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Variations in the Obliteration of Processus Vaginialis in Indian Children

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Abstract

Background: During the intrauterine life, the testis is located just below the developing kidney within the abdomen. As the testis descends through the inguinal canal and enters into the scrotal sac it is accompanied by a sac like extension of peritoneum known as the processus vaginalis. Once the testis descends completely into the scrotum, the processus vaginalis obliterates under normal circumstances but remains as a fibrous cord without any lumen. However, the most distal portion of it remains as tunica vaginalis sac around the testis with a potential space between the two layers of the sac, the visceral layer around the tunica albugenia of the testis and the parietal layer just beneath the internal spermatic fascia of the scrotal layers. Under certain circumstances, the processus vaginalis does not obliterate and its patency persists. Depending upon its extent of patency and its communication with the peritoneal cavity various anomalies occur. I had an opportunity of working in various Armed Forces hospitals located all over India. As a surgeon I worked in the North- eastern region, western region and the southern region over a period of three decades. During that time I operated upon 778 children of various age groups with persistent processus vaginalis in various forms. In this article I will discuss about the incidence of various variations of processus vaginalis amongst Indian children. *Methods:* The various anomalies of the persistent processus vaginalis observed in the children who underwent surgery in different armed forces hospitals spread all over India, for the same were recorded and analysed. *Results:* The commonest anomaly observed was communicating congenital hydrocele. The rare anomaly was encysted hydrocele of the cord. The other anomalies in order of frequency were congenital inguinal hernia, infantile hydrocele, funicular hydrocele and non-communicating congenital hydrocele. *Conclusions:* One can encounter all types of variations of persistent processus vaginalis with variable frequency in Indian children.

Keywords: Processus Vaginalis; Congenital Inguinal Hernia; Congenital Hydrocele; Funicular Hydrocele; Infantile Hydrocele; Encysted Hydrocele of the Cord.

Introduction

The processus vaginalis is a peritoneal extension into the scrotal sac during the descent of the testis. The testis develops in the abdominal cavity just below the developing kidney during the seventh and eighth week of intra uterine life from the primordial germ cells. At about nine weeks the testis moves across the pelvis to lie at the deep inguinal ring with the help of gubernaculums testis. The processus vaginalis appears at about 13 weeks of development as an out pouching of the parietal peritoneum inside the gubernaculums, surrounded by the mesenchyme. This developing tunnel moves medial and caudal between the internal and external abdominal oblique muscles and into the scrotum. The testis stays at the internal inguinal ring enclosed in the processus vaginalis for 10 to 12 weeks [1,2]. During the next three months of gestation, various factors cause the testis to descend from the abdominal cavity to the scrotum through the inguinal canal. The testis takes a few days to traverse the inguinal canal as the external and deep inguinal rings are almost adjacent to each other. However, testis takes about four weeks to

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migrate from the external ring to the bottom of the scrotum. Once the testis reaches the bottom of the scrotum, the processus vaginalis gets obliterated normally and becomes a fibrous cord without any lumen (3). However, the distal most part of the processus vaginalis remains as a tunica vaginalis sac around the testis with a potential space between the two layers of the sac, the parietal layer and the visceral layer. Thus under normal circumstances, the peritoneal cavity does not communicate with the tunica vaginalis sac. Under certain circumstances, the patent processus vaginalis persists in various forms resulting in various different clinical conditions, ranging from congenital inguinal hernia to non-communicating congenital hydrocele (4). The current study is primarily aimed to study the various forms of persistence of processus vaginalis in Indian children.

Materials and Methods

This study is an observational retrospective study. The author worked in various armed forces hospitals spread all over India in a span of more than a quarter century from 1980 to 2006. During this study period, the author attended 778 children who presented with the various anomalies of patent processus vaginalis. The data was collected as and when the child underwent surgery by the author. In a span of almost twenty six years, a total of 778 children of both male and female sexes underwent surgery. No case was excluded. Even the children presented with the complications like irreducible congenital inguinal hernia or obstructed hernia that underwent emergency surgery, were also included. The sex of the child was recorded. The operative findings with respect to the variation of the processus vaginalis were meticulously recorded. If it is a congenital hydrocele, its status of communication with the peritoneal cavity is recorded. If it is a congenital inguinal hernia, the natures of the contents were also recorded. All the findings were tabulated and analysed.

Results

This retrospective observational study was conducted over a period of almost twenty six years. During this study period, 778 children underwent operative treatment for various congenital variations of persistent processus vaginalis. Of these 730 (93.83%) were male children, while 48 (6.17%) were female children as shown in the Table 1. The right sided variations were 587 (75.45%), the left sided variations were 169 (21.72%) and the bilateral variations were 22 (2.83%) as shown in the Table 2. The various congenital variations of the processus vaginalis noted in the male were, congenital inguinal hernia 604 (82.74%), communicating congenital hydrocele 61 (8.36%), non-communicating congenital hydrocele 16 (2.19%), funicular hydrocele 22 (3.01%), encysted hydrocele of the cord 18 (2.47%) and infantile hydrocele 09 (1.33%) as shown in the Table 3.

Similarly, the variations in the female children were, inguinal hernia 43 (89.58%) and hydrocele of the canal of Nuck 5 (10.42%) as shown in the

Table 4. Regarding the contents of the hernia, in the male the majority of the cases contained omentum 526 (87.08%). The intestine was the content in 75 (12.42%). Appendix was encountered in 3 (0.50%) cases as shown in the

Table 5. In case of female children, omentum was seen in 35 (81.40%), intestine 4 (9.30%), Fallopian tube with ovary was seen in 3 (6.98%) and appendix was seen in 1 (2.32%) cases as shown in the Table 6. The majority of the cases amongst male children 598 (99%), presented without complications and underwent elective operations, whereas six cases (1%) presented with complications in the form of irreducible hernia as shown in the Table 7. Fortunately, no child was presented with incarceration. No female child presented with any complication.

The undescended testis was seen in 26 (4.30%) cases of inguinal hernia. Associated Phimosis was seen in 12 (1.64%) children.

Table 1: Sex ratio of persistent processus vaginalis in Indian Children (N = 778)

Sex	Number	Percentage (%)
Male	730	93.83
Female	48	6.17

Table 2: Laterality of persistent processus vaginalis in Indian Children (N = 778)

Laterality	Number	Percentage (%)
Right	587	75.45
Left	169	21.72
Bilateral	22	2.83

Table 3: Clinical presentation of persistent processus vaginalis in Male Children (N=730)

Clinical Presentation	Number	Percentage (%)
Congenital Inguinal Hernia	604	82.74
Communicating congenital Hydrocele	61	8.36
Non-communicating congenital Hydrocele	16	2.19
Funicular Hydrocele	22	3.01
Encysted Hydrocele of the cord	18	2.47
Infantile Hydrocele	09	1.33

Table 4: Clinical presentation of persistent processus vaginalis in Female Children (N= 48)

Clinical Presentation	Number	Percentage (%)
Inguinal Hernia	43	89.58
Hydrocele of canal of Nuck	5	10.42

Table 5: Contents of Hernia in Male Children (N= 604)

Content	Number	Percentage (%)
Omentum	526	87.08
Intestine	75	12.42
Appendix	3	0.60

Table 6: Contents of Hernia in Female Children (N=43)

Content	Number	Percentage (%)
Omentum	35	81.4
Intestine	4	9.30
Ovary and Fallopian tube	3	6.98
Appendix	1	2.32

Table 7: Complications in Male Children with Hernia (N-604)

Complicated/Uncomplicated	Number	Percentage (%)
Uncomplicated Hernia	599	99
Complicated Hernia	06	1

Table 8: Associated anomalies with persistent processus vaginalis in Male Children (N=730)

Associated Anomaly	Number	Percentage (%)
Undescended Testis	26	3.56
Phimosis	12	1.64

Discussion

The processus vaginalis is a peritoneal extension into the scrotal sac during the descent of the testis. During the intrauterine life, in males the testis develops at the cranial end of the mesonephros and just below the metanephros within the abdomen. It is joined to the area of the future inguinal canal by a continuous column of mesenchyme known as the gubernacular testis. In the abdomen, the gubernaculums forms a well defined ridge, the plica gubernaculi, projecting into the abdominal cavity. As the testis descends through the inguinal canal and enters into the scrotal sac, it is accompanied by a sac like extension of peritoneum, known as the processus vaginalis. This processus vaginalis protrudes just ahead of descending testis to facilitate its descent into the scrotum through the inguinal canal [5,6]. As a result of this, the processus vaginalis is a blind pouch, opening at its cranial end into the peritoneal cavity and lined with coelomic epithelium [7]. Later on, the open sleeve of the processus vaginalis grows longer as the testis moves downwards [8]. Once the testis descends completely into the scrotum, the processus vaginalis obliterates completely in the normal child and becomes a fibrous cord without any lumen. However, the distal most part of the processus vaginalis remains as tunica vaginalis sac around the testis with a potential space between the two layers of the sac, the parietal layer just beneath the internal spermatic fascia of the scrotum and the visceral layer next to the tunica albugenia of the testis. Sometimes, the processus vaginalis does not obliterate and its patency remains leading to various clinical conditions.

The intimate anatomical and chronological relation of testicular descent into the scrotum and the final obliteration of processus vaginalis have led to many speculations, on how the various factors affect processus vaginalis development and its subsequent obliteration on testicular descent [9,10,11].

Multiple theories are proposed regarding the non-obliteration of processus vaginalis. According to one theory, some smooth muscle fibres exist in the processus vaginalis and these fibres keep on contracting and keep the processus vaginalis patent. In fact, the amount of smooth muscle fibres present may correlate well with the degree of patency especially in those children who present with congenital inguinal hernia [12]. This is considered as a result of a halted programmed cell death process and a reason for non obliteration of the processus vaginalis, since the smooth muscle cells are not observed on peritoneal tissue and on obliterated processus vaginalis specimen [13]. Investigations continue to determine the role of smooth muscles in the pathogenesis of congenital inguinal hernia.

According to another theory, hormonal changes cause the processus vaginalis to obliterate only after the complete testicular descent. This normal obliteration is complete in three stages. The first stage includes closure of the deep inguinal ring, and then the part of the processus vaginalis superior to the testis is obliterated. The remaining cavity between these obliterated parts is called the funicular process and is the last to get obliterated leading to disappearance of the processus vaginalis. Once the process of obliteration is complete the portion of the processus vaginalis covering the testis remains as the tunica vaginalis sac with a potential space between the two layers, the parietal layer just beneath the internal spermatic fascia and the visceral layer next to the tunica albugenia of the testis [14].

If there is any condition that increases intra abdominal pressure, there is a delay in the obliteration of the processus vaginalis. In some cases there may be complete non-obliteration of processus vaginalis. However, in our series there was no evidence of increased intra abdominal pressure in any child. The available literature reveals that undescended testis or even cryptorchidism may be associated with congenital inguinal hernia [15]. In our series undescended testis

was noticed in 26 cases (4.3%). We have seen 12 cases of phimosis (1.99) also (Table 8).

The incidence of congenital inguinal hernias is 10-20% per 1000 live births. It is much higher after premature birth. In certain studies, congenital inguinal hernias are 20 times more common in premature infants who weigh less than 1500 grams than in babies born at term. We could not ascertain this fact in our series because of non availability of relevant data.

Hernias are six times more common in boys than in girls. In our series there were 43 girls who presented with congenital inguinal hernia and there were 604 boys who presented with hernias. So it is almost 14 times more common in boys. However, this gross variation may be because, less number of girls are brought to the hospital for treatment in their childhood. Though the incidence of bowel incarceration is more common in females than in males, we did not encounter any girl with bowel incarceration. Even amongst boys also, there were only six cases (1%) of irreducibility. Fortunately there was no evidence of bowel incarceration in any of these cases.

Most congenital hernias and hydroceles are most probably due to idiopathic failure of non-obliteration of processus vaginalis.

More precisely, a completely patent processus vaginalis is the cause of either a congenital communicating hydrocele or an indirect inguinoscrotal hernia. When the funicular process fails to obliterate proximally and communicates with the abdomen, a funicular hydrocele occurs. A funicular hydrocele can lead to formation of an inguinal hernia. When there is a proximally and distally obliterated funicular process with a patent central part, an encysted hydrocele of the cord arises. Complete obliteration of the proximal part of the processus vaginalis coexisting with a partially open processus vaginalis distally results in a non communicating hydrocele. In some cases, the processus vaginalis is obliterated proximally at the level of the deep inguinal ring and the fluid filled processus vaginalis is present distally. It is known as infantile hydrocele. Very rarely, abdomino-scrotal hydrocele results from a communicating congenital hydrocele. The hydrocele continues to enlarge and eventually bulge upwards into the abdomen, causing a fluid filled mass in the abdomen. Hydrocele of the canal of Nuck occurs in girls when fluid accumulates within the patent processus vaginalis in the inguinal canal.

In a study to determine whether a laparoscopically diagnosed patent processus vaginalis is a risk factor for the development of groin hernia, the authors detected 12% of the studied population appeared to have a patent processus vaginalis in adult life [16].

Conclusion

Defective obliteration of the processus vaginalis results in various congenital abnormalities. If there is a persistence of processus vaginalis completely the intra abdominal organ enters the distal portion of the sac resulting in congenital inguinal hernia. If the processus vaginalis persists incompletely, it may result in various types of hydrocele. These various entities require different techniques of surgical intervention. Though the available literature does not reveal the actual incidence of various variations of non-obliteration of processus vaginalis, this present study document the same in Indian children.

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