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Systemic Hypoxia as a Predisposing Factor for Neonatal Appendiceal Perforation: A Case Report of a Term Female with Pulmonary Stenosis

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1. Abstract

Background: Neonatal appendicitis (NA) is an exceptionally rare condition, with an incidence of 0.04–0.2% of live births. Its nonspecific presentation often overlaps with necrotizing enterocolitis (NEC) and other abdominal pathologies, making timely diagnosis challenging. Morbidity and mortality remain significant despite advances in neonatal intensive care and surgical management.

1.2. Case Presentation

We report a term female neonate with severe pulmonary valve stenosis who developed abdominal distension and rapid deterioration. Initial imaging was inconclusive, but subsequent abdominal radiography revealed pneumoperitoneum. Emergency laparotomy demonstrated a perforated appendix with otherwise healthy bowel. Histopathology confirmed acute appendicitis with ganglion cells present, excluding Hirschsprung's disease. The patient underwent appendectomy and ileostomy, followed by successful balloon valvuloplasty and eventual stoma reversal. She was discharged in good condition and remained well at six-month follow-up.

1.3. Conclusion

This case highlights systemic hypoxia as a potential predisposing factor for neonatal appendiceal perforation. Clinicians should maintain a high index of suspicion for NA in neonates with congenital heart disease presenting with abdominal distension. Prompt recognition and surgical intervention are critical for survival.

2. Introduction

Neonatal Appendicitis (NA) is an exceedingly rare clinical entity, with a reported incidence ranging from 0.04% to 0.2% of all live births [1]. Unlike appendicitis in older children, NA poses a significant diagnostic challenge because its symptoms, such as abdominal distension and feeding intolerance, frequently overlap with more common conditions, including necrotizing enterocolitis (NEC), intestinal obstruction, and gastroenteritis [2].

Recent multicentre data indicates a significant improvement in outcomes, with mortality rates dropping from a historical high of 23% to approximately 5.4% [3]. This improvement is largely attributed to advancements in neonatal intensive care and surgical management. The pathogenesis of NA differs from the paediatric and adult populations, where luminal obstruction by fecaliths is the primary aetiology. In neonates, the cause is often multifactorial [3,4]. Current literature proposes three primary pathophysiological theories: Immune deficiency associated with NEC or localized NEC of the appendix. [4,5], vascular insufficiency resulting from systemic hypoxia or low-flow states and distal obstruction typically driven by underlying pathologies such as Hirschsprung's disease (HD) or meconium ileus [4].

We present a rare case of a term female neonate with severe pulmonary stenosis who developed perforated appendicitis. This report highlights systemic hypoxia as a potential predisposing factor and emphasizes the necessity of maintaining a high index of suspicion in neonates with congenital heart disease.

3. Case Report

A female neonate was born at term (gestational age 38 weeks, weight 3.5 kg), via normal vaginal delivery. On the second day of life, she was referred to our institution for suspected congenital heart disease due to resting oxygen saturations of 80–90% on room air. Echocardiography confirmed severe pulmonary valve stenosis with a dysplastic valve annulus.

On the third day of life, while awaiting cardiac intervention, the patient developed abdominal distension with no vomiting and normal bowel motion. No fever or tachycardia. Initial laboratory investigations showed a C-reactive protein (CRP) level of 0.9 mg/L and a white blood cell (WBC) count of 9,000/µL. An initial abdominal X-ray was negative for pneumatosis intestinalis or pneumoperitoneum.

However, within 24 hours, the patient's condition deteriorated rapidly with severe abdominal distension, vomiting, and a significant CRP rise to 88 mg/L. A repeat abdominal X-ray revealed pneumoperitoneum. See Figure 1.

The patient underwent an emergency exploratory laparotomy, which revealed a perforated appendix at the base with the remainder of the bowel appearing healthy. See Figure 2. Appendectomy was performed, the caecal wall was debrided and closed, and a diverting ileostomy was created.

Histopathology confirmed an inflamed perforated appendix, with muscular tissue infiltrated by neutrophils and haemorrhage, consistent with NA, and confirmed the presence of ganglion cells in the appendix and caecal biopsy, ruling out HD. Following the surgery, the patient was stabilized on Total Parenteral Nutrition (TPN). On the 14th day of life, she successfully underwent balloon valvuloplasty for her pulmonary stenosis. At two months of age, a contrast study confirmed no strictures, and the ileostomy was reversed. She was discharged in good condition and remained well at a six-month follow-up.

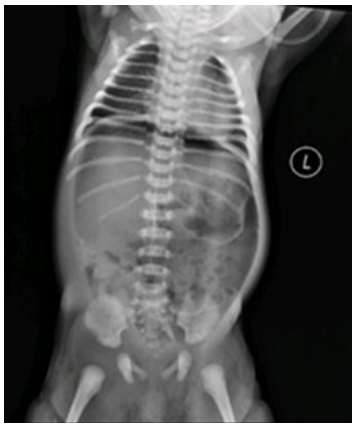

Figure 1: Plain abdominal radiograph showing pneumoperitoneum.

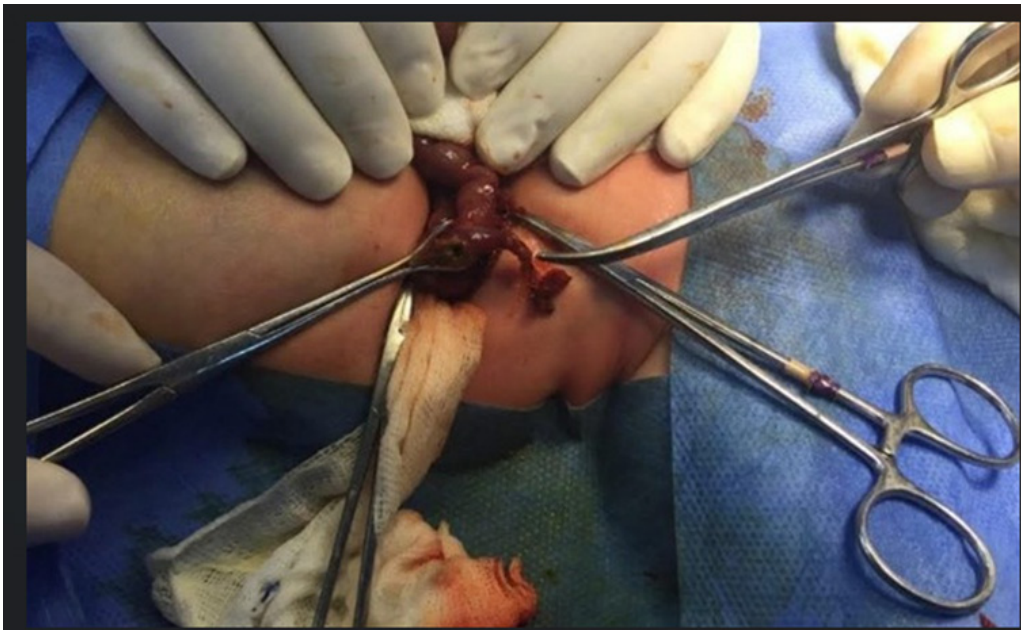

Figure 2: Intraoperative image showing a perforated appendix at its base.

4. Discussion

NA is a rare and deceptive pathology that requires a high index of suspicion. Due to its infrequency, it is rarely included in the initial differential diagnosis, which often leads to delayed diagnosis and management. Consequently, the presentation of a term female neonate, as seen in this case, is atypical and can further complicate timely diagnosis [6].

Several anatomical factors contribute to the rarity of appendicitis in newborns, including the funnel-shaped fetal appendix, a wide appendiceal orifice, and underdeveloped lymphoid tissue, which collectively decrease the likelihood of luminal obstruction [7]. However, once inflammation begins, neonates are uniquely vulnerable to rapid progression. The neonatal appendiceal wall is thin, making it highly prone to early perforation [7,8]. Furthermore, the neonatal momentum is underdeveloped and unable to wall off the infection effectively, leading to rapid dissemination of peritonitis [8].

In contrast to older children, neonates lack well-developed ab-

dominal musculature; therefore, they rarely present with the classic board-like rigidity, making the physical examination unreliable [9]. The clinical presentation of NA is non-specific, with abdominal distension being the most common presenting symptoms (52.2%), followed by feeding intolerance and vomiting [2]. This non-specific presentation frequently leads to misdiagnosis of NEC and delays in definitive surgical management [4,10].

In the present case, distal obstruction was ruled by histological confirmation. Vascular insufficiency hypothesis is the most likely mechanism. The appendix is supplied by an end-artery, making it uniquely susceptible to low-flow or hypoxic states. Although our patient remained hemodynamically stable, she persistently exhibited reduced oxygen saturations due to severe pulmonary valve stenosis. We propose that this chronic hypoxic state predisposed the appendix to ischemia and subsequent perforation. Similar associations have been reported, including cases involving hypoplastic left heart disease [11] and in a preterm baby with chronic anaemia [12]. Additional support for an ischemic aetiology comes from histopathological studies demonstrating transmural coagulative necrosis in the absence of classic inflammatory infiltrate [13].

The diagnostic approach to suspected NA must be decisive. Plain abdominal radiography is the first-line investigation, where the presence of pneumoperitoneum serves as an absolute indication for emergency laparotomy. When radiographic findings are equivocal, abdominal ultrasound is the preferred next modality, diagnostic features include appendiceal diameter ≥ 3.5–4 mm or wall thickening, or peri-appendiceal fluid [14,15]. Computed Tomography (CT), while highly sensitive, is generally reserved for cases in which ultrasound is inconclusive, given concerns regarding radiation exposure in neonates [16].

Paradoxically, neonates with appendiceal perforation and pneumoperitoneum often experience better outcomes, as the presence of free intraperitoneal air prompts immediate surgical intervention [17,18]. In this case, recognition of pneumoperitoneum on repeat radiography led directly to timely operative management, which was a key determinant of survival. Current evidence suggests that non-operative management of NA is associated with higher rates of morbidity and mortality compared to early surgical intervention [19].

5. Conclusion

Neonatal appendicitis remains a rare but life-threatening condition that is frequently misdiagnosed due to its nonspecific presentation and overlap with more common neonatal abdominal pathologies such as necrotizing enterocolitis. This case demonstrates that systemic hypoxia related to congenital heart disease may serve as a predisposing factor for appendiceal ischemia and perforation. The atypical presentation in a term female neonate further underscores the need for clinicians to maintain a broad differential diagnosis and a high index of suspicion. Early recognition, decisive imaging, and prompt surgical intervention are critical determinants of survival. Our patient's favourable outcome highlights the importance of rapid operative management once pneumoperitoneum is identified. This report adds to the growing body of evidence suggesting that vascular insufficiency should be considered in the pathogenesis of neonatal appendicitis, particularly in neonates with underlying cardiac disease.

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