Journal of Pediatric Surgery (2006) **41**, 980–986

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Journal of Pediatric Surgery

www.elsevier.com/locate/jpedsurg

Six thousand three hundred sixty-one pediatric inguinal hernias: a 35-year review

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Index word:
Pediatric inguinal hernia

Abstract

Purpose: This study, by its mere size and uniformity (1 pediatric surgeon), aims to corroborate or refute the teachings and myths of the pediatric inguinal hernia.

Methods: From July 1969 to January 2004, 6361 infants and children with inguinal hernias were seen, operated on, and followed by the senior author. A retrospective survey of their charts was carried out to evaluate the demographics and clinical aspects of these patients. The hospital's research ethics board approved of this study.

Results: The ages ranged from premature to 18 years (mean age, 3.3 years) with a male-to female ratio of 5:1. There were 59% right, 29% left, and 12% bilateral hernias (almost all indirect). Hydroceles were found in 19%. Incarceration occurred in 12%. A modified Ferguson repair was used. An opposite-side hernia developed in 5%, 95% within the first 5 years, and was not sex or age specific. There were 1.2% recurrences, 96% within 5 years. Thirteen percent had ventriculo-peritoneal shunts, 1.2% wound infections, and 0.3% testicular atrophy. There were no postoperative deaths. One percent had a documented hernia disappearance.

Conclusions: Three of our results have not corresponded with previous teachings and myths: (1) a hernia of a premature baby should be fixed sooner than later; (2) routine contralateral groin exploration is not indicated in any situation; and (3) teenage recurrence rate is 4 times greater than the overall series.

The inguinal hernia is the commonest defect the pediatric surgeon performs surgery on and is usually indirect. It is believed that these hernias rarely go away, and therefore, virtually all should be repaired. Much has been written about this condition, but the controversy on different aspects of it still exists. This study, by its mere size and uniformity (1 pediatric surgeon), aims to corroborate or refute previous teachings and myths about pediatric inguinal hernias. This is the largest and longest series by 1 pediatric surgeon so far in the literature.

1. Materials and methods

From July 1969 to January 2004 (35 years), 6361 infants and children (average, 182 per year) with inguinal hernias were seen, examined, and operated on by the senior author. The hernias in this series did not include the ones usually found with undescended testes, although some boys did require an orchidopexy with their hernia repair (usually incarcerated).

Presented at the 37th Annual Meeting of the Canadian Association of Paediatric Surgeons, Quebec, Canada, September 22-25, 2005.

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0022-3468/$ – see front matter © 2006 Elsevier Inc. All rights reserved.
doi:10.1016/j.jpedsurg.2006.01.020

All the patients who had surgery were operated on by the same pediatric surgeon with his residents. The operative repair (all under general anesthesia) was the same throughout the series: skin crease incision, modified Ferguson repair [1], absorbable sutures, external oblique and ring opened, high suture ligation of twisted sac doubly tied, and as much of the distal sac/hydrocele as safely possible removed. The closure was in layers, with a subcuticular suture for skin. A Bassini repair was done to fix a direct hernia or weak posterior wall, to close (female) or tighten (male) the internal ring, and similarly, if there was a sliding hernia and therefore not a high ligation of the sac. Almost all hernia repairs were done as outpatients (day surgery) except for premature babies ("premies") younger than 50 weeks' gestation and those with medical problems that required overnight admission. All of the patients were followed postoperatively by the senior author for 1 month to 1 year (mean, 6 months) until the operative area had returned to normal.

A retrospective review of their records was done. The data for each patient were filed into a computer program. The variables evaluated were age, sex, type of inguinal hernia, presence of an associated hydrocele and/or cord lipoma, side of hernia, incarceration, obstruction, strangulation, occurrence of opposite-side hernia, recurrence, and other associated complications and conditions. This study had the approval of the research ethics board of the Hospital for Sick Children (HSC).

2. Results

The ages of the infants and children at the time of operation ranged from premature (<36 weeks) to 18 years (mean, 3.3 years). There were 5343 (84%) males and 1018 (16%) females (ratio, 5:1) with 59% right, 29% left, and 12% bilateral inguinal hernias. Eighty-nine (1.4%) patients were from a set of twins. Premies (<36 weeks) with hernias totaled 191 (3%); 179 were males and 12 were females; 39% had hernias on the right side, 26% on the left, and 35% had bilateral hernias. Most premie hernias were large, with bowel extending into the scrotum (large scrotal bowel hernia). There were 143 (2%) teenagers from 13 to 18 years, 118 boys and 25 girls; 57% of the hernias were on the right, 36% on the left, and 7% were bilateral. The youngest patient with hernia was a newborn; the smallest, 800 g; the oldest, 18 years; and the heaviest, 78 kg. Indirect inguinal hernias totaled 99%, whereas only 1% was direct. Twenty-four (0.4%) patients (including those with a pantaloon hernia) had both indirect and direct hernias on the same side, whereas only 3 had bilateral indirect and direct hernias. There were 146 (2.3%) Bassini repairs, and 2 required a LaRoque procedure (laparotomy) to repair the hernia [1].

Hydroceles were present in 19% (70% scrotal, 26% cord, and 4% both). Eight females had the equivalent of a cord hydrocele (cyst of the canal of Nuck). Most (60%) of the hydroceles were right-sided, 33% left-sided, 7% bilateral, and 4 were abdominoscrotal. The largest scrotal hydrocele had 500 mL of fluid (18 years). Only 2 teenaged boys required reoperation for a nonresolving large scrotal hydrocele after inguinal hernia repair 1 year before. At reoperation, they did not have a recurrent inguinal hernia as was thought. A few boys presented with an acute symptomatic large scrotal hydrocele (as part of a complete fluid hernia), which required fairly urgent surgery. Four percent of patients had a cord lipoma found during operation (48% right, 45% left, and 7% bilateral).

Incarceration (previous or irreducible) occurred in 12% of infants and children, (88% boys, 12% girls, with 74% right, 23% left, and 3% bilateral). The incarceration rate was 12% for boys and 9% for girls. Mean age at incarceration was 1.5 years compared with the overall mean, 3.3 years ($P < .01$). Eight percent of the 743 incarcerated hernias were irreducible and required emergency operation, but only 0.1% were clinically obstructed from the incarceration, and only 2 infants needed a bowel resection at the same time as their incarcerated hernia was repaired. Although the incidence of incarceration in premies was more than 3 times greater (39%), the incidence of incarceration in teenagers was one half the average at 6%. Opposite-side hernias had a 9% incarceration rate.

The first 235 (4%) patients had routine contralateral exploration, of which 88% had a hernia; there were 29 (12%) negative groin explorations—20 left and 9 right. After this, of the remaining 6126 hernia repairs, 316 (5%) developed a hernia on the opposite side; 86% were in males, 14% in females, 2% in premies, and 6% in teenagers (all boys). The mean age of the patient with an opposite-side hernia was 1.4 years. More than half (57%) of these opposite-side hernias appeared within 1 year of the original hernia repair, 95% by 5 years, and 100% by 10 years.

There were slightly more opposite-side hernias on the left side (53%) than the right (47%). Four percent of patients with a hernia repair on the right side later developed a hernia on the left side, and 8% of patients with a hernia repair on the left side later developed one on the right side. Age did not make a difference. Five percent of all male patients in this series and 4% of female patients developed an opposite-side hernia, and 9% were incarcerated. A boy with a hernia on the right side had a slightly greater than 1 chance (56%-44%) of developing an opposite-side hernia. On the other hand, a girl with a hernia on the left side had a 2 to 1 chance (66%-34%) of developing an opposite-side hernia. In all cases, age did not make a difference.

There were 84 (1.2%) recurrences, of which 97% were males and 3% females. The initial hernia operation of 20 (0.3%) of these recurrences was done by the senior author, but he repaired all of the recurrences. The mean age of the recurrence was 5.5 years compared with the overall mean, 3.3 years ($P < .01$). Of these recurrences, 56% were on the right, 40% on the left, and 4% were bilateral. The

recurrences occurred in 1.2% of all right-sided hernias, 1.6% of the left, and 0.4% of bilateral repairs. The incidence of recurrences in our premature patients was zero and in teenagers 5%. Three percent of all of our recurrences (5-7 years of age) had a previous incarceration. Fifty-four percent of the recurrences occurred within 1 year of the original hernia repair, 96% by 5 years, and 100% by 10 years. Nine (10%) of the 84 recurrences also had a ventriculo-peritoneal (VP) shunt compared with the overall recurrence rate of 1.2% ($P < .01$). One of the recurrences had Ehlers-Danlos syndrome. No recurrent inguinal hernias, once repaired, recurred again.

Ninety-two (1.4%) patients had VP shunts, of which 89% were males and 11% females; 34% were on the right, 36% on the left, and 30% bilateral. Their mean age was 5.5 years. There was no history of incarceration in any VP-shunt patient. Five (5%) of the 92 developed opposite-side hernias. There were 9 (10%) recurrences compared with the overall recurrence rate of 1.2% ($P < .01$).

An orchidopexy was also necessary in 65 (1%) of the boys having their hernia (symptomatic or incarcerated) repaired, 57% on the right and 43% on the left. Overall, 30 (0.5%) boys required a secondary orchidopexy because the testicle ended up out of the scrotum after the hernia repair. Sixty-three (1%) children (mostly boys, usually older than 3 years) also had their umbilical hernia concomitantly repaired.

In 28 (0.4%) boys, the vas deferens was absent; 2 were bilateral and also had cystic fibrosis (CF). Twenty-five percent of boys with an absent vas also had an absent ipsilateral kidney (all but 1 were on the left side). Four vasa (0.06%) were accidentally injured: 2 were cut (repair of an acute testicular torsion thought to be an incarcerated hernia and a large hernia of a patient aged 2 1/2 years); 2 were torn (1 large hernia of a patient aged 18 months and 1 hernia of a patient aged 2 months). None were repaired at the time of the injury.

During the same 35-year period, 20 (11 boys and 9 girls) had a femoral hernia repaired, 2 of which were first mistakenly operated on as indirect inguinal hernias. When their hernia lump recurred (actually persisted), the diagnosis of femoral hernia became obvious.

There were 25 (0.5%) sliding hernias (cecum, appendix, and sigmoid colon) in boys, 15% (ovary) in girls, and 2 (bladder) in both. All sliding hernias were uniformly treated with as high a ligation as possible and then closure (or snugging up) of the internal ring (modified Bassini repair). Seventy-six percent of the ovaries found at hernia repair were in females younger than 2 years. There were 4 girls (3-8 years old) who had large labial lipomas (presenting as an indirect inguinal hernia) excised. In this series, only 2 ovaries were infarcted (strangulated) at operation and were not removed. Seventy-nine (0.02%) hernias had omentum in the sac at operation (almost all were boys), mostly left-sided, nearly always incarcerated, and most were older than 5 years. There were 6 pantaloon hernias, 2 Meckel's (Littré hernia), and 8 appendices in the hernia sac, 1 of which was ruptured and presented as an incarcerated inguinal hernia in a 10-month-old premie. The appendices not stuck in the hernia sac (such as loops of bowel and VP-shunt tubing) were left alone and pushed back into the peritoneal cavity before routine high ligation of the sac. There were 6 boys who had a left varicocele found along with an inguinal hernia on the same side. Four intersex patients (testicular feminizing syndrome) were diagnosed, 3 in the operating room and 1 clinically. There were 2 other girls (1 operated on and 1 not) with bilateral inguinal hernias with 2 palpable ovaries who did not have testicular feminizing syndrome when tested. Four epididymal cysts were found during hernia operation, and there was chyle noted in 3 hernia sacs. Three children also had a tumor present with their inguinal hernia: 2 boys with a paratesticular and testicular dermoid and a girl with a metastatic rhabdomyosarcoma diagnosed as an incarcerated inguinal hernia. All of these tumors were resected, and the hernia was repaired. There was only 1 hernia in a bladder exstrophy (female) patient.

During this 35-year period, 1 boy did not have a hernia found during operation, despite being seen and examined preoperatively by the senior author. It is speculated that the groin lump (swelling) seen preoperatively by the mother (a nurse) must have been a retractile testicle, and the cord was felt to be thickened by the examiner. Ninety-four (1.5%) patients did not have an operation because the hernia disappeared in 73 (1%) (by history and examination), and the rest (21) (0.3%) were lost to follow-up. These 94 infants and children were not included in the overall total of 6361 patients. There was a 1.2% wound infection rate (mostly staphylococcus), and 16 (0.3%) testicles were atrophic at follow-up (50% postincarceration). There were 245 (4%) patients operated on who also had another medical condition and pathology. No deaths related to the hernia repair occurred during this 35-year series.

3. Discussion

Although larger series of pediatric inguinal hernias have been reported (meta-analysis, 15,000 Miltenburg et al [2]; 1 service, 8000 Gross [3]), this is the largest and longest series to date by 1 pediatric surgeon who scrubbed on all of the repairs with his residents. These 6361 inguinal hernia operations (average, 182 per year) comprised 26% of the senior author's more than 23,000 pediatric surgical procedures for more than 35 years from July 1969 to January 2004. No patient with hernia was operated on because of history alone.

The incidence of a pediatric inguinal hernia reported throughout the literature has ranged between 0.8% and 4.4% with 30% in premies. The male-to-female ratio of 5:1 noted in this article agrees with that quoted in the literature (3:1 to 10:1), as does the higher incidence of right-sided occurrence [1,3-9]. Our indirect hernia rate of 99% also agrees with the

thinking that the pediatric inguinal hernia develops from a continued patency of the processus vaginalis into the inguinal canal rather than a fascial defect of the posterior wall (direct space) as in adults [4]. This is further reinforced by the 19% rate of associated hydroceles in this series. The presence of 60% hydroceles on the right, 33% on the left, and 7% bilateral mirrors the distribution of the hernias and further emphasizes their common embryology [3,4]. Most of the hernias in this series occurred in the younger patients. There were more than 2000 hernias in infants younger than 1 year, more than 3000 in children younger than 2 years, and almost 5000 in children younger than 5 years.

Throughout the pediatric inguinal hernia literature, the terms *funicular process* (blind peritoneal sac), *patent processus vaginalis*, and *hernia sac* are used interchangeably [4,9-11]. From the beginning of his practice, the senior author made the following clarifications: a funicular process is a tiny protrusion of peritoneum barely into the proximal inguinal canal only seen by opening up the internal ring and is not a hernia; a patent processus vaginalis is a small indirect inguinal hernia sac (some say it has to be >2 cm long [10]), which is not clinically evident.

During this 35-year series, an average of 10 infants and children per year were also seen with hernias that were lost to follow-up (1 per year), disappeared (2 per year), or were false alarms (7 per year). Although several authors [7,9] have stated that "an inguinal hernia does not resolve spontaneously," we observed a small number (2 per year, 1%) of clinically evident inguinal hernias that did indeed disappear by follow-up, history, or examination. If the parents reported that the hernia (previously seen, examined, and diagnosed by the senior author) had disappeared between the time of diagnosis and scheduled surgery, the child was reexamined by the senior author, and if he could no longer confirm the presence of the previously diagnosed hernia, the operation was cancelled. In such cases, the theory we agree with states that the inguinal hernia sac can and rarely does become fused and obliterated [4,10]. The 7 infants and children per year who presented with "false-alarm hernias" were classified into 3 distinct groups: (1) lumps and hydroceles by history, but not confirmed by examination; among this small group were a few thin (and usually older) children who presented with groin bulges on coughing that were not considered to be hernias at the time and did not become hernias in follow-up; (2) groin pain usually in older children with a negative examination; (3) lymphadenopathy. One female infant had what was thought to be an incarcerated ovary in an indirect inguinal hernia mistakenly operated on only to find an inguinal lymph node abscess that required incision and drainage. Ultrasonography may have helped to differentiate the two. All of the previously mentioned infants and children were not included in the overall total of 6361.

All hernia repairs were carried out under general (usually endotracheal) anesthesia. The senior author requested intubation and no nitrous oxide if there was a large scrotal bowel hernia. If caudal analgesia was not used at the beginning of the operation for intraoperative and postoperative pain relief (the anesthesiologist's decision), a 0.5% bupivacaine 0.4 mg/kg (without epinephrine) block of the iliohypogastric and ilioinguinal nerves (beneath the external oblique and lateral to the internal ring) was carried out before the external oblique fascia was closed [12]. The success rate of this local anesthetic block (reported to the senior author by the recovery room nurses) was about 65%. Acetaminophen (or a nonsteroidal antiinflammatory medication) was used for postoperative pain relief at home, with liquid codeine added for those older than 3 years or >15 kg body weight [13].

Postoperative infection in the inguinal hernia repairs in this series was very unusual (1.5%) and seldom problematic. A stitch abscess(es) in the subcuticular skin closure was a "complication, although minor (which) may require additional postoperative wound care, can lead to a poor cosmetic result and causes the children and their parents needless anxiety [14]." There are only 2 articles in the pediatric surgical literature [14,15] that address this common problem. Surprisingly, Nagar [15] describes only 15 stitch abscesses in 2447 pediatric inguinal hernias and states: "all patients responded well to incision and drainage. Stitch granuloma appears to be associated with male herniotomy, emergency surgery, and use of silk sutures." Our incidence of stitch abscesses was much higher, but seldom required incision and drainage. They occurred equally throughout the series (male, female, elective, emergency) despite only absorbable sutures being used. To avoid this common occurrence, the senior author tried steristrips but found this inconvenient and messy. Unfortunately, the solution to the problem ("the L-stitch" [14]) did not present itself in the literature until mid-2003, 6 months before the series ended. Its use eliminated the need for "the initial and finishing knot of a running suture" [14] and this problem disappeared.

Only once was a patient operated on the wrong side. Fortunately, there was a definite indirect inguinal hernia present and the error was recognized before the anesthetic was ended, and surgery was performed on the so-called correct side and its hernia was also repaired. This unfortunate happening was only discussed in one other article in the literature [11] and can be avoided by marking the side with the hernia before the operation begins.

The percentage of patients followed until the operative area returned to normal (1 month to 1 year; mean, 6 months) was virtually 100%. No attempt at a longer follow-up was made; however, it was expected that if there was a new long-term problem, the patient would return to the original surgeon. This seems to be the best that can be achieved under the circumstances. Suffice it to say, in Toronto (population, 3 million) and Ontario (10 million), the referral patterns and patient base are mostly related to HSC. Moreover, if 1 of the original patients were operated on elsewhere, more often than not, that information would be transmitted to the HSC surgeon.

There seems to be a concensus that a newborn asymptomatic (so-called pure) scrotal hydrocele (no evidence of associated hernia) will usually spontaneously disappear when the patient reaches 1 to 2 years of age [3,8,9,13,16]. This was also the policy of the senior author. Boys with the late onset of a scrotal hydrocele were considered to have an accompanying hernia and were treated as such. On the other hand, there is debate in the literature about cord hydroceles and whether they are associated with an indirect inguinal hernia or not [4,16]. The senior author has always considered a cord hydrocele to be consistent with an indirect inguinal hernia, and it was treated as such even if the cord hydrocele disappeared before operation usually leaving a thick cord. At operation, this always turned out to be the case, and, as such, all cord hydroceles were excised as part of the indirect inguinal hernia sac. Furthermore, as much of the scrotal hydrocele sac as possibly was safely excised. Occasionally, if very large, the remainder of the sac was sewn (inside out) around the cord (bottling). The senior author agrees with Gross [3] who felt that this probably does not make a difference in postoperative swelling or recurrence of the hydrocele. Nonetheless, the previously mentioned intraoperative attention to the scrotal hydrocele must have been of some value because only 2 teenaged boys with a large postoperative recurrent scrotal hydrocele required reoperation after 1 year. Neither had a recurrent hernia, prompting one to suggest that in such cases, a scrotal approach may be appropriate. On the other hand, cord lipomas were about equally distributed between the right and left sides.

The finding of 39% hernias on the right, 26% on the left, and 35% bilateral in our 191 premies agrees with the common belief that premies have a higher incidence of bilateral inguinal hernias than nonpremature patients do [9,17]. All premature hernias were electively repaired after 50 weeks' gestation (as an outpatient procedure), unless there was a history of continuing symptoms or incarceration. If the baby was younger than 50 weeks' gestation and required repair (always under general anesthesia), he/she was admitted postoperatively for 24 hours and monitored on an apnea monitor in a constant care setting [18,19]. At the other end of the spectrum, however, the demographics of the 143 teens were more consistent with those of the overall series (mostly boys, mostly right-sided, and 7% bilateral).

At least 25% of the infants and children in this series had symptomatic inguinal hernias, mostly in the younger age group. Incarceration occurred in 12% at a mean age of 1.5 years, mostly in boys and mostly on the right side. Although most of these symptomatic patients with incarcerated hernia match the demographics of the overall series, the mean age of the patient with incarcerated hernia (1.5 years) was 50% younger than the series mean age of 3.3 years. Moreover, the 9% incarceration rate of females in our series was less than the 17% reported by Rowe and Clatworthy [20] in their large review. Our premie incarceration rate (39%) also does not agree with other authors who claimed that their premature incarceration rate was close to their older patients (13% [21] and 17% [22]). It is speculated that a possible reason for our higher premature incarceration rate is because of the finding that many of our premie hernias were of the large scrotal bowel variety. Our younger premature incarceration mean age of 1.5 years equaled that of Rowe and Clatworthy [20] in their series. The 2 previously mentioned findings (higher incarceration rate and at a younger age) suggest that once a premature baby has a hernia diagnosed, it should be fixed sooner than later [23].

In 1969, the senior author started his practice with a routine contralateral exploration of the opposite side, as was the practice in the 1960s. In this article, the word "contralateral" only applies to the routine "contralateral exploration" of the other groin at the same time as the original hernia repair. However, after the first 235 cases (4%), it became apparent that the findings of a significant contralateral sac precluded this part of the procedure, unless the parents gave a history suspicious for a hernia on the opposite side or there were enough clinical findings to warrant a contralateral exploration. These were the same conditions set forth by Gross [3] in 1953. Throughout this series, a hernia on any side was considered to be present if a sac (processus vaginalis) regardless of size was found in the inguinal canal without opening up the internal ring. However, the question has been raised whether this sac, especially in contralateral explorations, would ever become clinically evident. Rowe et al [10] concluded that the processus vaginalis obliterates in the perinatal period up to a few months in about 40%, and by 2 years of age in 60%, after which age, its closure, or obliteration is unlikely to occur. Others [4] have said that about half of the residual 40% patent processus vaginalis may become clinically evident during its lifetime. That means that 20% of children older than 2 years will develop an inguinal hernia sometime in their lives, but the remaining 20% will live out their lives with a patent processus vaginalis that never becomes clinically evident [10]. Gray and Skandalakis [4] reported that at autopsy, only 5% of adults have a patent processus vaginalis, which was never clinically apparent. Using the figures from this series, one can speculate that by subtracting the positive contralateral groin explorations (88%) from the postoperative occurrence of an opposite-side hernia (5%), it seems apparent that as high as 83% of opposite-side hernia sacs remain clinically dormant for most of one's life, especially because 100% of our opposite-side hernias occurred within 10 years of the original. Although the total number of opposite-side hernias (316) was almost equally divided between left (53%) and right (47%), our findings showed an 8% incidence of an opposite-side hernia occurring on the right after 1 was fixed on the left side. The male-female (5% and 4%) and right-to-left ratios (55% and 45%) were almost equal, and the opposite-side hernias were not age specific (from premie to teenager). Although our series showed that a girl with a hernia on the left side had a 2 to 1 chance (66%-34%) of developing an opposite-side hernia on her right side (which

was not age related), the fact that only 4% of girls ever developed an opposite-side hernia leads us to conclude that routine contralateral groin exploration is not indicated. Much controversy about contralateral exploration pro and con continues to exist from many authors [3,7-9,13,16,24-27]. Lloyd and Rintala [9] reviewed 8 reports with a contralateral hernia incidence from 1% to 34% with an overall average risk of 10% to 15%, still 2 to 3 times more than in our series that totaled more hernia repairs than all the previously mentioned series combined. Furthermore, Lloyd and Rintala [9] reviewed all of the parameters mentioned in our (and others') series (age, side, sex, and patency of processus vaginalis) and concluded, "...at least 5 out of 6 explorations are unnecessary." Nonetheless, in 2 (1996, 2004) hernia surveys of the Section on Surgery of the American Academy of Pediatrics [13,28], contralateral explorations in infants were still frequently performed, and the commonest reasons given were prematurity and the female left inguinal hernia. In our patients, neither of these 2 groups had any clinical reason to warrant contralateral exploration. Furthermore, our VP-shunt patients had the same opposite-side hernia occurrence of 5% as the overall group, which is much lower than reported elsewhere (20%-40%) [29,30].

The recurrence rate in our series (1.2%) falls between other reports of 0% and 3.8% [3,7-9,11,16,30,31]. Once again, in our series (as with the development of opposite-side hernias), more than 50% of the recurrences were noted within the first year after the original repair and 96% by 5 years. As with reports in the literature, our incidence of recurrence after an incarcerated hernia was repaired (3%) was also elevated. Similarly, our VP-shunt patients also had more recurrences (10%). The senior author believes that his 20 (0.3%) recurrences (one fourth of our reported total) were because of the dissolvable suture used for the high ligation of the sac dissolved too early, whereas most of the remaining three fourths of recurrences (most initially repaired by general surgeons) were because of the sac being completely missed, incompletely repaired, or not being ligated high enough. Surprisingly, because premie hernias are large scrotal bowel and their repair is not always easy, there were no premie recurrences in this series. On the other hand, at the other end of the age spectrum (where the repair is usually a lot easier), the teenage recurrence rate (5%), although acceptable, was 4 times greater than the overall series recurrence rate of 1.2%. It is hard to explain the reason for this other than to speculate that teenagers are more active even if postoperative activity was discouraged for 2 weeks. Although this higher recurrence rate is not unusual, Partrick et al [32] reported no recurrences in his series of 35 teenagers with an indirect inguinal hernia repair using a polypropylene mesh plug inserted in the internal ring and a similar mesh onlay covering the posterior wall. If there is a similarly low recurrence rate in a larger series of teenagers, one may have to adopt this method.

The demographics of the 92 infants and children in this series with VP shunts and hernias were very similar to those of the premies with a few exceptions. There were no incarcerations in our series compared with a 20% incidence reported by Grosfeld and Cooney [30]. The reason for this discrepancy is difficult to explain, although, compared with the scrotal bowel hernias in premies, the hernias in VP-shunt patients tend to be almost all complete fluid hernias. Another discrepancy with the Grosfeld series is the lack of an increased incidence of opposite-side hernias reported by others (20%-40%) [29,30]. The theoretical reason for this increase is said to be secondary to increased intraabdominal pressure from the cerebrospinal fluid shunted into the peritoneal cavity [9,33]. Our results do not suggest that a routine contralateral exploration be undertaken in VP-shunt patients. For the same reason, our recurrence rate (10%) was much greater than that of our entire series (1.2%) and agrees with the 12% reported in the literature [30].

An orchidopexy was necessary in 1 of every 94 inguinal hernia operations (almost equal on both sides), mainly because the boy with a known undescended testicle incarcerated the frequently present hernia forcing both to be repaired as an emergency.

We noted a 0.5% incidence of an absent vas at operation. The incidence in the literature varies between 0.5% and 1%, which apparently equals the incidence in the general population [34]. The coexistence of an absent ipsilateral kidney with an absent vas is 0.1%. In our series, the vas was absent on the left in 13 (52%) boys, on the right in 10 (40%), bilateral in 2 (8%), and 5 of the 6 absent kidneys were on the left side. Kaplan et al [35] found the vas (and spermatogenesis) abnormal in the 25 CF boys he examined and therefore felt that virtually all males with CF are infertile.

Iatrogenic injuries to the vas during pediatric inguinal hernia repairs are both upsetting, embarrassing, and should really never occur. Therefore, one wonders about the true incidence reported [7-9,36], especially with the apparent ease of damage when handled at operation [37]. There is also a divergence of opinion as to what should be done at the time of the injury, the long-lasting effects to the male patient, and/or the actual need for a repair (which does not seem all that successful) [7-9,35,38]. In this series, the 4 vas injuries occurred in the first 25 years. Therefore, it may be difficult to implicate experience with this procedure for the lack of such an injury in the final 10 years.

Of the more than 1000 females in this series, 15% had an ovary in their sac (sliding hernia), and of these, 76% were younger than 2 years. The incidence of incarceration (acute or chronic) was 9%, and 2 (0.2%) were found infarcted (strangulated). This incidence of 0.2% strangulation falls below other reports of 2% to 33% [39]. Once an ovary was noted in a female hernia sac on examination, repair was suggested soon thereafter to avoid incarceration, possible torsion, and strangulation, and if strangulation was found, regardless of its questioned viability, neither was it removed nor should it be removed [39-41]. In a similar fashion, a blue testicle found at the time of an incarcerated inguinal hernia (11%-29% in the literature [9]) was left alone. Our

incidence of testicular atrophy after inguinal hernia repair was small (16, 0.3%), with 8 (50%) of these after incarceration, and was always evident by 3 months after the operation. This small incidence (0%-19%) was not always found by other authors [3,8,9,16,20,39,42]. The single female case of an inguinal hernia in a bladder exstrophy child in this series is certainly a lot less than the 56% boys and 15% girls who developed such a hernia during a follow-up of 10 years; however, it must be assumed that most of these hernias are repaired by the pediatric urologist who repaired the bladder exstrophy [43].

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