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The etiology of indirect inguinal hernias: congenital and/or acquired?

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Abstract The development of indirect inguinal hernias in infants is caused by a patent processus vaginalis (PPV). Consequently, this type of hernia is cured by simple herniotomy. In adults, however, herniotomy alone is accompanied by a high recurrence rate. This indicates that additional factors play a part in the development of indirect inguinal hernias in adults. The aim of this study was to determine the etiology of the development of an indirect hernia in adult life. Also, the prevalence of a PPV without clinical evidence of a hernia was determined and related to age. From November 1998 until February 2002, 599 patients from four different teaching hospitals, who underwent abdominal laparoscopy for various pathologies, were included. During laparoscopy, the deep inguinal ring was bilaterally inspected. Patients undergoing laparoscopy for inguinal hernia repair were excluded. Mean age was 45 years (range 8–89 years). Thirty-two percent (189/599) were male. Twelve percent (71/599) had PPV, all without clinical symptoms. Fifty-five percent (39/71) with PPV were male ($P < 0.0001$). Fifty-nine percent (42/71) with PPV were right-sided, 29% (21/71) with PPV were left sided, and 12% (8/71) were bilateral ($P = 0.01$). The prevalence of PPV in patients under 20 years was 22%. Of those between 20 and 30 years of age, 6% had PPV. Of those between 30 and

50 years, 24 patients (11%) had PPV. Of patients over 50 years, 33 (14%) had PPV. No significant differences between ages were observed. It is concluded that asymptomatic patent processus vaginalis frequently exists in adult life. The prevalence of PPV does not increase significantly with age. Assuming that indirect hernias start with asymptomatic peritoneal protrusion that can be observed laparoscopically, the incidence of PPV, like the incidence of adult indirect hernias, should increase in case of acquired etiology. Such an increase of incidence with age was not confirmed by our results. It is concluded that the etiology of indirect inguinal hernia in adults, as in infants, is congenital.

Keywords Etiology · Indirect · Inguinal · Hernia

Introduction

Since ancient times it has been well known that simple herniotomy is the cure for inguinal hernias in infants [1]. Indirect hernias develop from incomplete obliteration of the processus vaginalis, the embryological protrusion of peritoneum that precedes the descent of the testes. The testes originate along the urogenital tract in the retro-peritoneum and migrate during the second trimester of pregnancy to the deep inguinal ring, where they arrive after 6 months of gestation. During the last trimester, they proceed through the abdominal wall via the inguinal canal and descend into the scrotum, the right testis slightly later than the left [2]. Normally the processus vaginalis postnatally obliterates. Failure of this process results in a patent processus vaginalis (PPV) and possibly in an indirect inguinal hernia.

The (scrotal) indirect hernia in adults is anatomically identical with that of an infant. This supports the congenital etiology of indirect hernias. Additional support is represented by autopsy findings that 15–30% of adult males without clinically apparent inguinal hernias have patent processu vaginales at death [2, 3].

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However, mere herniotomy for adult indirect inguinal hernias results in a high rate of recurrence [2]. This indicates that additional factors play a role in the development of indirect inguinal hernias in adults.

The aim of this study is to determine the etiology of indirect inguinal hernias in adult life. Especially, the prevalence of PPV in the adult population is studied.

Patients and methods

From November 1998 until February 2002, 599 consecutive, both male and female, patients in four different teaching hospitals, who underwent transperitoneal abdominal laparoscopic procedure, were included. During laparoscopy, the deep inguinal ring was bilaterally inspected. Patients who underwent laparoscopy for inguinal hernia repair or were known to have had hernia repair bilaterally were excluded.

During operation, a PPV was identified as a peritoneal protrusion at the side of the deep inguinal ring. Two types of protrusion were defined: grade 1: a dimple without hernial sac (Fig. 1) and grade 2: a larger defect with a hernial sac (Fig. 2). When a PPV was found, it was recorded on video or photographed.

The statistical analyses used were the Fisher exact test and the chi-square test.

Results

Mean age was 45 years (range 8–89 years). Thirty-two percent of the population was male. Main indications for laparoscopy were cholecystectomy (49%), appendectomy (20%), and diagnostic laparoscopy (22%). Other indications were adhesiolysis, gastric banding, bowel resection, placing CAPD catheters, Nissen fundoplication, and repair of incisional hernias.

In the case of laparoscopic gastric banding, the deep inguinal rings of the patients were very difficult to identify because of the intraperitoneal fat, resulting in exclusion of these patients afterwards.

Twelve percent of patients had patent processu vaginalis, all without clinical symptoms. Fifty-five percent

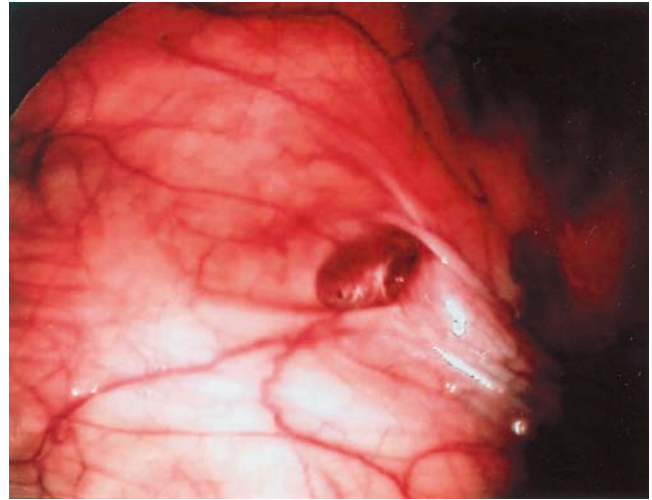


Fig. 2 Grade 2 patent processus vaginalis with hernial sac

were male. Thirty-nine out of 189 (21%) of the male population and 32/410 (8%) of the female population had a PPV ($P < 0.0001$).

PPV was located on the right side in 59% of patients, 29% on the left side, and in 12% it was bilateral ($P = 0.01$). These results are shown in Tables 1, 2, and 3. In most cases (95%), we found grade two protrusion of the peritoneum. Because of adhesions or intraperitoneal fat in 33 patients, the deep inguinal ring was not visualized on either side. In nine patients, only unilateral evaluation was possible; in four patients, only the right side, and in five patients only the left side could be visualized. The prevalence of PPV related to age is shown in Table 4 and Fig. 3. Of patients under the age 20, 22% had PPV. Of those between 20 and 30 years of age, 6% had PPV. Of those between 30 and 50 years of age, 24 patients (11%) had PPV. In patients over 50 years of

Table 1 Patient demographics

Studied population	
Mean age	45.0 years
Male	189/599 (32%)
Female	410/599 (68%)
Internal ring invisible	42/599 (7%)

Table 2 Patient demographics of patients with patent processus vaginalis

Patients with patent processus vaginalis	
Mean age	46.5 years
Male	39/71 (55%)
Female	32/71 (45%)
Right side	42/71 (59%)
Left side	21/71 (29%)
Bilateral	8/71 (12%)
Male population	39/189 (21%)
Female population	32/410 (8%)

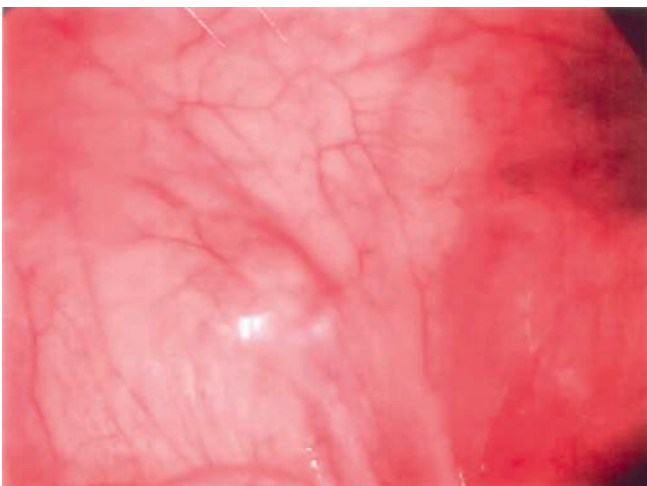


Fig. 1 Grade 1 patent processus vaginalis without hernial sac

Table 3 Patients with PPV

	With PPV	Without PPV	Total number of patients
Male	39	150	189
Female	32	378	410
Right side	46	516	562
Left side	25	536	561

PPV = patent processus vaginalis

Table 4 Patent processus vaginalis (PPV) related to age

Age	Number of PPV	Total studied population	PPV in studied population (%)
0–10 years	0	1	0
10–20 years	8	37	22
20–30 years	6	101	6
30–40 years	13	117	11
40–50 years	11	100	11
50–60 years	14	92	15
60–70 years	11	82	13
70–80 years	7	52	13
80–90 years	1	15	6
90+ years	0	0	0

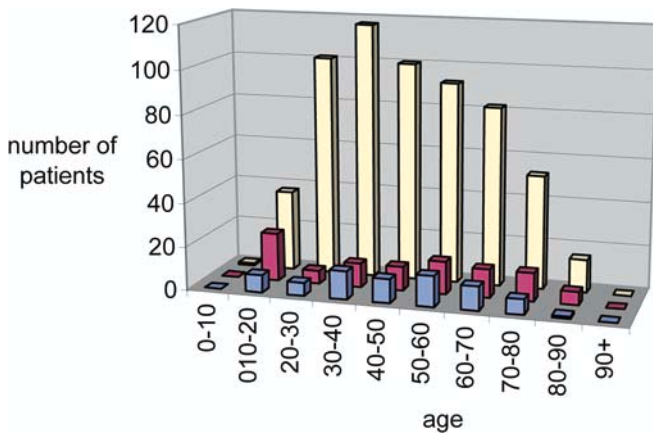


Fig. 3 Patent processus vaginalis (PPV) related to age. Blue number of PPV; red % PPV; yellow total number of patients

age, 33 (14%) had PPV. The percentage decreases again after 80 years of age (6%). No significant differences between ages were observed (chi-square test).

When analyzing only men with PPV, no significant differences in relation to age were shown either.

Discussion

Results from this study show that patent processi vaginales without clinical symptoms are a regular phenomenon in the general population. It also demonstrates that a PPV exists at all ages without significant difference concerning prevalences. Furthermore, as in the case of the inguinal hernia, males are significantly more often

affected than females, and, in addition, there are significantly more PPVs on the right side than on the left.

Thumbe et al. have shown that in adults with an inguinal hernia, a contralateral patent processus vaginalis can progress into a hernia if left untreated [4]. This could be expected as inguinal hernias are more common in males and occur more frequently on the right side, as well as PPVs.

The difference between gender can be found in the shape of the pelvis. Males have a low pubic arc with a relatively narrow pelvis. This is associated with a narrower origin of the external oblique muscle from the lateral inguinal ligament. Consequently, there is a shorter inguinal canal, and the deep ring may be unclosed by the internal oblique muscle. The canal may be so short that the shutter mechanism cannot be operative. African people have lower pubic arcs than Europeans and have a yet higher incidence of inguinal hernias [2].

In our study, we found that PPV in adult life occurs more frequently on the right side. This has also been shown in newborns; Mitchell found that in dissections of newborns, the processus vaginalis was patent on the right side in 70% of cases at birth, compared to 60% on the left [5].

Higher incidence of PPV on the right side can be explained by the fact that during fetal life, the descent of the testes down into the scrotum guided by the processus vaginalis is finished on the left side before the right. Only after descent of the testes into the scrotum, does the processus vaginalis close. The reason for this asymmetrical descent is unknown [2, 6].

In most people, the processus vaginalis closes during the first 2 years of life [6]. In this study, 12% of the studied population had a patent processus vaginalis in adult life. This percentage is much higher than the number of hernia repairs performed. It is likely that more factors than a PPV alone are needed to develop an indirect inguinal hernia. Coughing, straining, weight lifting, and other daily life activities generate high abdominal pressures. Yet the deep inguinal ring and the transversalis fascia maintain their integrity in most individuals (even in those with patent processi vaginales). This is attributed to the physiologic “shutter and sphincter mechanisms,” which are activated when abdominal muscles contract and increase abdominal pressure. At the medial margin of the deep inguinal ring, the fascia transversalis is condensed into a U-shaped sling (interfoveolar ligament of Hesselbach), representing the functional basis of the shutter mechanism; as the transverse abdominal muscle contracts, the limbs of the interfoveolar ligament are pulled together, drawing the spermatic cord upwards and laterally. As a consequence, the obliquity of the inguinal canal is increased, prohibiting protrusion of the peritoneum through the inguinal canal [3, 7, 8]. Reconstruction of the shutter mechanism is the objective of anterior inguinal hernioplasty.

It is also believed that the change of humans from quadrupedal to bipedal locomotion has opened up and stretched the groin region. This change to upright po-

sition brought alterations in the functional anatomy of man, such as reduction in mechanical efficiency of the shutter mechanism. Furthermore, in the upright posture the inguinal canal is subjected to gravity [3]. These may be significant factors causing weakening of the transversalis fascia and, subsequently, the development of groin hernias. In 1804, Cooper stated raised intra-abdominal pressure by cough, prostatism, constipation, pregnancy, obesity, and heavy lifting facilitates the development of inguinal hernias. However, recent studies show that cigarette smoking, coughing, long-term heavy labor, and diseases associated with abnormal collagen production (and abdominal aortic aneurysm) play a role in the development of groin hernias [9, 10]. Weight lifting, prostatism, and obstipation have not proven to be risk factors for the development of hernias.

It is possible that with aging, the shutter mechanism loses its ability because of weakening of the abdominal muscles. This could explain the increase in indirect hernias with increasing age [2] and indicates that a PPV is congenital and will only develop into an indirect inguinal hernia after weakening of the abdominal muscles.

On the other hand, as shown in our study, the prevalence of PPV is not significantly different among different ages. During life, many people will be operated on because of indirect inguinal hernias. Despite these people with their processus vaginalis closed, there is no decrease in prevalence of a PPV with increasing age. This observation argues for the theory that a PPV can possibly develop "de novo."

Further research needs to be done. A long-term follow-up of the persons in this study is needed, first of all to determine the percentage who will develop an indirect inguinal hernia with a PPV. Are there other factors facilitating the development of these hernias, such as smoking and coughing?

Second, a follow-up of the people with a closed processus vaginalis should seek to find out if they develop groin hernias. If so, are these hernias direct or indirect? If these people develop an indirect hernia, there will be proof that a PPV can be acquired.

In conclusion, asymptomatic patent processus vaginalis frequently exists in adult life. The prevalence of PPV does not increase significantly with age.

Assuming that indirect hernias start with asymptomatic peritoneal protrusion that can be observed laparoscopically, the incidence of PPV, like the incidence of adult indirect hernias, should increase in case of acquired etiology. Such increase of incidence with age was not confirmed by our results. It is concluded that the etiology of indirect inguinal hernia in adults, as in infants, is congenital.

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