Comparison of inguinal hernia and asymptomatic patent processus vaginalis in term and preterm infants

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ABSTRACT

Introduction: The aim of this study was to evaluate the characteristics of inguinal hernia (IH) and patent processus vaginalis (PPV) in term and preterm infants less than the age of 6 months.

Method: Between January 2004 and December 2012, 246 term and 165 preterm infants underwent laparoscopic herniorrhaphy within the first 6 months of life. Preoperative clinical presentation and intraoperative anatomical findings during the laparoscopic procedure were evaluated. Additionally, initial side of hernia, laterality of IH and PPV were analyzed in term and preterm infants.

Results: In the group of term infants, most infants presented with a primary right-sided IH (58.5%) versus 17.9% left-sided and 23.6% bilateral IH. Babies with primary unilateral IH were found to have a contralateral PPV in 41.0% of cases. A difference between left-sided PPV and right-sided PPV could not be identified.

In the group of preterm infants, initial bilateral presentation was predominant (38.8%) versus right-sided (30.3%) and left-sided IH (30.9%). Infants with primary unilateral IH were found to have a contralateral PPV in 56.4%. We identified a slight difference between left-sided PPV (54.0%) and right-sided PPV (58.8%).

Conclusion: IH is predominantly right sided in term infants, whereas preterm infants mostly present with bilateral IH. The incidence of PPV was found to be significantly higher in the preterm group. Regarding the incidence of a contralateral PPV in term and preterm infants, no difference between initial left-sided and right-sided IH could be identified between both groups.

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Inguinal hernia repair is the most common surgical procedure in pediatric surgery, notably in term and preterm infants. The incidence of IH in full-term infants ranges from 1% to 5% and rises to 30% in premature infants [1,2]. Since decades there has been a continuing debate about contralateral groin exploration in patients with unilateral presentation because of the increased risk of metachronous inguinal hernia (MIH) [3]. Especially preterm infants and initial left-sided clinical presentation were reported to be a risk factor for the development of MIH [4–7]. Additionally, patients less than 6 months of age at initial herniotomy were identified to be at increased risk for metachronous presentation [4]. Prematurity and patency of the processus vaginalis are the most important factors in the development of IH [11]. However, many previous studies excluded preterm infants or did not focus on the difference between term and preterm patients. Indeed differences between IH in term and preterm infants have already been suggested, but have not been analyzed [2]. The aim of this study was to investigate the characteristics of IH and PPV in term and preterm infants undergoing laparoscopic herniorrhaphy.

Within the first 6 months of life. We specifically included high risk patients (infants below 6 months of age at the time of hernia repair and preterm infants) and focused on the differences between term and preterm babies.

1. Patients and methods

In this retrospective, single-institution study all preterm and term infants undergoing laparoscopic inguinal herniorrhaphy within the first 6 months of life were included. Infants undergoing open herniotomy because of contraindications for laparoscopic surgery were excluded from this study. Between January 2004 and December 2012 246 term (191 male and 55 female) and 165 preterm infants (118 male and 47 female) were identified. Two groups were generated: group I including all term infants and group II including all preterm infants. Prematurity was defined as less than 37 weeks of gestational age.

1.1. Operative procedure

All patients underwent laparoscopic hernia repair under general anesthesia with tracheal intubation. The infants were placed in a supine position. A Veress needle was inserted through a small
infraumbilical incision and carbon dioxide was insufflated to a pressure of 8 to 12 mmHg. The Veress needle was exchanged for a 5-mm or 2-mm laparoscope. Two additional 2 mm trocars were advanced through the right and left anterior abdominal wall under visual control. The clinically diagnosed open inguinal ring was closed using a nonabsorbable monofilamentous purse-string or Z-type suture and 2-mm instruments. Incarcerated hernias were reduced intraoperatively. The asymptomatic contralateral inguinal ring was routinely evaluated for a patent processus vaginalis in all term and preterm infants. If an open inguinal processus vaginalis was identified, it was closed in the same way. Openings smaller than 2 mm (size of the needle drifter shaft) were considered unlikely to cause a hernia and thus were left open. This individual decision was based on personal experiences and influenced by the fact that insufflation widens the internal ring. All infants were monitored postoperatively for at least one night.

1.2. Statistical analysis

Term and preterm infants were compared regarding the incidence of IH and PPV in patients with initial unilateral IH. Ordinal and nominal data are described by absolute and relative frequencies; continuous data by mean, standard deviation and range. The \( \chi^2 \) test was used to investigate differences between groups. A p-value less than 0.05 was considered as statistically significant. Additionally, the 95% confidence interval for the difference between both groups in the occurrence of intraoperative PPV was calculated. No adjustment for multiple testing was done. SAS for Windows, version 9.3 (SAS Institute, Inc., Cary, NC) was used for statistical analysis.

2. Results

2.1. Group I (term infants, \( n = 246 \))

In the term group median gestational age at birth was 39 weeks with a range from 37 to 42 weeks. Birth weight varied from 1.8 kg to 5.0 kg (median 3.5 kg) and median weight at the time of surgery was 4.7 kg with a range from 2.6 to 8.3 kg. On average, the operation was performed on the 60th postnatal day.

In the group of term infants 144 of 246 term patients \( (58.5\%) \) presented with a primary right-sided hernia and 44 \( (17.9\%) \) with a left-sided IH. Fifty eight of 246 \( (23.6\%) \) initially had bilateral IH. Twenty-seven patients \( (11.0\%) \) had a history of incarceration. Intraoperatively, a total of 304 indirect IH sacs were closed. During the laparoscopic procedure, a PPV was identified in 77 of 188 term infants \( (41.0\%) \) initially presenting with unilateral IH. Regarding the term infants presenting with initial left-sided hernia 18 of 44 patients \( (41.0\%) \) were found to have a PPV on the right side. Equally, 59 of 144 term babies \( (41.0\%) \) initially presenting with a right-sided hernia were found to have a PPV on the left side. Finally, laparoscopic closure of both internal inguinal rings was performed in 135 of 246 term infants \( (54.9\%) \).

2.2. Group II (preterm infants, \( n = 165 \))

In preterm group median gestational age at birth was 32 weeks with a range from 23 to 36 weeks. Birth weight varied from 0.5 to 4.0 kg (median 2.1 kg) and median weight at the time of surgery was 3.4 kg (range 1.6 to 6.6 kg). On average, the operation was performed on the 71th postnatal day.

In the group of preterm infants 50 patients \( (30.3\%) \) presented with a primary right-sided hernia and 51 \( (30.9\%) \) with a left-sided hernia. Sixty-four preterm patients \( (38.8\%) \) initially had bilateral IH. Nineteen patients \( (11.5\%) \) had a history of incarceration. Intraoperatively, a total of 229 indirect inguinal hernia sacs were closed. At laparoscopic exploration, a PPV was identified in 57 of 101 preterm infants \( (56.4\%) \) initially presenting with unilateral IH. Thirty of 51 preterm infants \( (58.8\%) \) with primary left-sided IH were found to have an asymptomatic PPV on the right side. Regarding the preterm infants initially presenting with a right-sided IH, we identified 27 of 50 patients \( (54.0\%) \) with a PPV on the left side. Finally, laparoscopic closure of both internal inguinal rings was performed in 121 of 165 preterm infants \( (73.3\%) \).

Fig. 1 compares the incidence and laterality of IH in term and preterm infants.

2.3. Group comparisons

The group comparisons showed a significant difference concerning primary presentation of IH in the groups of term and preterm infants \( (p < 0.01) \). Regarding identification of a PPV either on the right or left side in infants with unilateral IH, a statistically significant difference could be found between term and preterm patients \( (p = 0.01) \). However, comparing term and preterm infants with primary right-sided IH and left-sided PPV no statistically significance could be found \( (p = 0.11) \). Equally, initial left-sided IH and PPV on the right side did not show a significant difference between term and preterm infants \( (p = 0.08) \). Table 1 demonstrates incidences of unilateral IH, PPV, p-values and confidence interval for the differences between both groups.

3. Discussion

IH and PPV have been a matter of concern in pediatric surgery for decades. In 1955 Rothenberg and Barnett suggested contralateral groin exploration in infants with unilateral inguinal hernia to prevent the formation of a MIH [3]. Ever since, there has been a continuing debate about the management of unilateral IH in infants and children. With the introduction of laparoscopic surgery, visualization of both internal inguinal rings and reliable detection of a PPV has been enabled [8]. Rothenberg reported a contralateral PPV in 75% of patients with unilateral IH [3]. Later studies reported an incidence of contralateral PPV found on open surgical exploration from 57% to 60% [9]. A lower incidence of contralateral PPV was described using laparoscopy [10]. Tackett et al. reported an incidence of PPV from 39% to 61% by laparoscopy [9]. It has been shown that the incidence of PPV is age dependent, ranging from 41% in children less than 1 year of age to 8% to 19% in children older than 9 years [11]. The PPV is the major factor in the development of IH [1], but not every PPV subsequently

![Fig. 1. Incidence and laterality of inguinal hernia (IH) in term and preterm infants.](image-url)
Incidence and laterality of PPV in term and preterm infants with unilateral IH.

<table>
<thead>
<tr>
<th>Laterality (%)</th>
<th>Term group (n = 246)</th>
<th>Preterm group (n = 165)</th>
<th>Group comparison: p-value (confidence interval for the difference between groups)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Unilateral IH</td>
<td>188</td>
<td>101</td>
<td>0.01 (−0.27; −0.02)</td>
</tr>
<tr>
<td>(left or right sided)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Intraoperative PPV</td>
<td>77 (41.0)</td>
<td>57 (56.4)</td>
<td>0.01 (−0.27; −0.02)</td>
</tr>
<tr>
<td>Initial right-sided IH</td>
<td>144</td>
<td>50</td>
<td>0.11 (−0.29; +0.04)</td>
</tr>
<tr>
<td>Intraoperative left-sided PPV</td>
<td>59 (41.0)</td>
<td>27 (54.0)</td>
<td>0.11 (−0.29; +0.04)</td>
</tr>
<tr>
<td>Initial left-sided IH</td>
<td>44</td>
<td>51</td>
<td>0.08 (−0.37; +0.03)</td>
</tr>
<tr>
<td>Intraoperative right-sided PPV</td>
<td>18 (41.0)</td>
<td>30 (58.8)</td>
<td>0.08 (−0.37; +0.03)</td>
</tr>
</tbody>
</table>

Develops into a hernia. Prediction of the development of a MIH based on the presence of a PPV is uncertain. In the literature the incidence of MIH ranges from 5.76% to 14.3% [2,4]. Marulaiah et al. showed that the incidence of MIH is higher in preterm (10.52%) than in term infants (5.92%) after unilateral open herniotomy, but their results were not statistically significant. All their MIH developed within 4 months of the initial surgery [5]. In 2011 Nataraja et al. reported in their systematic review about a significant increased incidence of MIH in patients less than 6 months of age at initial inguinal herniotomy [4]. Additionally, initial presentation of a left-sided IH has been assumed to be a risk factor for metachronous presentation [7,12]. In contrast, Steven et al. reported that MIH were more common in preterm infants who had an initial right-sided hernia. He stated that this fact is suggesting that there is a difference in IH of term and preterm infants [2]. The hypothesis of this study was to verify the assumed differences of IH and PPV in term and preterm infants. Therefore the incidence and laterality of IH and PPV in these two groups of patients were investigated and the results were statistically analyzed.

Concerning laterality we found that the majority of term infants presented with a right-sided IH (58.5%). In the preterm group most patients (38.8%) presented with bilateral IH. Statistical analysis of laterality of IH in both groups revealed a statistical significant difference (p < 0.01). The incidence of PPV in patients with unilateral IH was higher in the preterm group (56.4%) than in the term group (41.0%). These differences were also statistically significant (p = 0.01). Because of the exploratory character of the study, the results of the statistical tests have to be interpreted in an exploratory sense, i.e. as hypothesis generating.

These results confirm the higher incidence of MIH in preterm infants compared with term infants reported by Marulaiah et al. in 2006 [5]. Concerning laterality we could not identify a difference in the incidence of PPV based on initial right-sided or left-sided IH in both groups. In the literature initial left-sided and also right-sided presentation involved a higher incidence of metachronous presentation [2,7,12]. From the theoretical point of view, the results of this study implicate no difference in the incidence of MIH after primary right-sided or left-sided presentation of IH in term and preterm infants. Nevertheless, we did not evaluate the incidence of MIH in this study. This is a limitation of the present study, as well as the retrospective study design. However, there is already an ongoing trial analyzing the chance of developing a MIH after laparoscopic hernia repair with closure of the contralateral PPV [2].

In this retrospective study the incidence and laterality of IH and PPV in term and preterm infants undergoing laparoscopic herniorrhaphy was evaluated. Only infants less than the age of 6 months were included and the differences between term and preterm infants were highlighted and statistically analyzed. In summary, statistically significant differences in the incidence and laterality of IH between term and preterm infants could be demonstrated: whereas IH is predominantly right sided in term infants, most preterm babies present with bilateral IH. The incidence of PPV in term and preterm infants with initial unilateral IH was significantly higher in the preterm group. Regarding the incidence of PPV based on primary left-sided or right-sided IH, no difference between term and preterm infants could be found. The results of this study indicate the differences of IH and PPV regarding incidence and laterality in term and preterm infants within the first 6 months of life.

References