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小儿嵌顿性腹股沟斜疝研究进展与诊疗现状

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摘　要

背景：嵌顿性腹股沟斜疝(IIH)是儿科急症，源于腹膜鞘状突未闭。及时诊断与处理对于预防肠管或性腺缺血坏死等严重并发症至关重要。方法：本文综述了当前关于小儿IIH的胚胎学、流行病学、临床表现、诊断方法及治疗策略的文献，重点关注当代存在的争议与管理细节。结果：IIH的诊断基于临床检查，并辅以彩色多普勒超声评估疝内容物活力及睾丸血供。对于无并发症的病例，初始处理可尝试手法复位。手术治疗仍是根治方法，其中腹腔镜技术因其微创优势及可同时处理对侧未闭鞘状突(PPV)的能力，日益成为标准术式。主要的管理争议包括：1) 男性IIH中是否需常规探查睾丸以及对缺血睾丸的处理；2) 女性卵巢嵌顿的最佳手术时机，目前强烈倾向于保留卵巢；3) 针对早产儿及低出生体重儿的手术时机，近期证据支持出院后择期手术；以及4) 对于腹腔镜术中发现的对侧PPV，应采取基于风险分层的个体化处理策略。结论：尽管小儿IIH的微创治疗已取得显著进展，但在性腺管理、高危婴儿手术时机等关键方面仍缺乏统一标准。临床决策应个体化，综合考虑外科医生经验、家属意愿及最新证据。未来需要高质量、长期的随访研究来解决现有争议，以优化患者诊疗。

关键词

小儿嵌顿性腹股沟斜疝，性腺缺血，腹腔镜手术，疝囊高位结扎术，早产儿

Research Advances and Current Status of Diagnosis and Management of Pediatric Incarcerated Indirect Inguinal Hernia

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Abstract

Background: Incarcerated indirect inguinal hernia (IIH) is a critical surgical emergency in pediatric patients, arising from the failure of the processus vaginalis to close. Prompt diagnosis and management are essential to prevent severe complications such as intestinal or gonadal ischemia and necrosis. Methods: This review synthesizes current literature on the embryology, epidemiology, clinical presentation, diagnostic approaches, and therapeutic strategies for pediatric IIH, with a focus on contemporary controversies and management nuances. Results: IIH diagnosis relies on clinical examination, supported by color Doppler ultrasonography to assess the viability of the hernia content and testicular blood flow. Initial management for uncomplicated cases involves attempted manual reduction. Surgical intervention remains the definitive treatment, with laparoscopic techniques increasingly becoming the standard due to their minimally invasive advantages and ability to address contralateral patent processus vaginalis (PPV). Key management controversies include: 1) the necessity of routine testicular exploration and the management of ischemic testes in male IIH; 2) the optimal timing of surgery for ovarian incarceration in females, with a strong consensus favoring ovarian preservation; 3) the debate between pre-discharge and post-discharge elective repair for premature and low-birth-weight infants, with recent evidence favoring the latter; and 4) the individualized, risk-stratified approach to managing contralateral PPV discovered during laparoscopic surgery. Conclusion: While significant advances have been made in the minimally invasive management of pediatric IIH, standardized protocols for several critical aspects, including gonadal management and timing of repair in high-risk infants, are lacking. Decision-making should be individualized, incorporating the surgeon's experience, family preferences, and the latest evidence. Future high-quality, long-term outcome studies are needed to resolve existing controversies and optimize patient care.

Keywords

Pediatric Incarcerated Indirect Inguinal Hernia, Gonadal Ischemia, Laparoscopy, High Ligation of Hernial Sac, Premature Infant

1. 引言

腹股沟斜疝是儿童与新生儿外科最常见的先天性疾病之一，源于腹膜鞘状突未闭所致腹股沟管后壁缺损；腹腔内容物(肠管、卵巢等)沿此薄弱通道突出于腹股沟、阴囊或大阴唇。当脏器无法自行回纳而滞留于疝囊内时，即演变为嵌顿性腹股沟斜疝(incarcerated inguinal hernia, IIH) [1]。随着嵌顿持续，疝环持续性机械性卡压先阻断静脉回流，致组织淤血、水肿，继而动脉血流锐减，可在数小时内进展为疝内容物坏死，甚至同侧性腺亦受累缺血坏死[2]，成为婴幼儿期必须紧急识别与处理的危重急症[3]。

2. 胚胎解剖基础

IIH 的病理基础源于胚胎发育过程中的正常结构——鞘状突。胚胎时期，男性胎儿约妊娠第 8 周，腹膜自腹股沟内环处向外突出形成鞘状突，作为睾丸下降的引导通道，而女性胎儿则因子宫圆韧带进入腹

股沟，并伴随其周围腹膜延伸进入腹股沟管，形成 Nuck 管，类似男性胎儿的鞘状突[4] [5]。正常情况下，鞘状突和Nuck管均在出生前或出生后早期闭合，若此闭合过程发生停顿或延迟，则形成未闭鞘状突(patent processus vaginalis, PPV)，成为腹腔内容物疝出的潜在通道。PPV 本身并非疝，但它是腹股沟斜疝发生的必要前提。

3. 流行病学特征

流行病学显示，IH 的发病率在不同年龄、性别及出生状况人群中存在显著差异。据统计，在足月新生儿中，腹股沟斜疝总体发病率为 0.8%~5% [1] [6]，在早产儿及低出生体重儿(<2500 g)中其发病率可显著升高，甚至高达 30%，其原因是出生时腹股沟管结构发育不全[6]-[8]。就性别而言，男孩发病率约为女孩的 5~10 倍[9]-[11]。究其原因与男性精索穿过腹股沟管所形成的解剖薄弱点有关：睾丸下降需鞘状突持续开放，且精索通过使腹股沟管腔先天较宽；而女性圆韧带下降路径短、鞘突早闭且管腔狭窄，故男孩疝囊形成机会远高于女孩[12]-[14]。IH 中右侧最为常见，约占 60%，左侧睾丸通常比右侧更早开始并完成下降过程，鞘状突闭合亦更早，而右侧闭合相对延迟[15]。在 IH 患儿里，IIH 的发病率为 3%~16%，且随着年龄增大，嵌顿风险降低；若系早产儿，这一比例可飙升至 31%，且多集中发生在出生后第一年[16]。大约三分之一的病例在 6 个月前就会出现，双侧疝发生在 15%到 20%的儿童中。

4. 临床表现与诊断

多数腹股沟疝患儿无明显不适，常在常规体检或家长偶然观察中发现：腹股沟、阴囊(男)或大阴唇(女)区域于哭闹、咳嗽等腹压增高时出现包块，安静或平卧后可自行回纳或消失[17]。

一旦发生嵌顿，包块则变为固定、不可回纳，局部可伴触痛、红肿，并出现肠梗阻表现，如恶心、呕吐、腹胀及停止排便排气。

然而，在无法准确表达症状的婴幼儿，尤其是新生儿中，嵌顿表现常不典型——可能仅表现为局部轻微肿胀、拒奶、烦躁不安等非特异性症状，极易被家长忽视，导致就诊延误。若未及时处理，嵌顿内容物(包括肠管及性腺)可迅速发生缺血坏死[11] [18]，继发腹膜炎、便血，严重者可进展为血流动力学不稳定，甚至休克死亡。

体格检查仍是诊断 IH 的基础，但在哭闹剧烈不能配合或肥胖患儿中操作困难。此时超声检查，尤其是彩色多普勒超声(Color Doppler Flow Imaging Ultrasonography, CDFI)可成为关键辅助手段[17] [19]。超声可了解疝囊内容物性质(肠管、卵巢等)，观察肠壁蠕动及血流信号，同时测量睾丸大小、结构与血供，并且将 IIH 与腹股沟淋巴结肿大、鞘膜积液及睾丸回缩相鉴别。腹部 X 线可提示肠梗阻征象(如液气平)，但特异性有限。

5. 治疗

对于嵌顿时间短、无腹膜炎、休克或完全性肠梗阻表现患儿，可首先尝试手法复位，据报道其成功率可高达 70%~85% [16] [20]。标准操作需在镇静或镇痛下进行：患儿仰卧呈头低足高位，术者一手拇指压于外环处防止内容物外突，另一手沿腹股沟管走向缓慢、持续地将疝囊推回腹腔[21]。复位成功后需严密观察至少 6~12 小时，警惕迟发性肠坏死或穿孔。

复位失败、怀疑肠/性腺坏死或存在绝对禁忌证者，需行急诊手术。传统的开放手术仍是治疗 IIH 的金标准：经腹股沟斜切口入路，暴露疝囊，松解内环口，检查并回纳疝内容物，完整游离疝囊后行高位结扎。然而，随着微创外科技术的不断进步，腹腔镜手术在小儿 IIH 治疗中的应用日趋成熟，并已逐步成为主流术式[22] [23]。

相较于传统开放手术，腹腔镜手术的诸多优势已获大量研究充分证实。腹腔镜可在直视下明确疝内容物(如肠管、卵巢等)，并在复位后实时评估其血流灌注，从而及时识别坏死组织并作出精准术中决策[24]。全身麻醉联合气腹可有效松弛腹肌、舒张并扩大内环口，显著提高嵌顿复位成功率[25] [26]。此外，腹腔镜可直观评估对侧内环口状态，及时发现未闭鞘状突，并同期行高位结扎，有效预防对侧迟发疝[24]。

对于嵌顿时间不明或过长的患儿，传统开放手术常因严重水肿导致组织层次不清，分离疝囊时易损伤精索血管、输精管及腹股沟神经等结构；而腹腔镜手术可有效规避此类风险，降低腹股沟或阴囊血肿、感染等术后并发症发生率[24] [27] [28]。此外，腹腔镜手术还可缩短住院时间，减轻术后疼痛，并改善切口美观度[3]。然而，对于已出现腹膜炎体征、怀疑肠穿孔、严重脱水或显著腹胀的患儿，腹腔镜手术风险较高，更推荐采用开放手术。

6. 性腺及早产管理

1、男性患儿

男性 IIH 患儿行急诊手术时，是否常规探查睾丸在临床实践中存在争议。一方面，术中同时探查可能会影响睾丸血供[29]，且有研究认为嵌顿复位后缺血睾丸血供常可自行恢复，故无需常规探查[30]。另一方面，部分学者主张结合术前超声评估——若显示睾丸实质回声不均、血流分布异常[31]，应术中积极探查以识别坏死睾丸[32] [33]。然而，即使术中证实存在睾丸坏死，是否立即切除仍具争议，有观点认为保留坏死睾丸可能通过免疫或毒性机制影响对侧功能[2] [34]，但亦有随访研究显示保留坏死睾丸仍有存活机会且未导致感染或对侧功能受损[35]。目前尚缺乏高质量长期随访研究明确保留或切除坏死睾丸对患儿远期生育能力的影响。因此，是否探查及切除睾丸需结合术者经验、家长意愿综合判断；对于术中未证实完全坏死的性腺，需予以保留[13]，并加强术后随访。

2、女性患儿

在少数女性 IH 患儿中，疝内容物可包含卵巢、输卵管，甚至子宫，发生率约为 15%~31% [1]。此类疝虽相对少见，却极易发生嵌顿、扭转及绞窄[36]。多项研究证实，卵巢嵌顿时扭转风险显著增高，且因体积增大超过内环口，导致血管蒂严重受压，在多重机制作用下显著增加坏死风[37]-[40]。尤其是一岁以下婴儿[41]。故在女性 IIH 患儿中，性腺治疗的核心并非是否探查，而是一旦超声发现嵌顿疝内容物为卵巢时，是否均需急诊手术。部分学者持积极态度，主张所有卵巢嵌顿均需急诊手术[42]-[44]，另有研究则认为，对无症状或慢性嵌顿者可在 24~48 小时内行限期手术[42] [44]。一项针对小儿外科医生的调查显示，对于无症状卵巢嵌顿，约 32%选择限期或急诊手术，而 50%倾向于择期手术[45]，目前共识倾向于采用腹腔镜手术作为最佳术式[46]，不仅因其微创优势，更因其为卵巢保留提供了可靠技术平台。Hughes 等人主张在所有情况下保留卵巢，无论术中对外观或缺血程度的评估如何；其随访结果显示，所有患者均存有功能性卵巢组织[47]，这一理念已逐渐被广泛接受——当前文献与指南普遍推荐，对嵌顿或扭转的卵巢应行复位并保留，而非切除。

3、早产儿及低出生体重儿

目前早产儿及低出生体重儿 IH 最佳手术时机仍存在争议。临床实践调查发现，63%的小儿外科医生选择在患儿出院前(即新生儿重症监护室住院期间)进行手术，18%根据患儿的年龄和体重决定手术时机，另有 5%则选择出院后择期行手术[45]。出院前手术可显著降低嵌顿风险，但围术期并发症(如呼吸衰竭、心动过缓、心肺骤停)风险显著增高[48]-[50]，且对侧异时性疝发生风险明显升高。反之，若出院后择期手术，患儿因生理更趋成熟，麻醉风险可能降低，传统观点认为其可能增加等待期间的嵌顿风险[51]。一项研究显示，40 周胎龄后手术者发生嵌顿的风险是 39 周前手术者的两倍[8]。然而，近期证据表明，择期手术并未显著增加嵌顿发生率，反而与更低的疝复发率及呼吸系统并发症风险相关[52]-[54]。目前对于

低出生体重及早产儿疝修补的最佳手术时机尚无明确共识，但最新 RCT 研究及系统综述均支持出院后择期手术[53] [54]。具体方案应由外科医生根据患儿个体情况综合判断。

7. 对侧 PPV 的管理策略

随着腹腔镜技术的普及，是否常规探查对侧内环口已不再是争议焦点；与此同时，传统的开放对侧腹股沟探查术因创伤较大且缺乏必要性，已逐渐被淘汰[55] [56]。当前的核心问题在于：对术中发现的对侧未闭鞘状突(PPV)是否同期手术。

2019 年一项涵盖 32 项研究、近两万名患儿的系统综述显示，约 38.5%的单侧疝患儿存在对侧 PPV [57]。尽管部分学者认为常规预防性结扎可能导致过度治疗[55] [58]。但多项研究证实结扎对侧 PPV 可有效预防异时性腹股沟斜疝发生[57] [59] [60]。2020 年一项基于前瞻性研究的荟萃分析指出，未处理的对侧 PPV 患儿异时腹股沟斜疝发生率高达 13.8%，即每 7 名患儿中约有 1 人会发展为对侧临床疝[61]，相比之下，2019 年系统指出腹腔镜下预防性结扎对侧 PPV 可使异时性腹股沟斜疝的绝对发生风险降低 5.7%。另一项荟萃分析报告了行腹腔镜下结扎对侧 PPV 后腹股沟斜疝发生率仅为 1.31% [62]。此外，腹腔镜下操作相对简便，并发症风险可忽略不计，且能有效避免二次手术及麻醉相关风险[57]。

因此，目前推荐采用基于风险分层的个体化策略：对高危患儿(如早产、低体重、嵌顿史、腹压增高或结缔组织病等)，建议在初次手术中同期行腹腔镜下对侧 PPV 高位结扎[63]；其余患儿可选择观察随访。最终决策应在充分告知家长干预的潜在获益(避免二次手术)、风险(过度干预)及现有证据的不确定性后，结合家庭意愿、随访依从性及医疗资源共同作出，并纳入知情同意过程。

8. 术后护理

多数无肠管坏死等并发症的患儿术后住院 1~2 天。早产儿需密切监测呼吸及循环功能，高危患儿(如肠管或性腺坏死、严重感染或休克)推荐术后转入 ICU 监护[48] [64]。

9. 结论

IIH 为儿外科常见急症，早期症状隐匿，易致肠管或性腺坏死，嵌顿 6~8 小时内且全身情况良好者可考虑手法复位，若已出现腹膜刺激征或休克迹象，则应立即手术。针对其并发症及特殊情况处理策略尚未形成统一临床标准：女性患儿卵巢嵌顿时腹腔镜为首选术式；男性患儿术中是否探查睾丸需综合评估血供影响并尊重家属意愿；术中若行腹腔镜手术且术中发现对侧未闭鞘状突(PPV)，对早产、左侧嵌顿等高危患儿可考虑一期结扎以降低再手术风险，而开放手术则不宜常规探查对侧。早产儿及高危患儿术后需密切监护。

参考文献

[1] Chang, S.J., Chen, J.Y., Hsu, C.K., Chuang, F. and Yang, S.S. (2015) The Incidence of Inguinal Hernia and Associated Risk Factors of Incarceration in Pediatric Inguinal Hernia: A Nation-Wide Longitudinal Population-Based Study. *Hernia*, **20**, 559-563. https://doi.org/10.1007/s10029-015-1450-x

[2] Dudek-Warchoł, T., Gług, W., Kurek, A., Bombiński, P. and Warchoł, S. (2018) Testicular Necrosis Secondary to Incarcerated Inguinal Hernia in Male Infants. Own Observations. *Developmental Period Medicine*, **22**, 65-70.

[3] Mishra, P.K., Burnand, K., Minocha, A., Mathur, A.B., Kulkarni, M.S. and Tsang, T. (2014) Incarcerated Inguinal Hernia Management in Children: 'A Comparison of the Open and Laparoscopic Approach'. *Pediatric Surgery International*, **30**, 621-624. https://doi.org/10.1007/s00383-014-3507-9

[4] Anderson, C.C., Broadie, T.A., Mackey, J.E. and Kopecky, K.K. (1995) Hydrocele of the Canal of NUCK: Ultrasound Appearance. *The American Surgeon*, **61**, 959-961.

[5] Nasser, H., King, M., Rosenberg, H.K., Rosen, A., Wilck, E. and Simpson, W.L. (2018) Anatomy and Pathology of the

Canal of NUCK. *Clinical Imaging*, **51**, 83-92. https://doi.org/10.1016/j.clinimag.2018.02.003

[6] Burgmeier, C., Dreyhaupt, J. and Schier, F. (2014) Comparison of Inguinal Hernia and Asymptomatic Patent Processus Vaginalis in Term and Preterm Infants. *Journal of Pediatric Surgery*, **49**, 1416-1418. https://doi.org/10.1016/j.jpedsurg.2014.03.013

[7] Aneiros Castro, B., Cano Novillo, I., García Vázquez, A. and de Miguel Moya, M. (2019) Is the Laparoscopic Approach Safe for Inguinal Hernia Repair in Preterms? *Journal of Laparoendoscopic & Advanced Surgical Techniques*, **29**, 1302-1305. https://doi.org/10.1089/lap.2019.0116

[8] Lautz, T.B., Raval, M.V. and Reynolds, M. (2011) Does Timing Matter? A National Perspective on the Risk of Incarceration in Premature Neonates with Inguinal Hernia. *The Journal of Pediatrics*, **158**, 573-577. https://doi.org/10.1016/j.jpeds.2010.09.047

[9] Ashley, T., Ashley, H., Wladis, A., Bolkan, H.A., van Duinen, A.J., Beard, J.H., *et al.* (2021) Outcomes after Elective Inguinal Hernia Repair Performed by Associate Clinicians vs Medical Doctors in Sierra Leone: A Randomized Clinical Trial. *JAMA Network Open*, **4**, e2032681. https://doi.org/10.1001/jamanetworkopen.2020.32681

[10] Pivo, S., Huynh, D., Oh, C. and Towfigh, S. (2023) Sex-Based Differences in Inguinal Hernia Factors. *Surgical Endoscopy*, **37**, 8841-8845. https://doi.org/10.1007/s00464-023-10367-5

[11] Tsai, T., Lin, C., Cheang, I.N., Hsu, Y., Wei, C., Chin, T., *et al.* (2023) Comparing Outcomes of Single-Incision Laparoscopic Herniorrhaphy in Newborns and Infants. *Diagnostics*, **13**, Article 529. https://doi.org/10.3390/diagnostics13030529

[12] Liu, J., Chen, J. and Shen, Y. (2019) The Results of Open Preperitoneal Prosthetic Mesh Repair for Acutely Incarcerated or Strangulated Inguinal Hernia: A Retrospective Study of 146 Cases. *Surgical Endoscopy*, **34**, 47-52. https://doi.org/10.1007/s00464-019-06729-7

[13] Ein, S.H., Njere, I. and Ein, A. (2006) Six Thousand Three Hundred Sixty-One Pediatric Inguinal Hernias: A 35-Year Review. *Journal of Pediatric Surgery*, **41**, 980-986. https://doi.org/10.1016/j.jpedsurg.2006.01.020

[14] Bisciotti, G.N., Bisciotti, A., Auci, A., Bisciotti, A. and Volpi, P. (2024) Anatomical Features in Inguinal-Pubic-Adductor Area That May Contribute to Gender Difference in Susceptibility to Groin Pain Syndrome. *Journal of Personalized Medicine*, **14**, Article 860. https://doi.org/10.3390/jpm14080860

[15] Tabiri, S., Russell, K.W., Gyamfi, F.E., Jalali, A., Price, R.R. and Katz, M.G. (2018) Local Anesthesia Underutilized for Inguinal Hernia Repair in Northern Ghana. *PLOS ONE*, **13**, e0206465. https://doi.org/10.1371/journal.pone.0206465

[16] Stylianos, S., Jacir, N.N. and Harris, B.H. (1993) Incarceration of Inguinal Hernia in Infants Prior to Elective Repair. *Journal of Pediatric Surgery*, **28**, 582-583. https://doi.org/10.1016/0022-3468(93)90665-8

[17] Shehata, S., Shehata, S., Wella, H.L., Abouheba, M. and Elrouby, A. (2018) Pediatric Inguinal Hernias, Are They All the Same? A Proposed Pediatric Hernia Classification and Tailored Treatment. *Hernia*, **22**, 941-946. https://doi.org/10.1007/s10029-018-1816-y

[18] Xie, X., Li, K. and Xiang, B. (2023) Influencing Factors of Parental Selections of Minimally Invasive Procedure in Children's Abdominal Surgery: A Cross-Sectional Study in China. *Journal of Robotic Surgery*, **17**, 1681-1687. https://doi.org/10.1007/s11701-023-01566-2

[19] Erez, I., Rathause, V., Vacian, I., Zohar, E., Hoppenstein, D., Werner, M., *et al.* (2002) Preoperative Ultrasound and Intraoperative Findings of Inguinal Hernias in Children: A Prospective Study of 642 Children. *Journal of Pediatric Surgery*, **37**, 865-868. https://doi.org/10.1053/jpsu.2002.32889

[20] Goldman, R.D., Balasubramanian, S., Wales, P. and Mace, S.E. (2005) Pediatric Surgeons and Pediatric Emergency Physicians' Attitudes towards Analgesia and Sedation for Incarcerated Inguinal Hernia Reduction. *The Journal of Pain*, **6**, 650-655. https://doi.org/10.1016/j.jpain.2005.05.001

[21] Zhou, X., Peng, L., Sha, Y. and Song, D. (2014) Transumbilical Endoscopic Surgery for Incarcerated Inguinal Hernias in Infants and Children. *Journal of Pediatric Surgery*, **49**, 214-217. https://doi.org/10.1016/j.jpedsurg.2013.10.024

[22] Eto, S., Yoshikawa, K., Yoshimoto, T., Takasu, C., Kashihara, H., Nishi, M., *et al.* (2021) Strategy for Laparoscopic Repair of Inguinal Hernia after Robot-Assisted Radical Prostatectomy. *Asian Journal of Endoscopic Surgery*, **15**, 155-161. https://doi.org/10.1111/ases.12985

[23] Petridou, M., Karanikas, M. and Kaselas, C. (2023) Laparoscopic Vs. Laparoscopically Assisted Pediatric Inguinal Hernia Repair: A Systematic Review. *Pediatric Surgery International*, **39**, Article No. 212. https://doi.org/10.1007/s00383-023-05492-0

[24] Zhang, G., Ding, H., Wang, D., Guo, F. and Hu, B. (2024) Pediatric Incarcerated Inguinal Hernia: Traditional Open or Laparoscopic-Assisted Approach? *Medicine*, **103**, e37810. https://doi.org/10.1097/md.0000000000037810

[25] Abbas, A., Laverde, R., Yap, A., Stephens, C.Q., Samad, L., Seyi-Olajide, J.O., *et al.* (2023) Routine Pediatric Surgical Emergencies: Incidence, Morbidity, and Mortality during the 1st 8000 Days of Life—A Narrative Review. *World Journal*

of Surgery, **47**, 3419-3428. https://doi.org/10.1007/s00268-023-07097-z

[26] Jinxiang, L., Qingwei, C., Shenghua, Q., Yunqiang, X., Haiyang, L., Chengliang, L., *et al.* (2022) Contralateral Patent Processus Vaginalis Repair in Boys: A Single-Center Retrospective Study. *Scientific Reports*, **12**, Article No. 12073. https://doi.org/10.1038/s41598-022-15435-9

[27] Esposito, C., Turial, S., Alicchio, F., Enders, J., Castagnetti, M., Krause, K., *et al.* (2012) Laparoscopic Repair of Incarcerated Inguinal Hernia. A Safe and Effective Procedure to Adopt in Children. *Hernia*, **17**, 235-239. https://doi.org/10.1007/s10029-012-0948-8

[28] Kaya, M., Hückstedt, T. and Schier, F. (2006) Laparoscopic Approach to Incarcerated Inguinal Hernia in Children. *Journal of Pediatric Surgery*, **41**, 567-569. https://doi.org/10.1016/j.jpedsurg.2005.11.066

[29] Sokratous, A., Österberg, J. and Sandblom, G. (2018) The Impact of Groin Surgery during Childhood on the Incidence of Inguinal Hernia Repair and Its Postoperative Complications in Adult Life. *European Journal of Pediatric Surgery*, **29**, 271-275. https://doi.org/10.1055/s-0038-1641598

[30] Orth, R.C. and Towbin, A.J. (2011) Acute Testicular Ischemia Caused by Incarcerated Inguinal Hernia. *Pediatric Radiology*, **42**, 196-200. https://doi.org/10.1007/s00247-011-2210-4

[31] Hosokawa, T., Sato, Y., Tanami, Y., Deie, K., Yoshizawa, S., Ohashi, K., *et al.* (2025) Sonographic Diagnosis of Testicular Loss or Atrophy after Incarcerated Inguinal Hernia in Pediatric Patients. *Emergency Radiology*, **32**, 309-317. https://doi.org/10.1007/s10140-025-02338-1

[32] Baird, R., Gholoum, S., Laberge, J. and Puligandla, P. (2011) Prematurity, Not Age at Operation or Incarceration, Impacts Complication Rates of Inguinal Hernia Repair. *Journal of Pediatric Surgery*, **46**, 908-911. https://doi.org/10.1016/j.jpedsurg.2011.02.059

[33] Parelkar, S.V., Mundada, D., Sanghvi, B.V., Joshi, P.B., Oak, S.N., Kapadnis, S.P., *et al.* (2014) Should the Ovary Always Be Conserved in Torsion? A Tertiary Care Institute Experience. *Journal of Pediatric Surgery*, **49**, 465-468. https://doi.org/10.1016/j.jpedsurg.2013.11.055

[34] Ozdamar, M.Y. and Karakus, O.Z. (2017) Testicular Ischemia Caused by Incarcerated Inguinal Hernia in Infants: Incidence, Conservative Treatment Procedure, and Follow-Up. *Journal of Urology*, **14**, 4030-4033.

[35] Hou, J., Feng, W., Liu, Q., Wang, Y., Guo, Z. and Liu, W. (2023) Can We Preserve the Necrotic Testis Caused by Incarcerated Inguinal Hernia in Infants under 3 Months? *Pediatric Surgery International*, **40**, Article No. 16. https://doi.org/10.1007/s00383-023-05592-x

[36] Lao, O.B., Fitzgibbons, R.J. and Cusick, R.A. (2012) Pediatric Inguinal Hernias, Hydroceles, and Undescended Testicles. *Surgical Clinics of North America*, **92**, 487-504. https://doi.org/10.1016/j.suc.2012.03.017

[37] Choi, K.H. and Baek, H.J. (2016) Incarcerated Ovarian Herniation of the Canal of NUCK in a Female Infant: Ultrasonographic Findings and Review of Literature. *Annals of Medicine & Surgery*, **9**, 38-40. https://doi.org/10.1016/j.amsu.2016.06.003

[38] Boley, S.J., Cahn, D., Lauer, T., Weinberg, G. and Kleinhaus, S. (1991) The Irreducible Ovary: A True Emergency. *Journal of Pediatric Surgery*, **26**, 1035-1038. https://doi.org/10.1016/0022-3468(91)90668-j

[39] Zeng, K., Murphy, J. and Wilson, E.E. (2019) Female Reproductive Structures Found in Inguinal Hernia Sacs: A Retrospective Review. *Journal of Pediatric Surgery*, **54**, 2134-2137. https://doi.org/10.1016/j.jpedsurg.2019.03.018

[40] Merriman, T.E. and Auldist, A.W. (2000) Ovarian Torsion in Inguinal Hernias. *Pediatric Surgery International*, **16**, 383-385. https://doi.org/10.1007/s003830000428

[41] Yang, D.M., Kim, H.C., Kim, S.W., Lim, S.J., Park, S.J. and Lim, J.W. (2014) Ultrasonographic Diagnosis of Ovary-Containing Hernias of the Canal of NUCK. *Ultrasonography*, **33**, 178-183. https://doi.org/10.14366/usg.14010

[42] van Heurn, L.W.E., Pakarinen, M.P. and Wester, T. (2014) Contemporary Management of Abdominal Surgical Emergencies in Infants and Children. *Journal of British Surgery*, **101**, e24-e33. https://doi.org/10.1002/bjs.9335

[43] Lee, S.R. (2021) Ovarian Incarceration and Torsion in Single-Ovary versus Multiple-Reproductive Organ Prolapse in Female Inguinal Hernia: A Retrospective Study of 510 Infants Who Underwent Laparoscopic Hernia Repair. *Journal of Laparoendoscopic & Advanced Surgical Techniques*, **31**, 110-116. https://doi.org/10.1089/lap.2020.0531

[44] Takehara, H., Hanaoka, J. and Arakawa, Y. (2009) Laparoscopic Strategy for Inguinal Ovarian Hernias in Children: When to Operate for Irreducible Ovary. *Journal of Laparoendoscopic & Advanced Surgical Techniques*, **19**, s129-s131. https://doi.org/10.1089/lap.2008.0204.supp

[45] Antonoff, M.B., Kreykes, N.S., Saltzman, D.A. and Acton, R.D. (2005) American Academy of Pediatrics Section on Surgery Hernia Survey Revisited. *Journal of Pediatric Surgery*, **40**, 1009-1014. https://doi.org/10.1016/j.jpedsurg.2005.03.018

[46] Esposito, C., Gargiulo, F., Farina, A., Del Conte, F., Cortese, G., Servillo, G., *et al.* (2019) Laparoscopic Treatment of Inguinal Ovarian Hernia in Female Infants and Children: Standardizing the Technique. *Journal of Laparoendoscopic &*

Advanced Surgical Techniques, **29**, 568-572. https://doi.org/10.1089/lap.2018.0630

[47] Hughes, P., Abdelhafeez, A., Byrne, A.T., Real, D. and Gillick, J. (2015) A Paediatric Hernia with a Twist: The Presentation, Imaging Findings and Management of a Strangulated Ovarian Hernia. *Irish Medical Journal*, **108**, 282-283.

[48] Murphy, J.J., Swanson, T., Ansermino, M. and Milner, R. (2008) The Frequency of Apneas in Premature Infants after Inguinal Hernia Repair: Do They Need Overnight Monitoring in the Intensive Care Unit? *Journal of Pediatric Surgery*, **43**, 865-868. https://doi.org/10.1016/j.jpedsurg.2007.12.028

[49] Ramachandran, V., Edwards, C.F. and Bichianu, D.C. (2020) Inguinal Hernia in Premature Infants. *NeoReviews*, **21**, e392-e403. https://doi.org/10.1542/neo.21-6-e392

[50] Mowitz, M., Gao, W., Sipsma, H., Zuckerman, P., Wong, H., Ayyagari, R., *et al.* (2022) Burden of Comorbidities and Healthcare Resource Utilization among Medicaid-Enrolled Extremely Premature Infants. *Journal of Health Economics and Outcomes Research*, **9**, 147-155. https://doi.org/10.36469/jheor.2022.38847

[51] Morgado, M. and Holland, A.J. (2024) Inguinal Hernias in Children: Update on Management Guidelines. *Journal of Paediatrics and Child Health*, **60**, 648-653. https://doi.org/10.1111/jpc.16677

[52] Provinciatto, H., Barbosa Moreira, M.V., de Freitas, L.R. and Araujo Júnior, E. (2025) Early versus Delayed Inguinal Hernia Repair in Preterm Infants: A Systematic Review and Meta-Analysis. *Journal of Neonatal-Perinatal Medicine*, **18**, 3-8. https://doi.org/10.1177/19345798251318594

[53] Khan, M.O., Fatimi, A.S., Thobani, H., Ehsan, A.N., Saqib, S., Tahan, D., *et al.* (2025) Early versus Late Inguinal Hernia Repair in Preterm Neonates: An Updated Systematic Review and Meta-Analysis with Trial Sequential Analysis. *Journal of Pediatric Surgery*, **60**, Article ID: 162463. https://doi.org/10.1016/j.jpedsurg.2025.162463

[54] Blakely, M.L., Krzyzaniak, A., Dassinger, M.S., Pedroza, C., Weitkamp, J., Gosain, A., *et al.* (2024) Effect of Early vs Late Inguinal Hernia Repair on Serious Adverse Event Rates in Preterm Infants: A Randomized Clinical Trial. *JAMA*, **331**, 1035-1044. https://doi.org/10.1001/jama.2024.2302

[55] Ron, O., Eaton, S. and Pierro, A. (2007) Systematic Review of the Risk of Developing a Metachronous Contralateral Inguinal Hernia in Children. *British Journal of Surgery*, **94**, 804-811. https://doi.org/10.1002/bjs.5856

[56] Kamesh, S., Sinha, A., Rathod, K.J., Pathak, M., Jadhav, A., Saxena, R., *et al.* (2025) Navigating the Pediatric Inguinal Hernia Repair Conundrum: Occult Bilaterality of Patent Processus Vaginalis as an Indication for Laparoscopy. *Journal of Indian Association of Pediatric Surgeons*, **30**, 195-199. https://doi.org/10.4103/jiaps.jiaps_184_24

[57] Muensterer, O.J. and Gianicolo, E. (2019) Contralateral Processus Closure to Prevent Metachronous Inguinal Hernia: A Systematic Review. *International Journal of Surgery*, **68**, 11-19. https://doi.org/10.1016/j.ijsu.2019.06.001

[58] Wenk, K., Sick, B., Sasse, T., Moehrlen, U., Meuli, M. and Vuille-dit-Bille, R.N. (2015) Incidence of Metachronous Contralateral Inguinal Hernias in Children Following Unilateral Repair—A Meta-Analysis of Prospective Studies. *Journal of Pediatric Surgery*, **50**, 2147-2154. https://doi.org/10.1016/j.jpedsurg.2015.08.056

[59] Miyake, H., Fukumoto, K., Yamoto, M., Nouso, H., Kaneshiro, M., Nakajima, H., *et al.* (2015) Comparison of Percutaneous Extraperitoneal Closure (LPEC) and Open Repair for Pediatric Inguinal Hernia: Experience of a Single Institution with over 1000 Cases. *Surgical Endoscopy*, **30**, 1466-1472. https://doi.org/10.1007/s00464-015-4354-z

[60] Amano, H., Tanaka, Y., Kawashima, H., Deie, K., Fujiogi, M., Suzuki, K., *et al.* (2017) Comparison of Single-Incision Laparoscopic Percutaneous Extraperitoneal Closure (SILPEC) and Open Repair for Pediatric Inguinal Hernia: A Single-Center Retrospective Cohort Study of 2028 Cases. *Surgical Endoscopy*, **31**, 4988-4995. https://doi.org/10.1007/s00464-017-5472-6

[61] Staerkle, R.F., Guglielmetti, L.C., Bielicki, I.N., Gaukel, S., Frongia, G., Hilton, S., *et al.* (2020) Is It Worth to Explore the Contralateral Side in Unilateral Childhood Inguinal Hernia? A PRISMA-Compliant Meta-Analysis. *Medicine*, **99**, e21501. https://doi.org/10.1097/md.0000000000021501

[62] Zhong, H. and Wang, F. (2014) Contralateral Metachronous Hernia Following Negative Laparoscopic Evaluation for Contralateral Patent Processus Vaginalis: A Meta-Analysis. *Journal of Laparoendoscopic & Advanced Surgical Techniques*, **24**, 111-116. https://doi.org/10.1089/lap.2013.0429

[63] Ikeda, H., Suzuki, N., Takahashi, A., Kuroiwa, M., Sakai, M. and Tsuchida, Y. (2000) Risk of Contralateral Manifestation in Children with Unilateral Inguinal Hernia: Should Hernia in Children Be Treated Contralaterally? *Journal of Pediatric Surgery*, **35**, 1746-1748. https://doi.org/10.1053/jpsu.2000.19239

[64] S.J. Duan, H.S. Liu, J. Niu, C.X. Wang, S.H. Chen, M.H. Wang, (2014) Classifications of Clinical and Bowel Morphological Changes and Their Relationship with Characteristics of Patients with Incarcerated Groin Hernias. *Medical Science Monitor*, **20**, 214-218. https://doi.org/10.12659/msm.889786