

Anorectal Malformations and Late-Term Problems

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ABSTRACT

Anorectal malformation is a disease with different subtypes and anatomical and functional multisystemic involvement that requires a unique approach in each age group. Anomalies associated with vertebral defects, anal atresia, cardiac defects, tracheo-esophageal fistula, renal anomalies, and limb abnormalities (VACTERL) association require detailed investigation and management. Beginning from the neonatal period, treatment is carried out with different surgical procedures. The clinical course of these patients may be associated with medical problems, accompanying congenital anomalies, perioperative management, or late sequelae. Constipation and fecal-urinary incontinence are the most common problems encountered in long-term follow-up. Renal failure is the most important cause of long-term mortality. In addition, these patients need to be under control until adulthood due to cardiological, spinal, genital, gynecological, and endocrine problems. In this follow-up, many pediatric disciplines such as neonatal intensive care, cardiology, nephrology, gastroenterology, and endocrinology cooperate with pediatric surgeons and pediatric urologists.

Keywords: Anorectal malformation, ARM, late-term, bowel management, urinary, sexual

INTRODUCTION

Anorectal malformation (ARM) is a congenital disease that has a wide place in pediatric and surgical practice with its anatomical and functional disorders. For each age group, it requires a unique approach. Congenital malformations accompanying in the early period should be detected and treated. Many problems that require medical and surgical treatment are encountered in late follow-ups. For this reason, ARM cases should be followed from birth to adulthood.

TERMINOLOGY, ASSOCIATED ANOMALIES, AND CLASSIFICATION

Anorectal malformation is the term used to describe a group of diseases that occur because of disorders in the development of anus, rectum, and pelvic neuromuscular structures in the prenatal period. In ancient times, ARM, also called "imperforated anus" in the past, was first described in animals by Aristotle.¹ Its incidence is 2-3.5:10000, and it is slightly more common among boys than girls.^{2,3} The most common variant is atresia with rectourethral fistula in boys and atresia with rectovestibular fistula in girls.² Five percent of the patients have anal atresia without fistula, and this variant is mainly associated with trisomy 21.⁴ The etiology of ARM is unclear.⁵ Embryologically, it is thought to result from defects in the dorsal component of the cloacal membrane.⁵

As with most congenital disorders, associated anomalies are common in ARM. The anomaly incidence is approximately 65%, and severe malformations have a higher incidence.^{5,6} Presence of vertebral defects, anal atresia, cardiac defects, tracheo-esophageal fistula, renal anomalies, and limb abnormalities (VACTERL) association requires a detailed investigation in each ARM case. The most common anomalies are genitourinary system anomalies

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(vesicoureteral reflux, hydronephrosis, renal dysplasia/agene sis/ectopia, duplicated system, bladder dysfunction, hypospa dias, undescended testis, ectopic vas deferens, vaginal septum, and double vagina), cardiovascular anomalies (ventricular septal defect, and tetralogy of Fallot), spinal anomalies (sacral agenesis/dysgenesis, vertebral deformities, and tethered spinal cord), gastrointestinal anomalies (esophageal atresia, intestinal atresia, and pouch colon), and limb defects. These disorders play a significant role in morbidity and mortality, and they are also essential factors that determine the prognosis.

In the past, the Wingspread classification was used for ARM variations, which grouped lesions into 3 groups as high, intermediate, and low. Today, however, the Krickenbeck classification developed at the “International Conference on the Development of Treatment and Classification Standards for Anorectal Malformations” pioneered by Alberto Peña in 2005 is preferred (Table 1).⁷ With this classification, questions about clinical groups and treatment approaches have decreased.

ANORECTAL MALFORMATIONS IN MALES

Anorectal Malformation with Perineal Fistula

It is the mildest type of malformation. Only the most distal part of the anorectum is misplaced. The rectum is fistulized to the skin more anteriorly (perineum, scrotal raphe, and ventral penile) than it should be, and this opening is usually stenotic.

Anorectal Malformation with Rectourethral Fistula

It is the most common variant in males. There is no anal opening in the perineum. The rectum may fistulize into the bulbar or prostatic urethra (Figure 1). In the region where the fistula opens into the urethra, the adjacent walls of the rectum and urethra are common. This contiguity is one of the critical points of great importance during the repair. Voluntary levator muscles come from both sides and converge in the middle between the fistula and the perineal skin. In atresia with bulbar fistula, these muscle structures are better developed, the midline fold in the perineum is more profound, the sacrum development is closer to normal, and the anal dimple is more prominent than prostatic fistulas. All these findings point to a better prognosis.

Anorectal Malformation with Rectovesical Fistula

The rectum is fistulized to the bladder neck. This variant is closely associated with poor prognosis for stool control. Levator

Table 1. Krickenbeck Classification	
Major Clinical Groups	
Male	Female
Perineal fistula	Perineal fistula
Rectourethral fistula • Bulbar • Prostatic	Rectovestibular fistula
Rectovesical fistula	Cloacal malformation
No fistula	No fistula
Anal stenosis	Anal stenosis
Rare/regional variants	
Rectal atresia/stenosis	
Pouch colon	
Rectovaginal fistula	
H fistula	
Surgical procedures	
Perineal operation	
Anterior sagittal approach	
Sacroperineal procedure	
Posterior sagittal anorectoplasty (PSARP/PSARVUP)	
Abdominosacroperineal pull-through	
Abdominoperineal pull-through	
Laparoscopic-assisted pull-through	
Associated conditions	
Sacral anomalies/tethered cord	

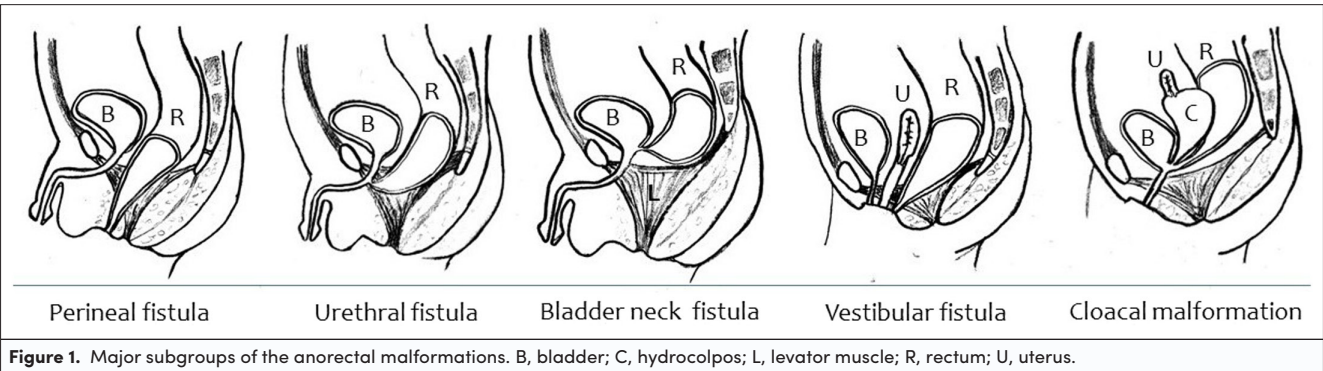
muscle and external sphincter structures are poorly developed. The perineum is straight, the gluteal folds are faint, and the sacrum is disgenetic and deformed. It constitutes approximately 10% of all male atresia.

Anorectal Malformation Without Fistula

It is usually seen with a well-developed musculature, gluteal folds, and complete sacrum. There is a blind-ending rectum approximately 2-3 cm proximal from the anal dimple, that is, from the perineal skin. There are no fistulas in the urinary system or the skin. While trisomy 21 is seen in half of these patients, over 90% of patients with anal atresia diagnosed with trisomy 21 have atresia without fistula.^{3,4}

Rectal Atresia

It is infrequent since anal canal development is normal and the prognosis is good.



ANORECTAL MALFORMATIONS IN FEMALES

Anorectal Malformation with Perineal Fistula

Similar to its male counterpart, there is a stenotic fistula mouth in the perineum close to the vestibulum.

Anorectal Malformation with Rectovestibular Fistula

It is the most common type in girls. In addition to the normal urethral and vaginal structure, there is a stenotic fistula opening in the posterior, inside the vestibulum, from which the stool comes (Figure 2). The prognosis is quite good.

Anorectal Malformation Without Fistula

These patients have similar characteristics as males.

Cloacal Malformation

It is the most complex malformation with the worst prognosis in females. Distal parts of the rectum, vagina, and urethra form a common channel that reaches the perineum as a single opening. The length of the common canal can vary between 1 cm and 8 cm and is the most crucial factor in prognosis, together with the length of the urethra. Repair with a posterior sagittal approach is recommended if the common channel length is shorter than 3 cm. On the other hand, patients with a common channel longer than 3 cm require an abdominoperineal approach, and the prognosis is worse in these patients. Hydrocolpos is present at the delivery time in 30% of patients and is often associated with hydroureteronephrosis.⁸

DIAGNOSIS AND TREATMENT

Prenatal diagnosis is rarely made based on the findings of accompanying anomalies, mostly in severe malformations.^{9,10} Apart from this, most of the cases are diagnosed in the early postnatal period. The treatment is surgery in almost all cases.

The most critical point in the first postnatal evaluation is whether the perineum has an opening with meconium output. If the perineal or vestibular fistula is present, surgical repair can be performed after investigating accompanying anomalies from the neonatal period, since stool discharge is present. However, dilatation to the stenotic orifice is required until the operation. Conversely, if an opening with stool output is not detected at the end of the first 24 hours, the distance of the



Figure 2. Perineal appearance of vestibular fistula at female newborn. The external genitalia is normal, and there is no anal opening. Meconium discharge is seen from the feeding tube inserted through the vestibular fistula into the rectum.

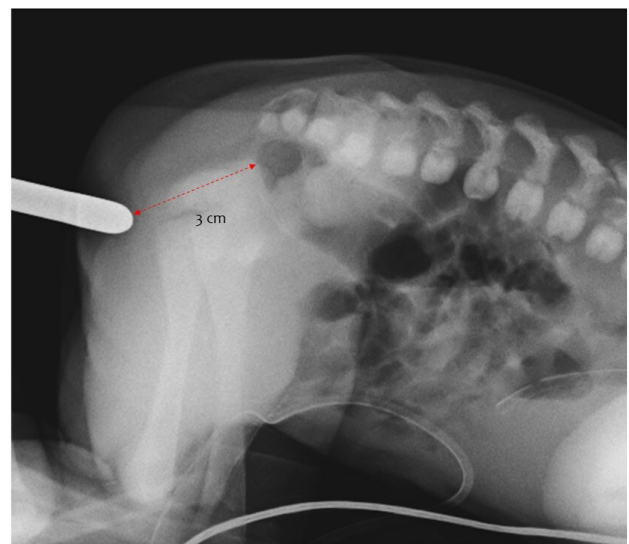


Figure 3. A cross-table lateral x-ray of a male newborn at 24 hours. Distance between skin and distal rectum is 3 cm and not suitable for neonatal definitive repair.

rectum to the perineal skin is evaluated. During this period, the stomach is drained with an orogastric tube. A cross-table lateral x-ray is taken to determine the distance between the rectum to the skin (Figure 3). The repair can be done with a primary approach if the rectum is closer than 1 cm to the skin on the x-ray. Associated disorders are investigated with urinary, sacral, pelvic ultrasonography, anteroposterior and lateral sacral x-ray, and echocardiography. On the contrary, if the rectum is more than 1 cm from the skin or if the rectum is closer than 1 cm to the skin, but the general condition and medical conditions of the baby are not suitable, or if there is a suspicion of a fistula at the proximal level to the urinary system, the primary repair is postponed. A colostomy is opened to the descending colon. Diverting colostomy is preferred to prevent stool passage into the distal colon and bowel prolapse (Figure 4). In this way, infection of the urinary system through the fistula is prevented. At the 10th week after the colostomy, a



Figure 4. Descending diverting colostomy of a male newborn. Stool discharge is obtained from the large proximal end on the cranial side. A distal colostogram is performed from the distal end on the caudal side.

high-pressure distal colostogram is performed and the structure of the rectum and the localization of the fistula, if any, are revealed. Definitive surgical repair is planned accordingly.

In the surgical technique, posterior sagittal repair, defined by Alberto Peña in 1980, is still accepted as the best method and is widely used today. After understanding the importance of the puborectal sling in continence, the surgical methods focused on repair without damaging this structure. Peña observed that the anatomical structures could not be revealed in these techniques. In line with this need, Peña et al¹¹ developed the posterior sagittal anorectoplasty (PSARP) technique, which prioritizes anatomical dissection, based on their embryology studies and experiences.

PSARP is applied to most variants. Posterior sagittal anorecto-vagino-urethroplasty (PSARVUP) is similarly applied to patients with the short common channel in cloacal malformation (Figure 5). Abdominoperineal approaches (by laparoscopy or laparotomy) and staged repairs are preferred for high-type cloaca malformations in females and ARMs with rectovesical fistula in males. Technically, the center of contraction of the muscle complex, that is the place where the anus will be moved to the skin, is determined with the electro-stimulator in the prone position. Then, dissection is advanced to the deep planes with a midline incision extending from the coccyx to the scrotum/vestibulum following the type of defect. The muscle groups are divided symmetrically, and the rectum is found and released. If there is a fistula in the urinary system, the rectum is opened, and the fistula is followed and ligated. Subsequently, the rectum is ultimately released, and anastomosis is made between the muscle groups to the skin. In cloaca malformation in girls, the rectum, vagina, and urethra are moved to the perineum separately. Vaginal replacement with intestinal conduits may be required in long common duct cloaca malformation cases. The muscles are brought close to each other in the anatomical plane, and the repair is completed. Anal dilatation is started early to prevent stenosis in the ano-cutaneous anastomosis line after definitive surgery. In patients with colostomy, the stoma is closed after it is observed that the neoanus has fully healed and reached the required diameter with dilatations. In the follow-up, anal dilatation should stop within months.

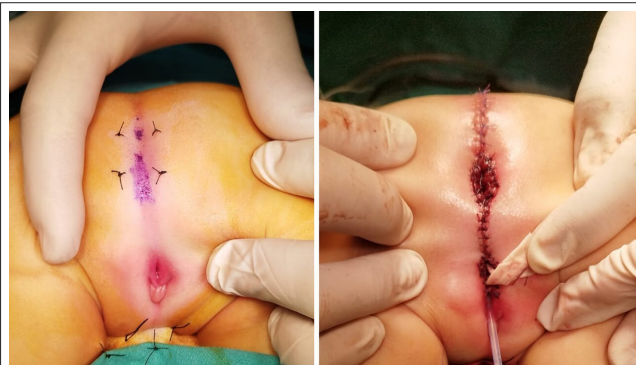


Figure 5. Appearance of the perineum of cloacal malformation case. The localization where the rectum will be pulled-through is marked with silk sutures just before the surgery. The urethra, vagina, and rectum are anastomosed to the perineum one by one with PSARVUP.

After removing the urinary catheter and the stoma closure, urinary functions and fecal control can be evaluated, respectively. Severe intestinal hyperactivity and perineal dermatitis usually occur in patients in the first few weeks after stoma closure. After that, constipation usually starts. It is best to evaluate the stool characteristics after the third postoperative month.¹¹ In terms of urinary problems, ultrasonographic evaluation is recommended in related cases at the postoperative second week. The follow-up of bladder dysfunction and hydroureteronephrosis is essential for long-term kidney functions, especially in cases with cloaca malformation and sacral agenesis. The need for CIC is quite common in these patients due to neurogenic bladder.¹²

COMPLICATIONS

In the follow-up of ARM cases, various complications may develop secondary to congenital anomalies or surgical treatments. Possible complications that pediatric surgeons and pediatricians may encounter can be grouped under 2 headings. These are perioperative complications and late-period problems. Perioperative early complications: surgical site infections, anastomotic separation, genitourinary system injuries, and perineal dermatitis. Surgical site infections are common in cases with the primary repair without a stoma. These infections, which affect only the skin and the subcutaneous superficial layer, are managed with local wound care. Anastomotic separation occurs in devascularized or tense anastomoses. This complication, which may adversely affect the patient's expectation of continence, can be resolved by reanastomosis of the rectum, which has retracted into the pelvis in the early postoperative period, with a posterior sagittal approach. Perianal dermatitis is encountered after stoma closure. It is treated with local treatments and constipation agents. When genitourinary system injuries are noticed, they should be treated intraoperatively. If diagnosed in the postoperative period, it can be resolved with conservative and surgical interventions (such as the urethra, bladder neck, ectopic ureter, and vas deferens injuries).

In the long term, complications such as stenosis, fistula, urethral diverticula, vaginal and urethral strictures, and rectal prolapse are encountered. Anastomotic strictures are usually treated with dilatations and skin-mucosa plastics. If the narrow segment is long, reanastomosis with excision and rectal mobilization may be required. Rectourethral fistulas occur when an overlooked urinary tract fistula is not repaired, when a previously detected fistula fails to close, or when the iatrogenic urethral injury is caused. A rectovaginal fistula develops due to intraoperative injury to the rectum or vagina in anal atresia with rectovestibular fistula and cloaca malformation. Fistulas require surgical repair. Urethral diverticulum develops in cases of atresia with rectourethral fistula, secondary to the attachment of the fistula to the urethra in an area far from it should and should be treated surgically if symptomatic (Figure 6). Rectal prolapse is especially common in patients with sacral agenesis whose pelvic musculature is poorly developed and requires treatment. Urethral atresia/stricture are conditions that can be encountered after complete iatrogenic transection of the urethra in boys and after anastomosis

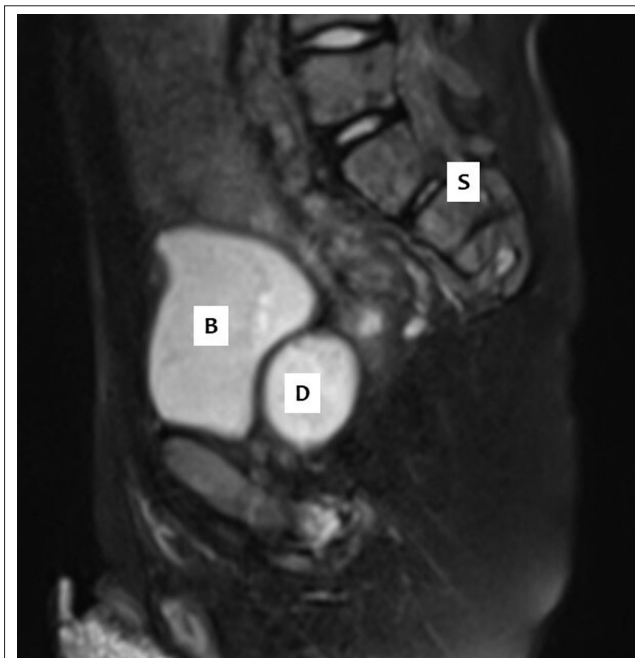


Figure 6. Urethral diverticulum due to long residual fistula. B, bladder; D, diverticulum; S, dysgenetic sacrum.

of the urethra with poor circulation to the perineum in girls in cloaca malformation. Vaginal atresia/stricture is also seen in cloacal malformation with long common channels when the poorly vascularized vagina goes under fibrosis after anastomosis to the perineum. These patients may present with symptoms such as amenorrhea, hematocolpos, and hematosalpinx in adolescence. Repair may require ileal or rectal conduit, and therefore, an abdominal approach is needed. For all the complications mentioned earlier, except for vaginal replacement, repair with a posterior sagittal approach is recommended primarily.

LATE-TERM PROBLEMS

The most important functional problems encountered in the late period are constipation and fecal incontinence, neurogenic bladder and urinary incontinence, sexual dysfunction and fertility problems, and poor quality of life secondary to the mentioned problems. The factors that are closely related to all these problems are the type of ARM, the degree of sacral agenesis, urinary anomalies, and the success of the treatment process.

CONSTIPATION, FECAL INCONTINENCE, AND BOWEL MANAGEMENT PROGRAM

Constipation is the most common sequela seen in ARM patients.¹² Its frequency is reported as 22%-86% in different studies.¹³ Constipation causes the rectosigmoid colon to remain constantly full, the feeling of voluntary defecation disappears over time, and incontinence occurs. Especially in patients who are expected to be continent, with the normal sacrum and well-developed pelvic muscles, the most crucial cause of stool incontinence is constipation (perineal fistula, vestibular fistula, atresia with rectobulbar urethral fistula, malformation of the

cloaca with short common canals, rectal atresia, and atresia without fistula). This type of incontinence, which is in the form of overflow due to the impaction of the stool in the rectosigmoid colon, is called "pseudo-incontinence." Most patients with pseudo-incontinence can be clear with diet, oral laxatives, and bowel management programs.¹⁴ In contrast, "true incontinence" is associated with sacral agenesis and poor pelvic neuromuscular structures. These patients benefit less from similar treatment modalities. In conclusion, 16%-76% of ARM patients were incontinent in the late period, and this entity continues in adulthood.^{13,15-18} This condition, which causes serious problems for patients in their daily routine should be treated in every possible case to increase the quality of life.¹⁶ Therefore, it is important for pediatricians to have knowledge about the management of constipation and fecal incontinence of ARM patients.

Anorectal malformation patients who have completed their surgical stages are evaluated for fecal continence starting from the age of 3 years. Voluntary bowel movements were seen in 75% of the patients, and half of them are continent without treatment.¹⁹ Other patients should be treated.

Patients with stool incontinence are examined in 2 groups: those requiring surgical treatment and those that need a bowel management program. In the first evaluation, the localization of the anus and whether there is stenosis or prolapse are checked. If there is prolapse or stenosis, it is surgically treated. A lumbosacral pelvic magnetic resonance imaging reveals the relationship between the rectum and the levator complex and spinal anomalies. Consultation with neurosurgery should be performed regarding the tethered spinal cord. Sacral and spinal anomalies, which are common in ARM cases, may cause stool and urinary incontinence by creating tension in the spinal cord.²⁰ Colon is visualized by radiopaque enema X-ray using water-soluble non-ionic contrast material. In cases where the localization of the anus is suspected in the physical examination, the location of the anus and its relationship with levator contractions are evaluated by performing an examination with electrostimulation under general anesthesia. Sacral agenesis is checked if the anus and rectum are not in the muscle complex. In cases with significant sacral agenesis (sacral ratio less than 0.4), revision surgery is not recommended even if the location of the anorectum is poor (Figure 7). Because these patients do not benefit from revision. On the other hand, half of the poorly placed rectum cases with normal sacrum benefit from revision

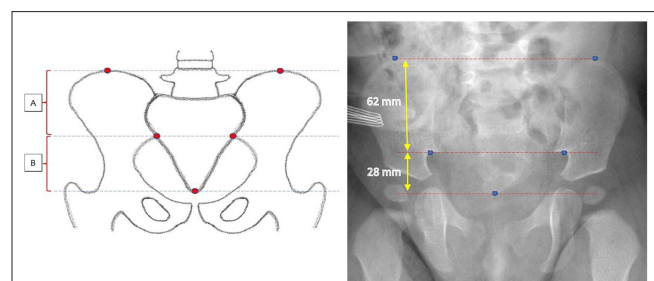


Figure 7. Schematic explanation of sacral ratio (B:A = 0.74, normally). Sacral ratio calculation on pelvic x-ray of male anorectal malformation case (28:62 = 0.45, sacral dysgenesis).



Figure 8. Contrast enemas of the colons with and without rectal reservoir.

surgery with the posterior sagittal approach.²¹ The bowel management program is applied to whose incontinence continues after surgical treatment and to patients who do not require surgical treatment.

The primary points evaluated in bowel management program patients are the functional and physical characteristics of the colon. In this respect, patients are gathered into 2 groups: patients with a hypomotile colon with a rectosigmoid reservoir and patients with a hypermotile colon without a reservoir (Figure 8). Most patients in the first group are pseudo-incontinence patients, and their sacrum is well developed. These patients, who have a high expectation of continence and feel voluntary defecation, can be caught only in the early constipation phase without incontinence. In patients at this stage, first, the impacted stool in the rectosigmoid colon is totally evacuated with enemas. Oral laxatives are administered after radiological control of rectal emptying. With this treatment, the constipations of pseudo-incontinence patients are vastly improved and remain clear. In some patients with reservoirs, among which the patients with sacral agenesis are the majority, continence cannot be achieved even if the constipation is treated. An enema program is recommended for these patients. No specific diet or medication is required. The main goal is to empty the colon with enemas applied once a day and to stay clean in the period between enemas.

When starting the bowel management program, the patient is hospitalized. The application of the enema should be taught to the patient and the person who will perform it, considering the age of the patient. Daily evacuation and defecation times, and the emptiness of the left colon with plain radiographs are followed. The preferred method is an isotonic enema. It can be prepared at home, so the cost is low. It is prepared by adding 9 g (3-4 teaspoons) of salt to 1 L of boiled water and applying with enema sets as 20 cc/kg. Since there may be leakage from the anus during the procedure, the prepared enema fluid is given to the colon with an inflated Foley catheter. If the colon does not empty during the follow-ups, the application should

be made in the prone position, the amount of liquid should be increased, or glycerin (10-30 cc) should be added to the liquid. If the discharge time is long, the salt concentration is temporarily increased. If there are complaints such as vomiting and pain, the enema is performed slowly and with warm liquid. Daily phosphate enema is also a method that can be used; however, it is not preferred because of its high cost, causing cramps and colitis, and the risk of hyperphosphatemia in patients with impaired renal function.

Patients with a non-reservoir hypermotile colon are generally those whose rectum was resected during the primary operation. In this group, in which patients with sacral agenesis are in the majority, there is continuous stool output in a liquid or semi-solid form. Constipating diet, motility-reducing drugs (such as loperamide or diphenoxylate-atropine), and enema treatment are applied in these patients (Table 2). Treatment should be uncompromising. Patients who stay clean between enemas for 3 consecutive days should try new foods individually and determine the foods that cause incontinence. These foods are personal, families and the patient themselves know best. In the long term, motility-reducing drugs can be discontinued in patients who stay clean with this program.

The duration of treatment for patients in a bowel management program is lifelong, especially in patients with a poor prognosis. Over time, patients cooperate better, and the results become more promising. In patients who know their bowel habits and

Table 2. Dietary Preferences and Restrictions for Anorectal Malformations with Hypermotile Colon

Preferred	Restricted
Peeled apple	Milk and milk products
Rice	Fatty foods
Bakery products	Fried foods
Well-cooked meat products	Fruits
Banana	Vegetables
Potatoes	Spicy foods
Crackers and cakes	Fruit juices (without pulp)

are under control, the enema program can be stopped in the future, and results can be observed under oral laxative treatment. Passive laxatives such as lactulose are not recommended in patients without voluntary defecation and anal sensitivity; rather, sennosides should be preferred. These trials should be done during long holidays away from social environments.

Most patients are compliant until puberty. But with puberty, privacy issues arise. The patient will object to the treatment for some part of his life and will want to make an easier enema on his own. Unique enema sets are available for these situations. On the other hand, continent appendicostomy, in which the anal route is not used for enema, is another way to achieve this.²² In this technique, the tip of the appendix is moved into the umbilicus or right lower quadrant. The patient catheterizes this tunnel and makes his enema. It can be preferred in selected cases with good treatment compliance.²³

Apart from all of these, some rare cases with complications, severe sacral agenesis, pouch colon, or no colon may need to be followed up with a permanent stoma. In these patients, to move the intestinal terminal tip to the perineum, the patient must first receive a bowel management program and stay clean with enemas made from the stoma. Otherwise, the operation will remain as a perineal stoma, it will cause complications that will require perineal care and cause the patient to walk around in a diaper.

URINARY INCONTINENCE, NEUROGENIC BLADDER, AND RENAL FAILURE

In different series, urinary incontinence rates are reported as 1.7%–52% in the late-term follow-up of ARM patients.^{13,24} Urinary incontinence is more common, especially in severe forms (cloaca malformation and ARM with prostatic and vesical fistula).¹⁸ The cause of incontinence in these patients is structurally affected urethra and bladder neck and neurogenic involvement due to accompanying sacral dysgenesis. Neurogenic bladder is common in these patients whose sacrum and pelvic muscular structures are not well developed. Malformations of the cloaca with long common channels and ARM cases with rectovesical fistula constitute most patients with neurogenic bladder. In addition, the incidence of urinary anomalies in these severe forms is higher than in other subgroups.²⁴ Ahn et al²⁵ reported that 7% of the cases achieved bladder emptying with clean intermittent catheterization (CIC) in their series consisting of pediatric patients in which they examined 525 patients.

Congenital urinary anomalies, neurogenic bladder, and recurrent urinary tract infections may result in end-stage renal disease and the need for renal replacement if not managed well.^{26,27} Despite previous abdominal surgeries in these patients, the first choice should be peritoneal dialysis.²⁸ When peritoneal dialysis fails, hemodialysis is preferred. Renal transplantation was observed in 0.7%–8% of the patients.^{26,29} Renal disorders play an important role in the mortality of ARM patients.²⁹ Therefore, urinary system complaints (such as dysuria, hematuria, decreased urine calibration, urinating by straining, and continuous and dribbling urination) should be questioned in the early and late follow-ups of ARM patients, and the cases should be consulted with nephrologists.

SEXUAL DYSFUNCTION AND INFERTILITY

The frequency of erectile dysfunction and ejaculation disorders in adult male ARM patients is reported to be 5.6%–11.8% and 15.6%–41.2%, respectively.¹³ Fertility was found to be approximately 29% when all ARM patients were evaluated.³⁰ The causes of infertility are Mullerian anomalies (uterovaginal malformations) in girls; ectopic ejaculatory duct, recurrent orchitis-epididymitis, and undescended testis in boys.^{31–36} In simple anomalies, sexual satisfaction, ejaculation, erection, and fertility rates are higher. However, these rates are lower in complex anomalies.^{30,37} These results reveal that ARM patients should be evaluated by pediatric endocrinology in addition to pediatric urology and surgery follow-up in adolescence and that they should continue their gynecology and urology follow-up into their adult ages.

CONCLUSION

Anorectal malformations, with their different subtypes, define several disorders that require a unique approach. Surgical and medical treatments aim to reintegrate these children with many congenital anomalies into the society as completely healthy individuals in terms of medical and social aspects. This process extends from birth to adulthood. In this follow-up, many pediatric disciplines such as neonatology, cardiology, nephrology, gastroenterology, and endocrinology cooperate with pediatric surgeons and pediatric urologists.

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