Eur J Pediatr (2009) 168:1479–1481
DOI 10.1007/s00431-009-0958-4

ORIGINAL PAPER

Double aortic arch with double aneuploidy—rare anomaly in combined Down and Klinefelter syndrome

Maaike F. Gerretsen · Willem Peelen · Lukas A. J. Rammeloo · David R. Koolbergen · Jaroslav Hruda

Received: 13 January 2009 / Accepted: 13 February 2009 / Published online: 5 March 2009
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Abstract A 14-month-old boy with double aneuploidy and a double aortic arch suffered from frequently recurrent severe feeding and respiratory problems. Chromosomal analysis showed a *48,XXY + 21* karyotype: a double aneuploidy of Down syndrome (DS) and Klinefelter syndrome (KS). Only four cases of double aneuploidy (DS + KS) associated with congenital heart defects have been published of which none had a double aortic arch. Our case report should draw attention to the possibility of a double aortic arch in patients with severe feeding and respiratory problems and a double aneuploidy.

Keywords Double aneuploidy · Down syndrome · Klinefelter syndrome · Double aortic arch · Vascular ring

Introduction

The first case of double aneuploidy of Down syndrome (DS) combined with Klinefelter syndrome (KS) was published in 1959 by Ford et al. [8]. Most of the papers published since then were focused to more extent on the double aneuploidy itself than on the clinical features of the patients. Pediatric cardiologists are familiar with screening of babies with DS for congenital heart defects (CHD), expecting in approximately 50% to find a heart defect, typically atrioventricular septal defect [9, 13]. However, in children diagnosed with KS, a CHD has only rarely been reported [1, 13, 15]. Reports on CHD with double aneuploidy of DS and KS are scarce. We report on a child with DS and KS associated with a double aortic arch.

M. F. Gerretsen · L. A. J. Rammeloo · J. Hruda (✉)
Department of Pediatric Cardiology,
VU University Medical Center,
Amsterdam, The Netherlands
e-mail: j.hruda@vumc.nl

W. Peelen
Department of Pediatrics, St. Jansdal Hospital,
Harderwijk, The Netherlands

D. R. Koolbergen
Department of Cardiothoracic Surgery, Academic Medical Center,
Amsterdam, The Netherlands

Case report

A 14-month-old boy was admitted to our department after frequent admissions in other hospitals because of recurrent severe feeding and respiratory problems. His weight was 7.6 kg, height 78 cm, blood pressure 90/75 mmHg, moderate psychomotor retardation was present. His parents were not consanguineous. He was born following an uneventful pregnancy with a birth weight of 2,560 g. The mother was 36 years old.

Chromosomal analysis performed because of facial dysmorphic features (Fig. 1) suggesting Down syndrome revealed a *48,XXY +21* karyotype: a double aneuploidy of Down syndrome and Klinefelter syndrome. Soon after birth, he had to be intubated because of severe respiratory problems. Echocardiography, bronchoscopy and CT thorax performed in another centre demonstrated a small atrial septal defect (secundum type) and narrowing of the trachea from its middle to the carina. The X-ray of the small bowel was normal; barium swallow was then not performed. The boy had to be fed by a tube and later exclusively via a percutaneous endoscopical gastrostomy. After extubation, the patient suffered repeatedly from severe respiratory distress in the course of intercurrent infections.

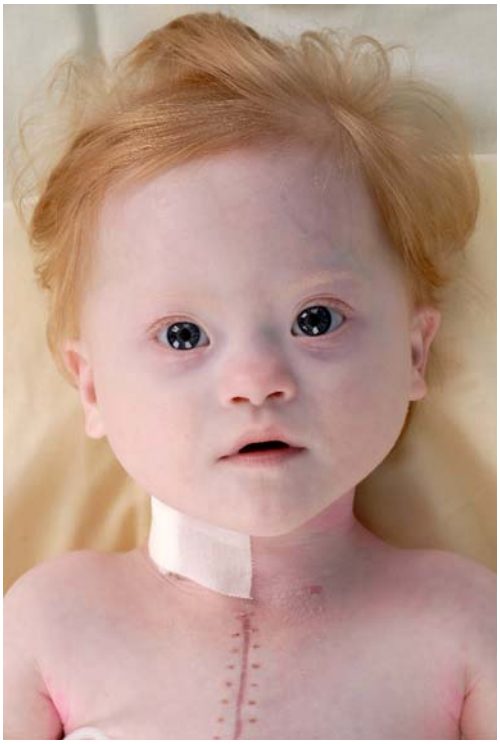

Fig. 1 Facial dysmorphic features in a child with double aneuploidy—Down syndrome and Klinefelter syndrome (with the permission of the parents)

This clinical picture accompanied by findings of a topical trachea and possibly also an oesophageal obstruction led to a suspicion of a vascular airway compression. A new echocardiography and a new CT of the thorax with contrast (Siemens Somatom Sensation 64-slice, contrast 25 ml omnipaque 300 intravenous) demonstrated a double aortic arch (Fig. 2), compressing both trachea and oesophagus. The anterior left arch appeared smaller with a localised narrowing, as compared to the posterior right arch. The descending aorta was running to the left of the spine. Barium swallow demonstrated a severe indentation in the proximal oesophagus (Fig. 3).

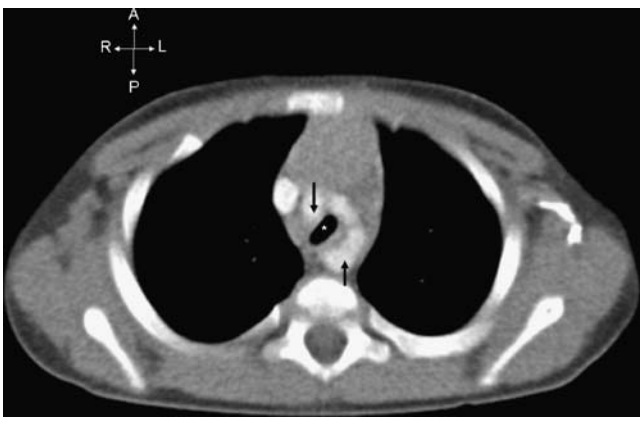

Fig. 2 CT scan, transverse projection. *Arrows* indicate anterior and posterior aortic arch. Trachea (*asterisk*) compressed by the vascular ring. *A* anterior, *L* left, *P* posterior, *R* right

Using a median sternotomy approach, the left anterior aortic arch was divided at the smallest point between the left carotid and subclavian artery. In addition, the ductal ligament was divided. Complete and thorough mobilization of the trachea and oesophagus has been performed. It was decided not to proceed with open heart surgery in order to close the small centrally located atrial septal defect, because if still necessary, it can later be closed percutaneously.

The postoperative course was complicated by a wound infection and pleural empyema for which he needed surgical treatment. The percutaneous endoscopical gastrostomy could be abolished and normal oral feeding restored.

Discussion

Aneuploidy is defined as an abnormal number of chromosomes. Double aneuploidy, the existence of two chromosomal abnormalities in the same person, is relatively rare. It can involve both autosomal (chromosome 13, 18 or 21) and

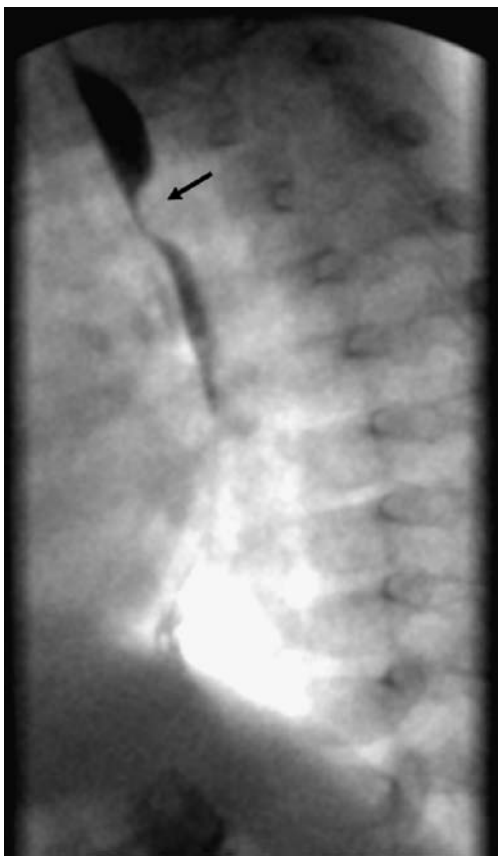

Fig. 3 Barium swallow. Posterior indentation of the oesophagus (*arrow*)

sex chromosomes [17] and each may manifest either as a monosomy or trisomy or even tetra- or pentasomy.

The incidence of a double aneuploidy with DS and KS varies in different publications [11]. Kovaleva and Mutton [12] have reported that 0.098% of the children with DS also have KS.

The incidence and spectrum of cardiovascular anomalies in children born with Down–Klinefelter syndrome is not known. Only four case reports on CHD in these patients have been published [2, 6, 7, 11], but none had a double aortic arch.

Adult patients with isolated KS may occasionally suffer from mitral valve prolapse. However, an obvious relationship between this syndrome and CHD has not been documented, with exception of several case reports [1, 15]. In contrast, Down syndrome alone is well known for cardiac anomalies, occurring in 40% to 50% of patients [13]. Freeman [9] reported a 44% incidence of CHD in a group of 227 infants with DS, of which 45% are atrioventricular, 35% are ventricular and 8% had an isolated atrial septal defect. The resting 12% of other anomalies did not include any infant with a vascular ring. As a matter of fact, an aberrant origin of the subclavian artery (arteria lusoria) seems to be found more and more frequently in children with DS, so that it has even been proposed to consider it as a new cardiac sign for DS [5]. In most of them, however, this should be only an incidental finding [14], not responsible for the feeding difficulties. Interestingly, in patients with DS less vascular anomalies than in general population were reported, probably because of an increase in inhibitors of vascular endothelial growth factor, whose genes are located on chromosome 21 [10]. Double aortic arch does not belong to the spectrum of defects known to be associated with DS.

Our observation should draw attention to a possible occurrence of a complete vascular ring in a young infant with clinical symptoms of recurrent respiratory and feeding problems and a (double) aneuploidy. In addition to assessing intracardiac anatomy, a careful assessment of aortic arch anatomy is warranted [3, 4, 16] before possible breathing or swallowing difficulties may be assigned to muscular hypotony, bronchial pathology and other factors, common for patients with (double) aneuploidies.

Conflict of interests The authors declare that they have no conflict of interest.

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