. Used by permission.)

Earwaker et al, 2003); initial manifestation can be *spondylodiskitis*; (2) CRMO-dyserythropoietic anemia: AR, four cases (Majeed et al, 2001).

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STEVENS-JOHNSON SYNDROME

Etiology: Various factors have been implicated: infections (mycoplasma pneumoniae [Tay et al, 1996]); drugs; collagen diseases; contactants; foods; visceral malignancies; radiation therapy.

Clinical Manifestations: (a) *systemic symptoms*; (b) *erythema multiforme-like lesions, toxic epidermal necrolysis*; (c) *vesicular lesions of the mucous membranes (stomatitis; urethritis; conjunctivitis)*; (d) other reported abnormalities: angular webbing; ulcerative colitis; ulcerative proctitis; nephritis; nephrotic syndrome; uremia, pericarditis; pericardial effusion; atrial arrhythmias; anonychia; oral mucosal scarring; chronic obliterative bronchitis; dysphagia; ocular cicatricial pemphigoid (a sequela); blindness; familial occurrence (rare).

Radiologic Manifestations: (a) patchy atypical pneumonia; pneumothorax; pneumomediastinum; subcutaneous emphysema; chronic lung disease (Basker et al, 1997); (b) cardiomegaly (pericardial effusion); (c) calcification of the bladder wall; (d) esophageal stricture; obliteration of the piriform sinus (Fig. SYME-S-25).

Note: Erythema multiforme major is a separate entity, associated with herpes virus (Roujeau, 1997).

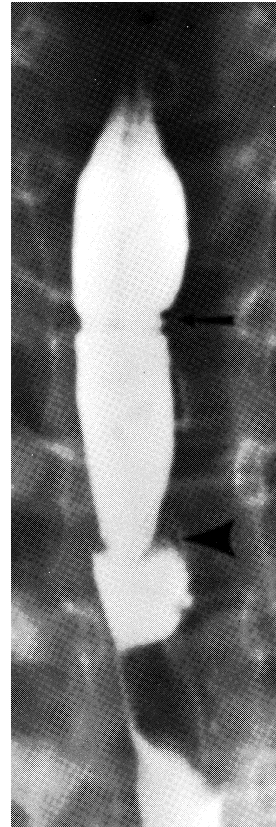


Figure SYME-S-25 ■ Stevens-Johnson syndrome. An esophagogram shows a short (3 mm) segment of mild (1.4 cm) narrowing (arrow) and a web with marked compromise (4 mm) of the lumen (arrowhead). (From Peters ME, Gourley G, Mann FA: Esophageal stricture and web secondary to Stevens-Johnson syndrome, *Pediatr Radiol* 13:290, 1983. Used by permission.)

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STEWART-TREVES SYNDROME

Definition (Etiology): Angiosarcoma developing in chronic lymphedema; (1) lymphedema immunologically rich for neoplasm development (Ruocco et al, 2002).

Clinical Manifestations: (1) most common postmastectomy (Chung et al, 2000); (2) usually upper extremity (Komorowski et al, 2003); (3) can mimic: Kaposi sarcoma (Allan et al, 2001), Masson's pseudoangiosarcoma (Romani et al, 1997).

Radiologic Manifestations: (1) MRI: low intensity on T1, intermediate on T2, persisting enhancement with gadolinium (Nakazono et al, 2000) (Fig. SYME-S-26).

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Figure SYME-S-26 ■ Stewart-Treves syndrome. Angiosarcoma associated with chronic lymphedema: 26-year-old woman with a 16-year history of idiopathic lymphedema of the right lower extremity and progressively increased swelling of the right lower leg (aggressive angiosarcoma). Contrast-enhanced CT scan shows marked skin thickening with raised nodules, thickened fibrous septa, and lakes of encapsulated fluid. (From Kazerooni E, Hessler C: CT appearance of angiosarcoma associated with chronic lymphedema, *AJR* 156:543, 1991. Used by permission.)

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STICKLER SYNDROME/DYSPLASIA

MIM#: 108300 (STL I); 604841 (STL II); 184840 (STL III).

Synonyms: Arthro-ophthalmopathy; Wagner-Stickler syndrome; STL.

Classification: Stickler type I (membranous vitreous); Stickler type II (beaded vitreous); Stickler type III (monocular type).

Mode of Inheritance: AD; All are collagenopathies: STL I, mutations in COL2A1 gene; STL II, locus: 1p21, mutations in COL11A1 gene; AR, STL III, locus 6p21.3, mutations in COL11A2 gene; (STL IV, other COL mutations excluded [Wilkin et al, 1998]).

Clinical Manifestations: A group of connective tissue disorders: (a) severe progressive myopia to minus 18 D; retinal detachment; glaucoma; amblyopia; astigmatism; strabismus; lenticular opacities; (b) typical facial features (less pronounced with age): midfacial hypoplasia; broad nasal bridge; long

philtrum; micrognathia; (c) progressive sensorineural hearing loss (STL I, 60%) (Szymko-Bennett et al, 2001); (d) cleft palate (20%); (e) enlarged wrist, knee, and ankle joints at birth; hypermobility of the joints; limitation of mobility of the joints in some cases; joint pain (hips, 79%); dislocated patella; (f) marfanoid body build; (g) Robin sequence in newborn in association with hypotonicity and hyperextensibility of the joints (STL III); (h) prenatal diagnosis: chorionic villus sampling and DNA analysis (Zlotogora et al, 1994), linkage analysis (Lisi et al, 2002); (i) other reported abnormalities: malocclusion and dental maleruption; supernumerary digits; short fourth metacarpal; talipes equinovarus; myelopathy of Brown-Séguard type associated with cervical spinal stenosis; increased urinary hydroxyproline excretion, mitral valve prolapse (uncommon) (Ahmad et al, 2003); mental retardation.

Radiologic Manifestations:

(A) Infants: (STL III); *rhizomelic limb shortening; wide metaphyses; vertebral coronal clefts.*

(B) Children, Adolescents, Adults: (Chondroosseous changes, almost all STL I); (a) narrowness of the diaphyses of long bones; thin cortices; normal width of the metaphyses; *irregularity in ossification; flattening and underdevelopment of some epiphyses; coxa valga (21%); wide femoral neck; subluxation of the femoral head; protrusio acetabuli (10%); hypoplasia of the iliac wings; arthritic changes in young adults (34%) (Rose et al, 2001b); synovial osteochondromatosis (Tins et al, 2003); (b) irregularity of the end plates of the vertebrae (74%); Scheuermann-like changes, Schmorl nodes (43/64%); thoracic kyphosis; anterior wedging of the vertebral bodies; scoliosis; cervical spinal stenosis and cervical cord myelopathy (Rose et al, 2001a).*

(C) Other: (a) prenatal US: polyhydramnios, cleft palate, micrognathia (Soulier et al, 2002) (Fig. SYME-S-27).

Differential Diagnosis: (a) type II collagenopathies: Kniest dysplasia; spondyloepiphyseal dysplasia congenita; STS-like with vitreoretinopathy, brachydactyly (phalangeal epiphyseal changes) (Richards et al, 2002); (b) spondylo-ocular syndrome: lens malformation, cataract, retinal detachment, platyspondyly with osteoporosis (AR) (Rudolph et al, 2003).

Note: (a) OSMED (with Weissenbacher-Zweymuller phenotype) is STL III (Giedion, 2001), (see OSMED, W-Z phenotype); (b) Col 2A1 (STL I) with exon 2 mutations have minimal to no systemic findings (Donoso et al, 2003; Parma et al, 2002).

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Figure SYME-S-27 ■ Stickler syndrome in an 8-year-old girl with hypoplasia of the iliac wing, narrow sciatic notches, flattening and irregularity of the femoral epiphyses, a wide femoral neck, and coxa valga. (From Spranger JW: Arthro-ophthalmopathia hereditaria, *Ann Radiol (Paris)* 11:359, 1968. Used by permission.)

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STIFF-MAN SYNDROME

MIM#: 184850.

Synonyms: Moersch-Woltmann syndrome; SMS.

Clinical Manifestations: An autoimmune disorder (heterogeneity related to autoantibodies): (a) *progressive symmetrical muscle rigidity*, in particular, those of the back (extensors) and abdominal wall; (b) *painful muscle spasms* with profuse sweating and tachycardia that are precipitated by stimuli or movements; increased tendon reflexes (occasionally); *movement in block* (tin soldier); (c) paroxysmal autonomic dysfunctions: transient hyperpyrexia; diaphoresis; tachypnea; tachycardia; pupillary dilatation; arterial hypertension; (d) *antibodies directed against glutamic acid decarboxylase* (60% of the cases), glutamate receptors; organ-specific autoimmune disease (insulin-dependent diabetes mellitus; hyperthyroidism) (Karlson et al, 1994); (e) electromyography: *continuous motor unit activity with superimposed bursts* (at rest or with activity) that are abolished by nerve block, curare, general anesthesia, sleep, and benzodiazepines; abnormal contractions of antagonistic muscles; positive head retraction reflex; (f) normal intellect; (g) SMS variants/plus (Brown et al, 1999; Meinck et al, 2002); (h) other reported abnormalities: solid tumor; sudden death (Grimaldi et al, 1993; Mitsumoto et al, 1991).

Radiologic Manifestations: (a) fractures resulting from muscular spasm; (b) hypertrophic arthropathy of the spinal column; (c) brain atrophy.

Differential Diagnosis: (1) *Kok disease* (stiff baby syndrome) MIM# 149400; (2) *Isaac-Mertens syndrome* (continuous muscle fiber activity) MIM# 121020.

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STOKES-ADAMS SYNDROME

MIM#: 140400, 113900.

Clinical Manifestations: Associated with paroxysmal or chronic atrioventricular block (50% to 60%), sinoatrial block (30% to 40%), or paroxysmal tachycardia or fibrillation (0 to 5%): (a) *sudden change in heart rate with a transient and abrupt loss of consciousness* with or without convulsions; (b) *decrease in cardiac output*; (c) *fall in blood pressure*; (d) *pallor*; (e) *flushing of the face with resumption of heart beats*; (f) abnormal electrocardiographic and electrophysiologic studies confirming the diagnosis.

Radiologic Manifestations: *Depend on etiologic factors:* congenital heart anomalies; myocarditis (Wang et al, 2002); acquired valvular diseases; myocardial infarction; metabolic diseases; infiltrative diseases of the myocardium; toxic agents; electrolyte disturbances; metastatic and primary neoplastic diseases.

Historical Note: Adams also described the thick medial cortex of femoral neck, 1836 ("Adam's bogen" or bend, arch) (Bartoniczek, 2002).

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STRAIGHT BACK SYNDROME

Clinical Manifestations: (a) dyspnea (rare); (b) *ejection systolic murmur at the base of the heart or a late systolic murmur*; (c) right axis deviation, an rSr' pattern in lead V1; (d) pressure gradient between the right and main pulmonary arteries; (e) pectus excavatum; (f) other reported abnormalities and associations: mitral valve prolapse, bicuspid aortic valve; post-scoliosis distraction/fusion (Danielsson et al, 2001); facioscapulohumeral dystrophy (Nakayama et al, 1999).

Radiologic Manifestations: (a) *straight dorsal spine*; (b) *narrow anteroposterior diameter of the thoracic cage*; (c) *heart flattened and displaced to the left*; (d) prominent pulmonary artery segment, prominent right hilus and pulmonary vasculature in the right lower lung field; (e) pulmonary venous obstruction and dilatation (very rare).

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STURGE-WEBER SYNDROME

MIM#: 185300.

Synonyms: Encephalotrigeminal angiomas; Sturge-Weber-Dimitri disease; SWS.

Mode of Inheritance: No definite evidence of heredity, almost always sporadic in occurrence.

Pathology: (a) *angiomas of skin lesions*; (b) *venous angiomas (leptomeninges, choroid plexus in association with enlargement of the choroid plexus)*; accelerated myelination (<6 months) (Adamsbaum et al, 1996); cerebrovascular thromboses; (c) calcium deposition around blood vessels.

Clinical Manifestations: (a) *angiomas of the face (port-wine nevi) of the face* in a trigeminal facial distribution, gingiva and alveolar ridges (Sturge, 1879; Weber, 1922; Yeakley et al, 1992); lymphatic/venous malformation of mandible (Ramli et al, 2003); acral arteriovenous (AV) tumor (Carrasco et al, 2003); (b) *ocular manifestations: hemangiomas of the conjunctiva, episclera, choroid, and retina*; retinal vascular tortuosity; *glaucoma*; buphthalmos; iris heterochromia; retinal detachment; strabismus (Sullivan et al, 1992); (c) *contralateral hemiplegia*; homonymous hemianopia; (d) *seizures* (Sturge, 1879; Weber, 1922); (e) *mental retardation*; (f) other reported abnormalities: external ear deformity; coarctation of the aorta; coloboma of the iris; cortical blindness; Klippel-Trenaunay syndrome; Klippel-Trenaunay; bilateral neonatal Sturge-Weber syndrome; contralateral leptomeningeal involvement; SWS without facial nevus (Aydin et al, 2000; Deutsch et al, 1976; Vissers et al, 2003; Widdess-Walsh et al, 2003; Yeakley et al, 1992).

Radiologic Manifestations:

(A) Skull Radiograph: *Asymmetry* with a smaller hemicranium on the involved side; enlarged vascular channels of the skull; enlarged frontal sinus (rare); occasionally ipsilateral enlargement of a hemicranium; *double-contour "gyriform" patterns of intracranial calcification* in the subcortical region, primarily in the parietal and occipital regions (Wilms et al, 1992), often bi-hemispheric calcification (Maria et al, 1998).

(B) CT of Brain: *Cerebral calcification* (unilateral or bilateral); *contrast enhancement of leptomeningeal angiomas*; *ipsilateral cortical atrophy*; enlargement of the ipsilateral ventricle; decreased volume of the ipsilateral hemicranium (very rarely increased volume); enlarged subarachnoid space in cases with an enlarged ipsilateral hemicranium; enlargement and increased enhancement of the choroid plexus on the same side as the facial and intracranial lesions; choroidal angioma (Laufer et al, 1994; Marti-Bonmati et al, 1992; Stimac et al, 1986; Wilms et al, 1992; Yeakley et al, 1992).

(C) MR of Brain and MR Angiography: Thickened cortex with decreased convolutions; accelerated myelination in the abnormal cerebral hemisphere; cerebral atrophy; enlarged choroid plexus; cerebellar involvement (uncommon); MRI shows more extensive involvement than CT; enhancement in the brain cortex after contrast injection, which is considered to be due to blood-brain barrier breakdown; cerebral and retinal angiomas; pial angiomas; reduced flow of the transverse sinuses and jugular veins; prominent deep collateral venous system; lack of superficial cortical veins; reduced arterial flow signal; proptosis (Benedikt et al, 1993; Decker et al, 1994; Griffiths et al, 1997; Laufer et al, 1994; Marti-Bonmati et al, 1992; Stimac et al, 1986; Vogl et al, 1993; Yeakley et al, 1992).

(D) Scintigraphy of Brain: Widened cap of radioactivity over the affected cerebral convexity; identical radioactivity in hemispheres in studies performed 1 to 3 hours following the injection of isotope material; regional cerebral hypoperfusion shown by ^{99m}Tc HMPAO (hexamethylpropyleneamineoxime) imaging and xenon 133 inhalation technique (Kuhl et al, 1972; Ton-That et al, 1990).

(E) Angiography of Brain: Arterial occlusion (rare); *capillary or venous angiomas stains*; *various venous abnormalities* (nonfilling of the superior sagittal sinus; tortuosity; segmental ectasia; bizarre course of the cerebral veins and absence, deformity, and caliber irregularities of the deep veins).

(F) Positron Emission Tomography (PET) of Brain, MR SPECT: Depressed local cerebral glucose utilization (Ichinose et al, 2003); elevated choline (early) (Lin et al, 2003).

(G) Other Reported Abnormalities: (a) *calcification*: cortical brain calcification present at birth; atypical intracranial calcifications (bilateral in about 15% of the cases); calcifications contralateral to the bulk of the facial nevus; isolated frontal lobe calcification; intracranial calcification and abnormalities of the superficial cortical veins with pathologic features of Sturge-Weber syndrome without facial angioma (Alonso et al, 1979; Hatfield et al, 1988; Yeakley et al, 1992); (b) *vascular anomalies*: megalencephaly and hydrocephalus resulting from impaired cerebral venous return; development of abnormal drainage channels via the periorbital veins in association with an absence of the deep cerebral veins, persistent trigeminal artery (Laufer et al, 1994; Loenver et al, 1992); (c) *esophageal foreign bodies* (Watson et al, 2003) (Figs. SYME-S-28 and SYME-S-29).

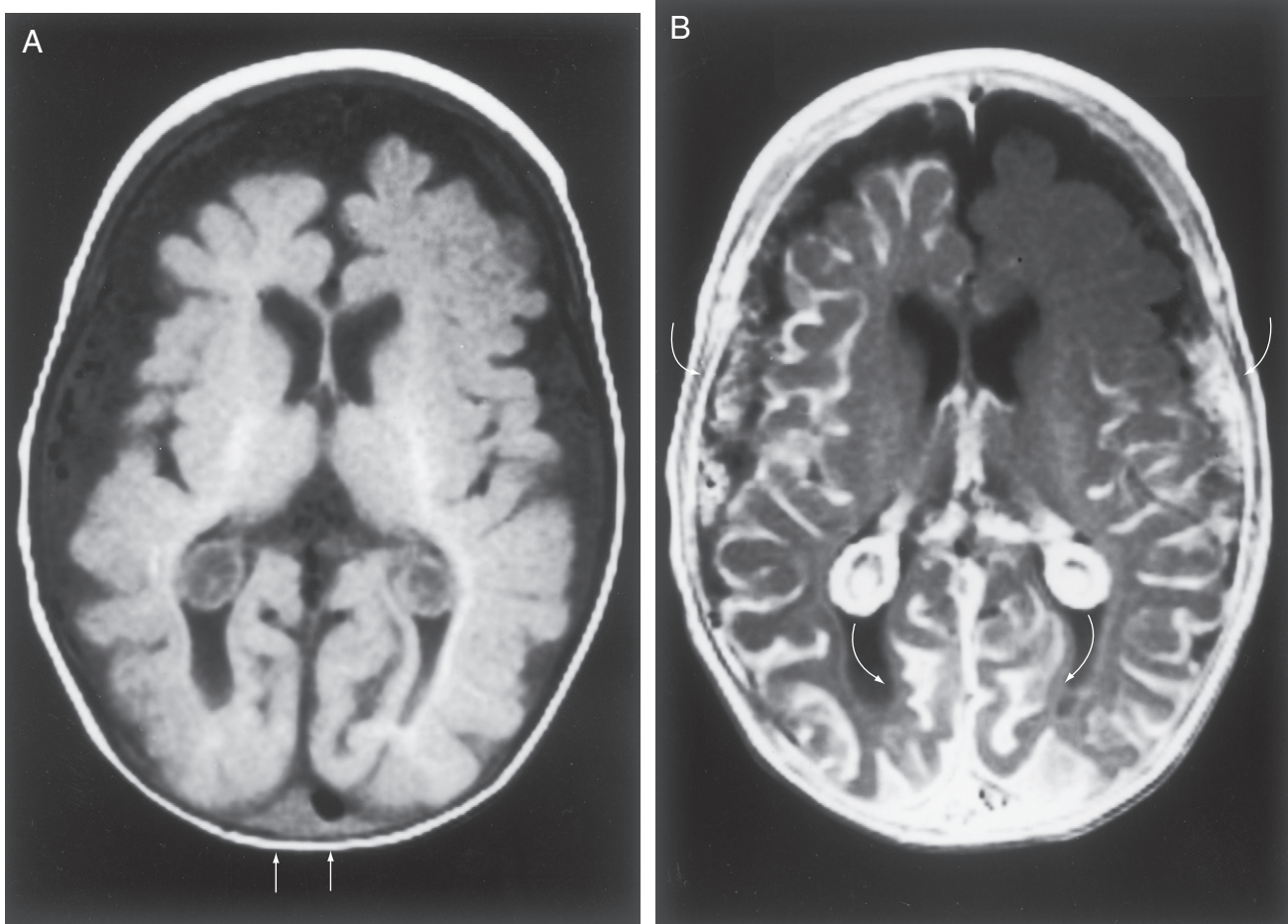


Figure SYME-S-28 ■ Sturge-Weber syndrome. **A**, Noncontrast axial T1W image reveals bilateral atrophy (right greater than left) with bilateral choroid plexus enlargement. Note partial sagittal sinus thrombosis confirmed with prior contrast CT with classic “delta sign” (white arrows). **B**, Contrast axial T1W MR image at same level reveals bilateral diffuse pial enhancement of angioma (right greater than left) corresponding to areas of atrophy with ring enhancement of the choroid plexus. Note enhancement fills calcarine fissure (posterior arrows) bilaterally indicating extraaxial location of pial enlargement. Bilateral enlarged dural veins demonstrate enhancement (anterior arrows). (From Benedikt RA et al: Sturge-Weber syndrome: cranial MR imaging with Gd-DTPA, *AJNR* 14:409, 1993. Copyright © by American Society of Neuroradiology. Used by permission.)

Differential Diagnosis: Gyriform calcification: tuberous sclerosis; glioma; infarction; purulent meningitis; viral encephalitis; ossifying meningoencephalitis; leukemia following intrathecal administration of methotrexate and skull irradiation; subarachnoid fat (Wilms et al, 1992); (2) SWS-like syndrome: cardiac (pulmonary atresia/ventricular septal defect [VSD]), facial port-wine stain, abnormal retinal vasculature (Tan et al, 2003).

Note: (1) MR imaging is better than CT in demonstrating the extent and degree of brain parenchymal atrophy, cranial diploë prominence, extent and patency of the leptomeningeal angiomatous malformation and the parenchymal venous anomalies; (2) Capillary/AV malformations (as in SWS) caused by RASA 1 mutations (Eerola et al, 2003); (3) SWS is a form of phakomatosis pigmentovascularis type II B.

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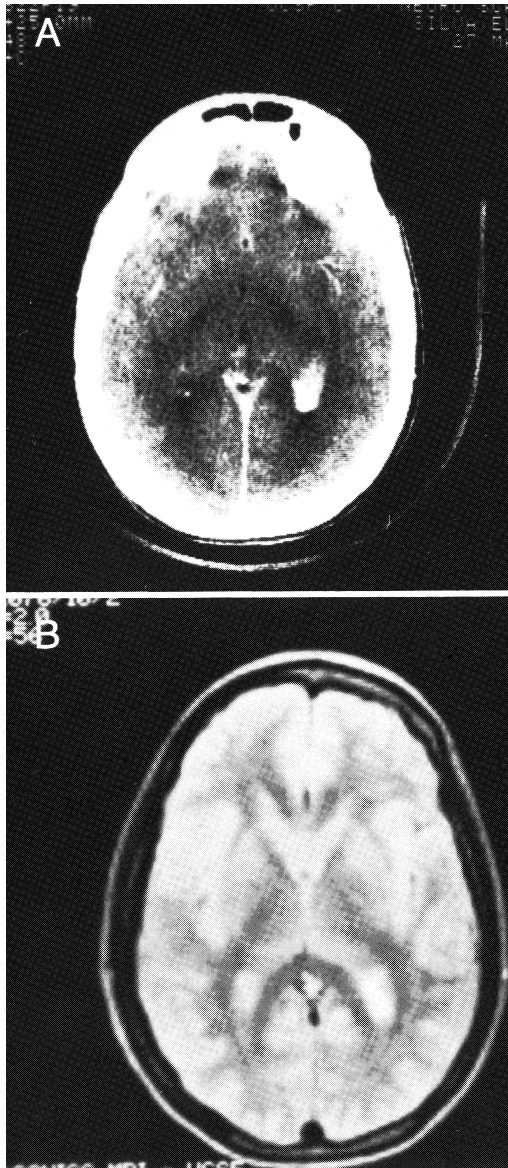


Figure SYME-S-29 ■ Sturge-Weber syndrome. Angiomatous malformations of the choroid plexus. **A**, Contrast computed tomography shows increased enhancement of the glomus of the choroid plexus on the left (the side of the facial port-wine stain). **B**, A magnetic resonance scan using a T2-weighted spin-echo technique (TR, 2000; TE, 56 ms) shows increased intensity in the same location. (From Stimac GK, Soloman MA, Newton TH: CT and MR of angiomatous malformations of the choroid plexus in patients with Sturge-Weber disease, *AJNR* 7:623, 1986. Copyright © by American Society of Neuroradiology. Used by permission.)

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SUBCLAVIAN STEAL SYNDROME

Pathophysiology: Circulation to an arm via the vertebral artery in a patient with subclavian or innominate artery obstruction proximal to the origin of the vertebral artery with ischemia of the brain and/or arm as a result.

Etiology: Arteriosclerosis; thrombosis; tumor; Takayasu syndrome (Roldan-Valadez et al, 2003); congenital anomaly (hypoplasia, atresia, or isolation of the subclavian artery with a right or cervical aortic arch (Singh et al, 2001), with left arch (one case) (Engleman et al, 1998); vascular rings; coarctation of the aorta with obliteration of the subclavian artery orifice; coarctation of aorta and interrupted aortic arch); extravascular obstruction resulting from a fibrous band and surgically corrected congenital anomalies; granulation tissue secondary to cannulation of an artery; trauma; *surgical procedures:* Blalock-Taussig procedure, coronary bypass using internal mammary artery (Mulvihill et al, 2003), dialysis arteriovenous (AV) fistula (Schenk, 2001), post angioplasty/stent placement (Gao Wang et al, 2001); subclavian artery aneurysm; during extracorporeal membrane oxygenation; and so forth.

Clinical Manifestations: (a) *pain and numbness of the arm and hand, claudication;* (b) *dizziness; light-headedness; syncopal episodes; headache; vertigo;* visual defect; coldness; fatigue during activity; aphasia; hearing loss; and so forth; (c) *absent radial pulse; a difference in brachial artery pressure greater than 20 mm Hg (screening tool [Tan et al, 2002]); supraclavicular bruit;* (d) *congenital subclavian steal usually asymptomatic in childhood.*

Radiologic Manifestations: (a) *angiographic demonstration of arterial obstruction to an arm and reverse direction of flow of contrast medium from the vertebral artery to the arm;* increased or decreased jugular vein opacity as compared with the opposite side; (b) *Doppler sonography: negative flow indicating backflow from brain (Paivansalo et al, 1998); color-coded Doppler (Kaneko et al, 1998);* (c) *MR angiography (phase encoded): demonstration of the normal*

and *abnormal flow direction in the vertebral arteries*, MRI (flow encoded) (Van Grimberge et al, 2000); (d) ^{99m}Tc sestamibi imaging (Rossum et al, 2000).

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SUPERIOR MESENTERIC ARTERY SYNDROME

Synonyms: Arteriomesenteric duodenal compression; *Wilkie syndrome*; SMAS.

Definition: Compression of the third portion of the duodenum secondary to an increase in acuteness of the aorto-superior mesenteric artery angle.

Etiology and Associations: *Rapid weight loss*; rapid growth without weight gain; hyperextension of the vertebral column (body brace, cast), *scoliosis surgery* (Shah et al, 2003); duodenal hypotonia; familial (a father and his four daughters) (Ortiz et al, 1990); identical twins (Iwaoka et al, 2001); prenatal (Caspi et al, 2003); severe traumatic brain injury; spastic para/quadruparesis (four cases) (Laffont et al, 2002); acquired immunodeficiency syndrome (AIDS) (Hoffman et al, 2000); *eating disorders* (Adson et al, 1997); diabetes mellitus (Azami, 2001); abdominal aneurysm (Komai et al, 1999); "nutcracker syndrome."

Clinical Manifestations: *Postprandial epigastric fullness, nausea, vomiting, abdominal cramps, weight loss, and slender habitus*; laparoscopic management (Bermas et al, 2003).

Radiologic Manifestations: (a) *dilatation of the duodenum proximal to a vertical linear extrinsic pressure defect of third portion of the duodenum*; marked "to-and-fro" peristaltic waves proximal to the obstruction; gastric dilatation (in some); relief of the obstruction in the prone position; (b) *narrow aorto-mesenteric angle* (10 to 12 degrees as compared with the normal of 45 to 65 degrees) and a *decrease in the aorto-mesenteric distance* (2 to 3 mm as compared with the normal of 7 to 20 mm); (c) computed tomography/ CT angio: duodenal distension and the close proximity of superior mesenteric vessels and aorta (Konen et al, 1998; Ooi et al, 1997); (d) endoscopic US (Lippi et al, 2002) (Fig. SYME-S-30).

Therapy: (1) laparoscopy (Richardson et al, 2001).

Differential Diagnosis: (1) ectopic pancreas (Verma et al, 2003).

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Figure SYME-S-30 ■ Superior mesenteric artery syndrome in a 16-year-old girl who had been in good health until a “boil” developed on her right nasolabial fold followed by pneumonia and meningitis. At admission to Children’s Hospital of San Francisco 19 days after the onset of the disease, she was in a cachectic state with abdominal distension and massive gastric fluid retention. Marked dilatation of the proximal segment of the duodenum with a sharp distal cutoff is seen. Conservative management failed, and finally duodenojejunostomy was performed. (Courtesy Dr. Robert S. Arkoff, San Francisco.)

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SUPERIOR VENA CAVA SYNDROME

Synonym: SVCS.

Etiology: (a) mediastinitis; (b) mediastinal tumors, *lung cancer* (Wudel et al, 2001); (c) vascular: aneurysms; fistula; vasculitis; thrombosis; long-term peritoneovenous shunt; transvenous pacemaker implantation; after the Mustard procedure; central venous catheter sequela (Broviac or Hickman catheters), dialysis access induced (Madan et al, 2002); (d) pneumomediastinum; pneumothorax; apical tense bulla; (e) mediastinal hematoma, lymphadenopathy (Roy et al, 1998);

(f) other reported causes: Behçet syndrome (Terzioglu et al, 1998); silicosis; sarcoidosis; intravascular papillary endothelial hyperplasia of superior vena cava; goiter; right-sided diaphragmatic hernia; bone-marrow transplant/aspergillosis (Takatsuka et al, 2002).

Clinical Manifestations: (a) headache; vertigo; somnolence; syncope; convulsions; (b) hoarseness; respiratory distress; (c) epistaxis; (d) cyanosis and edema of the face, neck, shoulder, and arms; (e) *engorgement and tortuosity of veins of the neck, thorax, and arms*; (f) vascular congestion of the eyes and nasal mucosa.

Radiologic Manifestations: (a) *irregular widening of the mediastinum*; tortuous density parallel to the spine (azygos and hemiazygos); dilated left superior intercostal vein; rib notching (rare); (b) hydrothorax, hydropericardium; (c) *venographic demonstration of the site of obstruction and collaterals*: between the innominate tributaries and azygos tributaries; between the superior vena cava (SVC) and inferior vena caval systems along the posterior and anterior portions of the trunk; collaterals between the arm and thorax; between the anterior and posterior veins and collaterals across the midline; (d) radionuclide venography (Mahmud et al, 1998); increased liver uptake of isotopes (apticide scintigraphy) (Sherman et al, 2002); (e) CT: SVC obstruction and demonstration of the etiologic factor; increased size and greater numbers of chest wall collaterals; (f) ultrasonography: absence of normal respiratory rhythmicity and response to a sudden sniff maneuver (venous collapse in a rapid, transient manner secondary to the sudden decrease in intrathoracic pressure); (g) central nervous system (CNS): communicating hydrocephalus secondary to SVC obstruction; CT: diffuse low-density lesions in paraventricular white matter.

Therapy: (1) stenting (Gross et al, 1997; Hochrein et al, 1998).

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SUSAC SYNDROME

Synonyms: (1) *encephalopathy-hearing loss-visual loss syndrome*; (2) *SICRET syndrome* (Mala et al, 1998).

Clinical and Radiologic Manifestations: Small vessel vasculopathy; (1) recurrent episodes: neurologic symptoms (global encephalopathy, 44%), fluctuating hearing loss (cochlea disorder), retinal artery occlusion; recurrence (Petty et al, 2001); (2) imaging: MRI (distinctive pattern), *multifocal supratentorial white matter lesions* (100%), *basal ganglia*, thalamus (70%), leptomeningeal enhancement (33%); FLAIR imaging most sensitive (Do et al, 2004; Susac et al, 2003; White et al, 2004).

Differential Diagnosis: (1) inflammatory vasculitis: lupus, Behçet syndrome; (2) multiple sclerosis; (3) noninflammatory vasculopathies: postpartum angiopathy, CADASIL, Sneddon syndrome (Bousser et al, 2004; Saw et al, 2000).

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SWEET SYNDROME

Synonym: Acute febrile *neutrophilic dermatosis*.

Clinical and Radiologic Manifestations: (1) *paraneoplastic syndrome* (a) fever; (b) raised painful plaques on the extremities, face, and neck; (c) dense dermal cellular infiltrate with neutrophils; (d) polymorphonuclear leukocytosis; (e) association with: malignancies (hematologic; metastatic breast carcinoma); therapy with granulocyte colony-stimulating factor in a woman with breast cancer; infections; myeloproliferative disorders, multiple myeloma (one case) (Bayer-Garner et al, 2003); lymphoproliferative disorders; myelodysplastic syndrome; Fanconi anemia, gastrointestinal (GI) tract involvement (McDermott et al, 2001); neuro-Behçet disease, "neuro-Sweet" disease (with benign recurrent encephalitis (Hisanaga et al, 1999); chronic granulomatous disease of childhood; pigmented villonodular synovitis (Gosheger et al, 2002); trisomy 8 in bone marrow cells (aplastic anemia) (Ohga et al, 2002); (2) pulmonary infiltrates (Lazarus et al, 1986).

Differential Diagnosis: (1) *neutrophilic dermatosis* (pustular vasculitis) (DiCaudo et al, 2002).

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SWYER-JAMES SYNDROME

Synonyms: *Unilateral hyperlucent lung syndrome; hypogenic lung syndrome; Macleod syndrome; Swyer-James-Macleod syndrome; SJS.*

Etiology: (a) sequela of various lung insults: bronchiolitis; bronchiolitis obliterans (Chang et al, 1998); measles; *Mycoplasma pneumoniae*; pertussis; adenovirus pneumonia; foreign-body aspiration; hydrocarbon pneumonia; radiotherapy; (b) *idiopathic*; bilateral (Erkasar et al, 2002); (c) *associations*: myocardial bridge (congenital systolic narrowing of coronary artery) (Yilmaz et al, 2003); lung abscess (Wang et al, 2000).

Clinical Manifestations: (a) *history of recurrent pulmonary infections in childhood*; (b) usually asymptomatic in adult life; however, the subject may have a cough, chronic and repeated pulmonary infections, decreased exercise tolerance, hemoptysis, and arterial blood desaturation; (c) therapy: endoscopic bullectomy (Inoue et al, 2002).

Radiologic Manifestations: (a) *unilateral small, hyperlucent lung (or lobe)*; (b) *poor air exchange and change of lung density between inspiration and expiration*; (c) *diminished pulmonary vasculature; small hilar shadow of the involved side*; (d) *bronchographic demonstration of dilatation of the bronchi and lack of alveolization of the contrast medium (pruned-tree appearance); hyperdistensible bronchial diameter shown by functional bronchography (inflation under 50 cm H₂O pressure)*; (e) *angiographic demonstration of diminished size and number of pulmonary vessels in the portion of the involved lung*; (f) *radionuclide lung scan: decreased perfusion and ventilation; may reveal otherwise unsuspected bilateral involvement* (Kiratli et al, 1999; Salmandazeh et al, 1997); (g) CT: more accurate than plain chest radiography (in particular using ultrafast high resolution method) in demonstration of the abnormalities including bilateral involvement: *hyperlucency; air-trapping; small pulmonary vessels*; (Ghossain et al, 1997); (h) MRI, MRA (Vrachliotis et al, 1996); (i) other reported abnormalities: unilateral pulmonary edema (Swyer-James syndrome protecting the affected lung from pulmonary edema) (Figs. SYME-S-31 and SYME-S-32).

Differential Diagnosis: Bronchial obstruction; congenital hypoplastic pulmonary artery; unilateral external muscular anomalies; *bronchiolitis obliterans syndrome post lung transplantation* (Luckraz et al, 2003).

Note: Another syndrome under the title of Swyer-James syndrome: 46,XY pure gonadal dysgenesis (Guidozzi et al, 1994).

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SYMPHALANGISM-BRACHYDACTYLY SYNDROME

MIM#: 186500.

Synonyms: *Facio-audio-symphalangism syndrome; multiple synostoses with conductive hearing impairment; symphalangism-surdity syndrome; WL syndrome; deafness-symphalangism syndrome of Herrmann; multiple synostosis syndrome 1; SYNS 1.*

Mode of Inheritance: *Autosomal dominant*; locus:17q22 (Krakow et al, 1998), mutations in Noggin gene.

Clinical Manifestations: (a) *progressive conduction deafness with onset in childhood*; fixation of the foot plate of the stapes in the oval window (Ensink et al, 1999); (b) *distinct facial features: long and narrow face; broad and hemicylindrical nose; lack of alar flare; broad nasal bridge; thin upper lip; low-set ears; asymmetrical mouth; internal strabismus*; (c) *proximal symphalangia of the fingers (2, 3, 4) and toes (2, 3, 4); brachydactyly; clinodactyly; hypoplasia or aplasia of the distal segments of the fingers and/or toes and corresponding nails; hypoplasia of the thenar and hypothenar muscles; cutaneous syndactyly of the fingers (2, 3, 4) and toes (2, 3).*

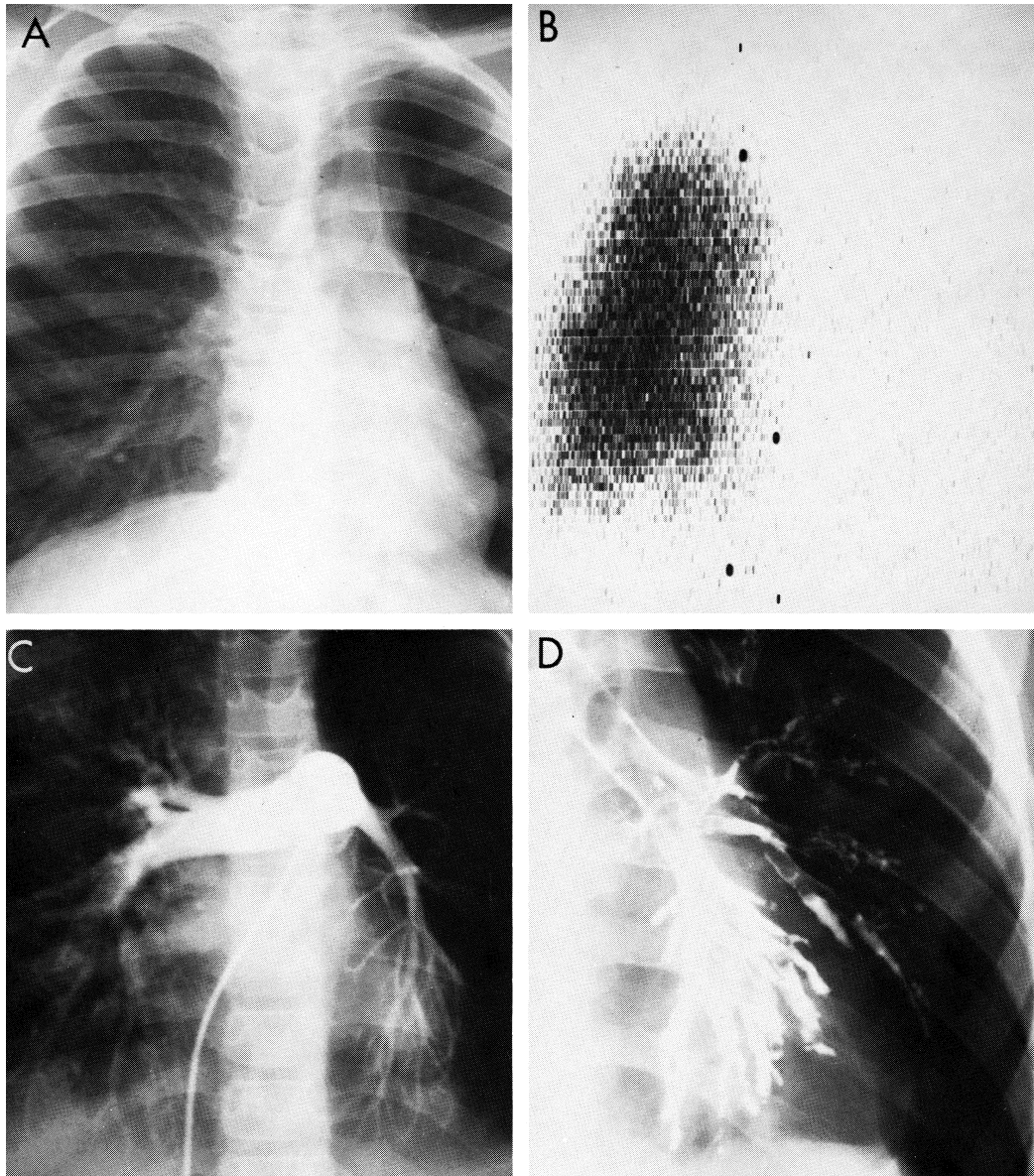


Figure SYME-S-31 ■ Swyer-James syndrome in a 7-year-old boy with a history of multiple episodes of pneumonitis from the age of 1 year. The patient was asymptomatic at time of this examination. **A**, The left lung is small and hyperlucent. **B**, A complete absence of perfusion of the left lung is noted on a lung scan. **C**, The left main pulmonary artery is small, and there is a lack of terminal arterial and capillary filling. **D**, Bronchiectatic changes in left lower lobe and lingula and lesser changes in the remainder of the left lung. (From Kogutt MS, Swischuk LE, Goldblum R: Swyer-James syndrome (unilateral hyperlucent lung) in children, *Am J Dis Child* 125:614, 1973. Copyright American Heart Association. Used by permission.)

Radiologic Manifestations: (a) *proximal symphalangism*: progressive narrowing of the interphalangeal joints resulting in fusion of the phalanges (proximal interphalangeal joints of the fingers and distal interphalangeal joints of the toes usually involved); thumbs and great toes usually not affected; (b) brachydactyly; (c) other reported abnormalities: (1) limbs: short arm; cubitus valgus; humeroradial fusion; dislocated head of the radius; carpal and tarsal fusion; clinodactyly; hypoplastic/aplastic middle phalanx; hypoplastic/dysplastic distal phalanx; short legs; overtubulation of tibia and fibula; genu valgus; pes planovalgus; short foot; short hallux; (2) thorax and spine: pectus excavatum; short sternum; wide costochondral junctions; Klippel-Feil anomaly; cervical spine stenosis (Edwards et al, 2000) (Fig. SYME-S-33).

Differential Diagnosis: (1) SYNS-like: symphalangism, multiple frenula, polydactyly, dysplastic ears, dental abnormalities (Kantaputra et al, 2003); (2) SYNS-like: distal symphalangism, hypoplastic carpals, dental anomalies, narrow zygomatic arch (AD) (Kantaputra et al, 2002); (3) SYNS-like: proximal symphalangism, coarse facies, hearing loss, nephropathy (Morimoto et al, 2001); (4) WL syndrome-like: stapes ankylosis, broad thumbs, hyperopia (AD) (Hilhorst-Hofstee et al, 1997).

Note: (1) A claim was made by Drinkwater that hereditary symphalangism was present in 14 generations of the Talbot family, tracing the anomaly back to John Talbot (1388–1453), the first Earl of Shrewbury. The validity of this claim has been questioned (Drinkwater, 1917; Elkington et al, 1967; Perme et al, 1994); (2) see multiple synostosis syndrome; (3) proximal symphalangism (MIM# 185800) is allelic with Noggin mutation (see: Noggin mutations table).

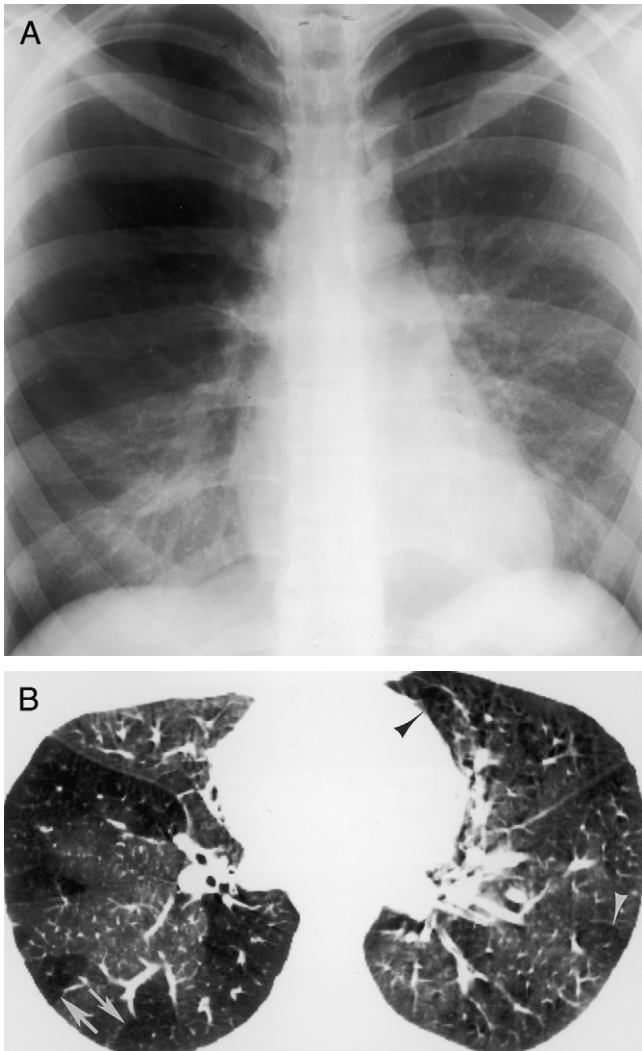


Figure SYME-S-32 ■ Swyer-James syndrome. A 22-year-old woman with mild dyspnea on exertion. **A**, Expiratory radiograph shows hyperlucent right lung, especially at the apex, and shift of mediastinum toward left compared with its position on inspiration radiograph; both findings indicate air trapping. **B**, Inspiratory CT scan (1.5 mm collimation) shows hyperlucent right lower lobe containing island of normal lung marginated by intralobular septa (arrows). Vessels in hyperlucent region are sparse and attenuated. Subtle, less clearly hyperlucent regions are present in left lung (arrowheads). (From Moore ADA et al: Swyer-James syndrome: CT findings in eight patients, *AJR* 158:1211, 1992. Courtesy Dr. JD Godwin. Used by permission.)

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SYNDROME OF INAPPROPRIATE SECRETION OF ANTIDIURETIC HORMONE

Synonyms: Inappropriate secretion of antidiuretic syndrome; SIADH.

Etiology: Ectopic production of antidiuretic hormone induced by nonosmotic stimuli: (a) neoplasia at various sites, particularly bronchogenic carcinoma; (b) infections in various organs; (c) central nervous system diseases including trauma, infection (hypothalamic encephalitis) (Ishikawa et al, 2001), vascular occlusion, neoplasm, vasculitis, multiple sclerosis (Tsui et al, 2002), cerebral atrophy, hypoplastic corpus callosum, hydrocephalus (Yoshino et al, 1999); surgery; (Singh et al, 2002); (d) medications (Bhargava et al, 1991): antidepressants and antipsychotics (serotonin-reuptake inhibitors) (Arinzon et al, 2002), antineoplastics, contrast agents, hypoglycemics, nonsteroidal antiinflammatory agents, and thiazide diuretics; (e) others: acute asthma; acute bronchitis; chronic obstructive pulmonary disease; pneumothorax; cystic fibrosis; psychosis; spinal fusion; pregnancy; and so forth.

Types: (a) transient and self-limited; (b) chronic and persistent.

Clinical Manifestations: (a) normovolemic or nearnormovolemic hyponatremia in a patient with unrestricted water intake; (b) inappropriately high urine osmolarity; (c) high urinary excretion of sodium; (d) normal renal function; (e) correction of the hyponatremia by fluid restriction; (f) neonate (Shirland, 2001); (g) familial SIADH (Tanaka et al, 2001).

Radiologic Manifestations: Those of the etiologic factors (reversible MRI changes) (Tsui et al, 2002).

Note: (1) care about water loading for US exam (Bhargava et al, 1991; Halperin et al, 2001).

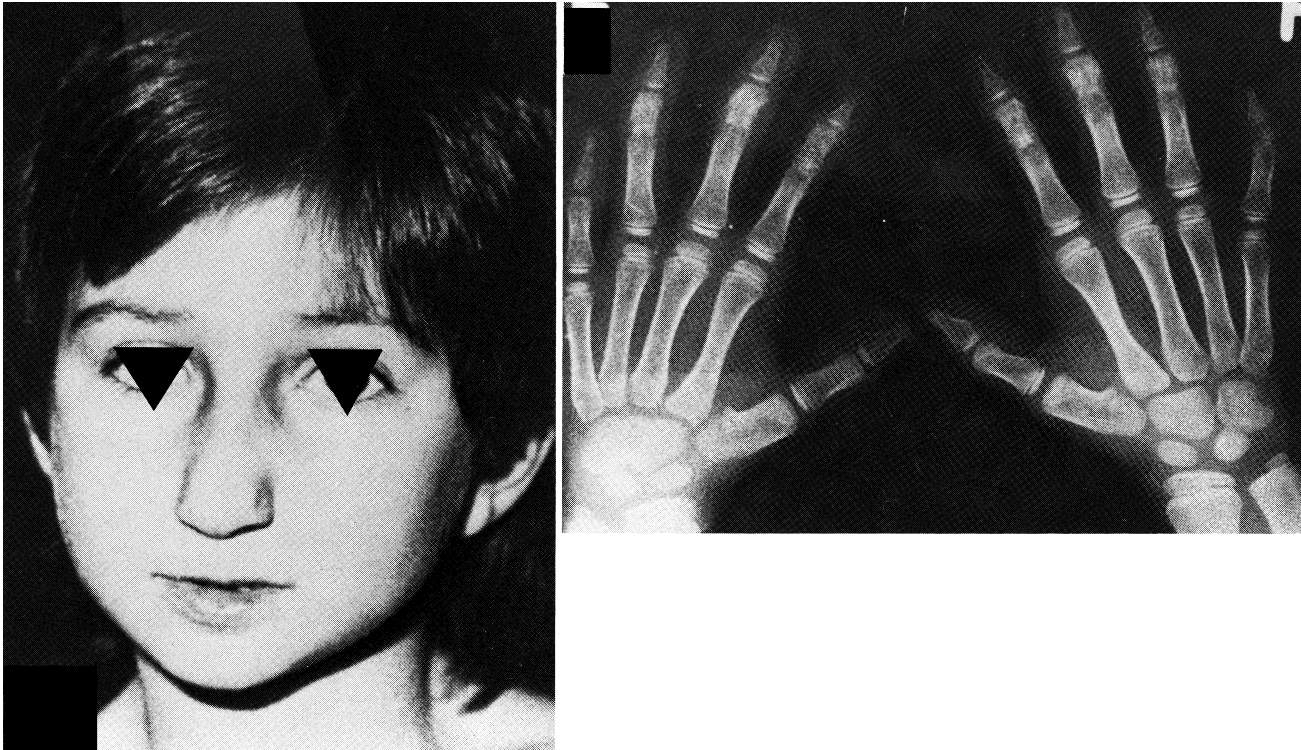


Figure SYME-S-33 ■ Symphalangism-surdity syndrome (symphalangism-brachydactyly syndrome) in a 5-year-old girl. A, Broad, hemicylindrical nose without an alar flare and an asymmetrical mouth with a thin upper lip. B, Symphalangia, short first metacarpal, fusion of the carpal bones, and clinodactyly of the fifth digits. (From Hurvitz SA et al: The facio-audio-symphalangism syndrome: report of a case and review of the literature, *Clin Genet* 28:61, 1985. Copyright © 1985 Munksgaard International Publishers, Ltd., Copenhagen, Denmark. Used by permission.)

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SYNDROME X

Synonyms: *Metabolic syndrome; microvascular angina; cardiac syndrome X.*

Clinical and Radiologic Manifestations: (a) *angina pectoris*; (b) *ischemic-appearing result on exercise test*; (c) *normal coronary arteriograms*; (d) no other explanation for the symptoms (hypertension; valve disease; cardiomyopathy); (e) *etiologies*: abnormal subendocardial perfusion (MRI, adenosine provoked) (Panting et al, 2002); PPRAGamma (Koutnikova et al, 2002); SREBP-1 (gene regulation) (Muller-Wieland et al, 2002); (f) higher female incidence (Kaski, 2002); (g) other reported abnormalities and associations: *diabetes* (insulin resistance syndrome [hyperinsulinemia]); high concentrations of triglyceride and low levels of high density lipoprotein cholesterol in nonobese men; thallium defects in the presence of normal coronary arteriograms (“microvascular angina”) (Wienecke et al, 1999); echocardiographically silent myocardial ischemia during dipyridamole echocardiography test; abnormal autonomic control of the cardiovascular system.

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SYNOVIAL FOLD SYNDROMES

Synonyms: *Plica syndrome*; medial synovial shelf plica syndrome; mediopatellar plica syndrome.

Locations: *Knee*; elbow (Awaya et al, 1984); hip (Atlihan et al, 2003); ankle (Masciocchi et al, 1997).

Pathogenesis: Plica (folds) are normal structures (three often seen normally within the knee); can produce pathologic change especially after trauma (adolescent athletes) (Ewing, 1993; Irha et al, 2003; Kinnard et al, 1984).

Radiologic Manifestations: (1) arthrography (cross-table views) (Aprin et al, 1984; Lupi et al, 1990); (2) MRI: (axial and sagittal views; T2 and fat suppressed) thickened band of low signal intensity with synovitis/cartilage erosion (Garcia-Valtuille et al, 2002; Jee, 1998); (3) other test: arthroscopy.

References

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TABATZNIK SYNDROME

Mode of Inheritance: Autosomal dominant or X-linked dominant.

Synonym: *Heart-hand syndrome II*.

Clinical Manifestations: (a) cardiac arrhythmias; (b) sloping shoulders, hypoplastic deltoid muscles, and short arm; (c) other reported abnormalities: cryptorchidism; mild mental retardation; facial dysmorphism.

Radiologic Manifestations: Upper limb deformities: flaring of lower end of humerus; flaring and obliquity of distal end of radius; absent styloid process of ulna; shortening and hypoplasia of fourth and fifth metacarpals; brachytelephalangy; accessory carpal bone; thumb polydactyly.

Differential Diagnosis: (1) Holt-Oram syndrome; (2) other cardiometabolic syndromes (MIM# 140450, 604381).

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TAKAYASU ARTERITIS

MIM#: 207600.

Synonyms: Aortitis syndrome; middle aortic syndrome; aortic arch syndrome; pulseless disease; aortoarteritis.

Clinical Manifestations: Two clinical stages: early systemic, followed by an occlusive phase: (a) asthenia; weight loss; fever; (b) dyspnea; palpitations; angina pectoris; myocardial infarction; hemoptysis; intermittent claudication; (c) pulse deficit; atherosclerosis (Numano et al, 2000); vascular bruit; heart failure; mitral insufficiency; aortic insufficiency; pericardial rub; elevated blood pressure; (d) headache; syncope; seizures; visual disturbances; amblyopia; retinopathy; hemiplegia; paraplegia; abnormal fundi; (e) abdominal pain; diarrhea; vomiting; pulmonary-renal syndrome (Savage et al, 2003); (f) other reported abnormalities: renovascular hypertension; association with tuberculosis; arthralgia; peripheral gangrene; annuloaortic ectasia associated with Hashimoto disease, Crohn disease, hyperthyroidism (Kettaneh et al, 2003); close association with two B-cell alloantigens; (g) occurrence of familial cases (AR); (h) disease activity markers: erythrocyte sedimentation rate (ESR), C-reactive protein (CRP), matrix metalloproteinases (Matsuyama et al, 2003), immunopathology (Seko, 2000).

Radiologic Manifestations: Multiple and diffuse arterial involvement: (a) *partial or total systemic arterial obstruction*; single or multiple sites, particularly the *aorta and major branches* (carotids at their origin and subclavian arteries