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Original article

Associated anomalies with anorectal malformations in the Eastern Indian population

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Abstract

Aim: Anorectal malformations (ARMs) are often associated with other anomalies. At present, there is no comprehensive protocol to detect these associated anomalies. This study aims to study prevalence of associated anomalies in the Eastern Indian population.

Materials and methods: All patients admitted with ARM in our institute (Department of Paediatric Surgery, NRS Medical College & Hospital, Kolkata, West Bengal, India) were studied from 2010 to 2012 (n = 182). Clinical examination and basic laboratory and radiological investigations were done in all patients. Advanced radiological investigations followed if abnormality was detected in the basic investigation. Incidence of associated anomalies was compared with known literature and correlation between level of ARM and other associated anomalies was studied.

Results: 102 of 182 ARM patients studied had associated anomalies. More associated anomalies were present in high ARM than low ARM (59.65% vs 50%). Genitourinary anomalies were the most common associated anomaly, followed by spinal, cardiovascular, tracheo-esophageal, gastrointestinal tract, limbs and facial anomalies.

Conclusion: In the Eastern Indian population, there is no significant sexual difference in patients who have associated anomalies with ARM. Full laboratory and radiological investigations are required in all ARM patients to detect and treat the associated anomalies as they may not be clinically apparent.

Keywords

Anorectal malformations, associated anomalies, type of anorectal malformation, genitourinary anomalies.

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Introduction

Anorectal malformations (ARMs) are a complex group of malformations diagnosed at the time of birth because of absence of anal opening at normal site. The gastrointestinal tract (GIT) is either blind ending or opens as a fistula in an abnormal or normal location or urogenital or an aberrant tract [1-3]. The incidence is approximately 1:5,000 live births. It is seen more commonly in boys [4]. ARM is associated with other anomalies in a high percentage of patients [1, 5]. These anomalies include genitourinary, cardiac, spinal, GIT anomalies [6-9]. There are protocols described for the diagnosis of urinary anomalies associated with ARM [10] and spinal anomalies with ARM [7]; however, a comprehensive protocol to diagnose all the anomalies associated with ARM has not been described. The present study detects the prevalence of associated anomalies with ARM in children.

Material and methods

All children (both male and female) less than 12 years of age with ARM presenting to the Department of Paediatric Surgery (NRS Medical College & Hospital, Kolkata, West Bengal, India) from October 2010 to April 2012 were included in this study. The study population included all religions across varied socio-economic status. All patients were clinically examined systematically for presence of any other co-existing congenital anomaly. After taking ethical clearance from college ethical committee and taking informed consent from parents, all patients underwent all necessary laboratory investigations and ultrasonography of kidney, ureter and bladder region, micturating cystourethrography, X-ray chest and lumbo-sacral spine and echocardiography. Patients with an abnormality in the ultrasonography of kidney, ureter and bladder underwent a renal isotope scan and those with abnormal radiological findings in the lumbo-sacral spine underwent an MRI of the lumbo-sacral spine. The incidence of all anomalies diagnosed during this study was then compared with the incidence in known literature. The International classification of ARM was followed to classify ARM into either high or low type [11]. Correlation of coexisting anomalies was studied and compared between high and low anomaly groups using Chi-Square Test.

Results

There were 182 patients of ARM admitted in the department during the above-mentioned period. Of these 182 patients, 114 were males (62.64%) and 68 were females (37.36%). Of the 114 males studied, 64 had associated anomalies with ARM (56.14%) and 50 patients had no associated anomalies (43.86%). Amongst the 68 females included in the study 38 had associated anomalies (55.88%) while 30 patients had no such associated anomalies (44.12%). So out of the total of 182 patients, 102 patients (56.04%) had other anomalies (**Tab. 1**).

Amongst the 182 patients, 114 had a high (62.64%) and 68 had low ARM (37.36%). Among the 114 patients with a high ARM, 93 (81.58%) were boys and 21 (18.42%) were girls. Of the 68 patients with low ARM, 21 patients (30.88%) were boys and 47 were girls (69.12%).

Amongst the 114 patients with high ARM, 68 (59.65%) had presence of other associated anomalies along with ARM, whereas 46 (40.35%) had no other anomalies. Amongst males with high ARM, 53 out of 93 males (56.99%) had other associated anomalies. In 21 females with high ARM 15 had other associated anomalies (71.42%). In the 68 patients with low ARM, 34 patients (50%) had other associated anomalies and 34 patients (50%) had no other anomalies. Among the male patients with low ARM, 11 out of 21 patients (52.38%) had associated anomalies. In the 47 females with

Table 1. Distribution of cases according to sex and presence of other anomalies.

	Males	Females	Total
Cases of ARM	114	68	182
Associated anomaly present	64	38	102
No associated anomaly	50	30	80

ARM: anorectal malformation.

low ARM, 23 had associated anomalies (48.93%) (**Tab. 2**).

Amongst the 114 males with ARM, 49 patients had recto-bulbar fistula, 22 patients had recto-prostatic fistula, 14 patients had a recto-vesical fistula, 6 patients had a pouch colon, 2 had rectal atresia and 21 had perineal fistula. Of the 68 females studied, 42 had vestibular fistula, 17 patients had cloaca, 5 had perineal fistula and 4 had rectovaginal fistula.

Among the patients having associated anomalies with ARMs (n = 102), a single associated anomaly was present in majority of the patients, i.e., 77 patients (75.49%), while multiple anomalies were present in 25 patients (24.51%). Of the 77 patients with single anomalies, 46 (59.74%) were males and 31 (40.26%) were females. Among the 25 patients with multiple anomalies, 18 (72%) were males and only 7 (28%) females had the presence of multiple associated anomalies (**Tab. 3**).

The patients with associated anomalies (n = 102) were then further classified according to the various systems involved. The genitourinary tract was the most commonly involved system i.e., in 50 patients of which 33 were boys and 17 were girls. Next most commonly associated systems were spine and spinal cord with 24 patients of which 19 were males and 5 were females. Cardiovascular system anomalies were seen in 22 patients. Of these 14 were males and 8 were females. Tracheo-esophageal anomalies and other upper GIT anomalies were present in 15 patients with 7 males and 8 females having these anomalies. Limb and facial anomalies were uncommon, with only 6 patients each. It was peculiar to note that all 6 of the limb anomalies were in males whereas majority of the facial anomalies were seen in females. Rarest of the anomalies associated were central nervous system and genetic anomalies with 3 and 2 patients respectively. Both patients of Down syndrome were females (**Tab. 4**).

Among the 182 patients, multiple system anomalies were present in 25 patients (18 males and 7 females). Genitourinary anomalies with spinal anomalies were most common combination with 12 patients (9 males and 3 females). Cardiovascular and genitourinary anomalies were the next common multiple anomaly set with ARM which was equally distributed amongst both the sexes. Limb anomalies with cardiovascular anomalies and limb anomalies with genitourinary anomalies were seen in 2 males. No female was found with this combination of anomalies. Spine anomalies with GIT anomalies were seen in 2 males whereas spine anomalies with cardiovascular anomalies were seen in 1 patient. Tracheo-esophageal fistula with Down syndrome was seen in 1 female with ARM. One female patient had 3 systems involved with ARM. The systems involved were genitourinary, cardiovascular and central nervous system anomalies with ARM in this patient.

Among the 114 patients of high ARM, a high number of patients, i.e. 68 patients had associated anomalies (59.65%). Of these 53 were males and 15 were females. On classifying these patients of high ARM with associated anomalies according to the system involved, it was found that 39 of the 114 patients (34.21%) had an anomaly of the genitourinary tract, which was the most common associated anomaly. Spinal anomalies were seen in 17 of the 114 patients (14.19%), majority of these patients were males accounting for 14 of

Table 2. Distribution of cases according to presence of associated anomalies in different level of anorectal malformation (ARM).

	High ARM	Low ARM
Associated anomaly present	68	34
No other anomaly	46	34

ARM: anorectal malformation.

Table 3. Distribution of cases according to number of associated anomalies.

Anomalies	Male	Female	Total
Single	46	31	77
Multiple	18	7	25

Table 4. Distribution according to system involved in associated anomalies.

Associated anomaly	Males	Females	Total
CNS	1	2	3
CVS	14	8	22
Limb	6	0	6
Face	2	4	6
Genetic	0	2	2
GIT + TEF	7	8	15
Spine	19	5	24
GUT	33	17	50

CNS: central nervous system; CVS: cardiovascular system; GIT: gastrointestinal tract; TEF: tracheo-esophageal fistula; GUT: genitourinary tract.

the 17 patients (82.35%). Cardiovascular system anomalies were the next most common with 15 patients out of 114 (13.16%); here too males were the affected group with 12 out of 15 patients (80%). Tracheo-esophageal anomalies were seen in 9 patients (7.89%) which were twice as common in males as females, with 6 males and 3 females involved. Limb anomalies were seen in 4 males, no female was seen with associated limb anomaly. Central nervous system anomalies were relatively uncommon in this group, seen in only 2 patients. Facial anomalies were also seen in 2 patients. Genetic anomalies with 1 case were the rarest (**Tab. 5**).

In this study, amongst the 68 patients of low ARM, a relatively lower proportion of patients, i.e. 34 patients had associated anomalies (50%). Of these 11 were males and 23 were females. On classifying patients of low ARM with associated anomalies according to the system involved, it was found that the most common associated anomaly was that of the genito-urinary tract seen in 11 of the 68 patients (16.18%). Spinal anomalies were seen in 7 of the 68 patients (10.29%), majority of these patients were males accounting for 5 of the 7 patients (71.43%). Cardiovascular system anomalies were also seen in 7 patients out of 68 (10.29%); here females were the most affected group with 5 out of 7 patients being females (71.43%). Tracheo-esophageal anomalies were seen in 6 patients (8.82%) which were more common in females than in males (5 females and 1 male). Central nervous system anomalies and genetic anomalies were relatively uncommon in this group with 1 case seen of each. Limb anomalies were seen in 2 patients, both males. Facial anomalies were more common in this group than in the patients with high ARM, with 4 patients seen in patients with low ARM (**Tab. 6**).

Discussion

A total of 182 patients of ARM were studied who were fully investigated for the presence of other associated anomalies. The male:female ratio in this study was 64:38; which is comparable to other large studies [12]. In the present study, there were exceptions in the sex distribution of perineal fistula and rectal atresia when compared with other studies [12, 13]. Perineal fistula was twice as common in males as in females and both cases of rectal atresia were found in males in this study.

In this study, the associated anomalies were distributed equally in males (56.14%) and females (55.88%). This is in contrast with other studies done in our country where associated anomalies were 4 times as common in males as in females [14]. There are other studies in which anomalies were 13 times more common in males than in females [2]. The incidence of high ARM in our study was 62.64% while that of low ARM was 37.36%. This is in contrast to the 26% incidence of high ARM reported in a large Japanese study [12]. The incidence of associated anomalies was higher in cases with high ARM (59.65%) than in cases with low ARM (50%).

In the present study, 56.04% of the patients had associated anomalies in other systems along with ARM which is comparable with various studies carried out over the years studying associated anomalies where the percentage of patients with associated anomalies ranged from

Table 5. Distribution of associated anomalies according to system in high anorectal malformation (ARM) cases.

Associated anomaly	Male	Female	Total
CNS	1	1	2
CVS	12	3	15
Limb	4	0	4
Face	1	1	2
Genetic	0	1	1
GIT + TEF	6	3	9
Spine	14	3	17
GUT	29	10	39

CNS: central nervous system; CVS: cardiovascular system; GIT: gastrointestinal tract; TEF: tracheo-esophageal fistula; GUT: genitourinary tract.

Table 6. Distribution of associated anomalies according to system in low anorectal malformation (ARM) cases.

Associated anomaly	Male	Female	Total
CNS	0	1	1
CVS	2	5	7
Limb	2	0	2
Face	1	3	4
Genetic	0	1	1
GIT + TEF	1	5	6
Spine	5	2	7
GUT	4	7	11

CNS: central nervous system; CVS: cardiovascular system; GIT: gastrointestinal tract; TEF: tracheo-esophageal fistula; GUT: genitourinary tract.

30-71% [14]. Among studies done in India, the same percentage ranged from 28-59%, which is comparable with our study [14]. One UK report suggested a 53% incidence and a Japanese study of 1,992 cases a 45.2% association [12]. In the more recent EUROCAT study, a 64% incidence was identified [13]. The reported occurrence of associated anomalies probably depends on how extensive the investigation of the patient has been. It may therefore be higher in areas of high resources and much lower in developing countries like India. Although post-mortem studies have demonstrated an extremely high (97% and 94%, respectively) incidence of associated anomalies, this can probably be partly attributed to patient selection, as those with multiple anomalies are most likely to succumb to the condition [15,16]. Multiple anomalies were seen in 13.74% of total patients and a single associated anomaly was seen in 42.31%. this is comparable with a South American study of more than 1 million births in 11 countries identified 121 (8.5%) of 1,428 babies with multiple anomalies that included anal, renal and genital anomalies [17]. In this study, VACTERL (Vertebral, Anorectal, Cardiac, Tracheo-Esophageal, Renal/Radial and Limb) association were seen in 21 cases (17.4%).

Genitourinary anomalies occur frequently in patients with ARM and previous retrospective reviews report incidences from 20% to 50% [8]. Even in the present study, amongst the associated anomalies, urogenital anomalies were the most common accounting for 39% of all anomalies. This is similar to most studies where urogenital anomalies are one of the most common association seen in ARM and occur in 20-54% of cases [8]. In the series by Peña, a 48% overall incidence was reported, being 14% in low lesions [18]. Urinary tract anomalies occurred in 25.6% in one study from a developing country, occurring more frequently in high lesions [19]. In this study, the associated anomaly most frequently encountered was vesicoureteric reflux (30%), non-functioning kidney (16%), anatomic aberrations of the kidneys (14%), hypospadias (12%). Most of these anomalies required surgical correction and hence the early detection of these anomalies is essential in order to prevent further morbidity and mortality of these patients.

The next most common anomaly was spino-vertebral which occurred as 19% of all cases with anomalies. A further association is with a tethered spinal cord in patients with ARM [20]. In one study of 55 patients with tethered cord in Japan, 10 (18%) had a high ARM [20]. Spino-vertebral anomaly incidence varied a lot in various other studies carried out over the world ranging from 5% to 41% [14]. The most common spino-vertebral anomaly seen in the present study was sacral agenesis (50%), spina bifida (29.16%) lumbosacral myelomeningocele (12.5%). The patients with myelomeningocele who have complete paralysis of the lower limbs and urinary incontinence have a very poor prognosis regarding fecal continence and parents need to be informed about the nature and severity of the anomaly and the care required for these patient is lifelong.

Associated cardiovascular anomalies accounted for 17% of the total anomalies which was similar to an early study done by Greenwood et al. who found a 14.9% association in his series of 222 patients [21]. Other studies performed with a larger sample size had cardiovascular anomalies in 7-10% of total anomalies [2]. The most common anomalies seen in our study were ventricular septal defects (40.9%), patent foramen ovale (31.81%) and atrial septal defects (31.81%). Early diagnosis and treatment of cardiovascular anomalies is essential as undetected anomalies are fatal.

GIT anomalies are relatively uncommon but have been reported in as many as 10% of patients [17]. Apart from tracheo-esophageal fistula as a part of the VACTERL association, they include malrotation, Hirschsprung's disease, gastrointestinal duplications and duodenal obstructions [17]. In this study, GIT anomalies accounted for 12% of all anomalies which is similar to earlier studies. Tracheo-esophageal fistula was the most common GIT anomaly (85%) amongst the cases with VACTERL association in this study. Other associations were isolated cases of malrotation, omphalocele and duodenal obstruction (6.7% each). The patients with tracheo-esophageal fistula in the present study had a high mortality rate with 10 fatalities out of 12 patients. One of the most interesting associations is with Down syndrome [12], which was seen in 2 patients.

Other associated anomalies included facial anomalies like cleft lip and palate and microtia, limb anomalies like radial club hand and central nervous system anomalies like arachnoid cysts, brachycephaly [12]. These anomalies were rare in other studies as well and accounted for less than 10% of the anomalies [14]. The facial anomalies

are fully correctable and need to be attended to at the right age. Cleft lips need to be repaired at 3 months, cleft palate is repaired around 9 months, microtia needs to be operated at 6 years of age in consultation with Ear, Nose, Throath (ENT) and plastic surgical team. Limb anomalies like radial club hand also need to be rectified surgically and need to be referred to hand/plastic surgeon for their treatment at the appropriate age. Central nervous system anomalies that are correctable like arachnoid cysts, brachycephaly need to be evaluated by a neurosurgeon and dealt with accordingly. Uncorrectable central nervous system anomalies like cerebral atrophy have a poor quality of life and these need to be explained to the parents. Patients with multiple anomalies in this study had a similar mortality rate as those with only 1 associated anomaly. Only patients with tracheo-esophageal fistula and ARM had a very poor prognosis in this study.

Conclusion

Associated anomalies are present in more than half of all patients with ARMs as seen in our study. It also highlights the fact that both high and low anomalies are associated with other congenital anomalies and hence all patients with ARM should be investigated to rule out such associated anomalies. All parents should be advised strict follow-up.

Declaration of interest

The Authors declare that there is no conflict of interest.

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