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Case Report

Benign pneumoperitoneum in a neonate receiving positive pressure ventilation: A case report and clinical insights ☆,☆☆

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ABSTRACT

The presence of air in the peritoneal cavity demonstrated radiographically as the crescent of air under the diaphragm is termed pneumoperitoneum. The causative agents may be divided into spontaneous, traumatic, iatrogenic, and miscellaneous. The majority (~ 90%) of cases are attributed to hollow viscus perforation which requires immediate surgical attention. Neonatal pneumoperitoneum is a surgical emergency unless proven otherwise. A distinct entity termed benign pneumoperitoneum occurs in the absence of clinical and paraclinical features of peritonitis. Benign pneumoperitoneum may be caused by various thoracic, abdominal, and gynecological conditions. In neonates with respiratory distress pneumoperitoneum is a frequent association especially when treated with mechanical ventilation. The air leak phenomenon leads to air tracking from the ruptured alveoli along the interstitium to the mediastinum then to the retroperitoneum and ultimately into the peritoneal cavity. Such patients usually do not require surgical intervention and are managed conservatively. Knowledge of the existence of benign pneumoperitoneum helps to avoid unnecessary surgery thereby reducing operative morbidity and mortality.

Introduction

The pneumoperitoneum is defined as the presence of free air in the peritoneal cavity. The pneumoperitoneum may be spontaneous, traumatic, or iatrogenic [1]. The Vast majority of spontaneous pneumoperitoneum is caused by perforation of the gastrointestinal tract; hence demonstration of free air under the diaphragm is considered the hallmark of hollow viscus perforation which is a surgical emergency [2,3]. Besides surgical causes pneumoperitoneum may be caused by various benign conditions termed as benign, or nonsurgical pneu-

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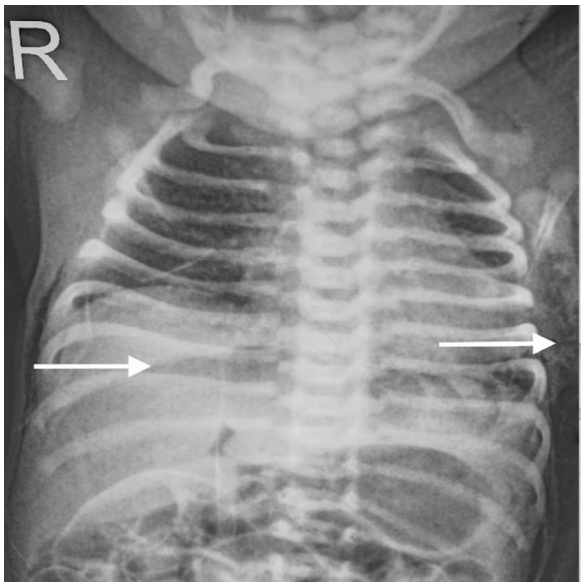

Fig. 1 – Chest X-ray AP view showing free air under the diaphragm with surgical emphysema. No pneumothorax or pneumomediastinum is seen.

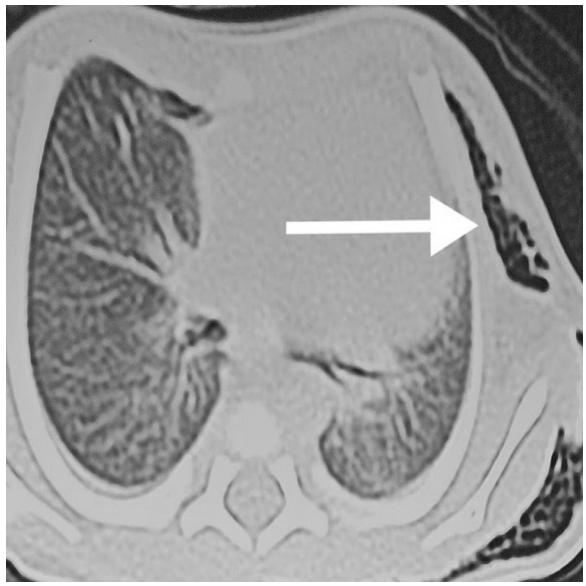

Fig. 2 – Axial CT chest lung window showing normal lung field. Presence of surgical emphysema in the left posterior and lateral chest wall (white arrow).

moperitoneum [3]. Benign pneumoperitoneum is diagnosed when free air is detected radiographically in the absence of clinical and paraclinical signs of peritonitis and is treated conservatively. Recognition of benign pneumoperitoneum obviates unnecessary laparotomy thereby reducing morbidity and mortality. We report a case of a neonate with respiratory distress syndrome treated with positive pressure ventilation who had later developed pneumoperitoneum and was treated successfully without surgical intervention.

Case report

A 9-day-old male child was referred to our hospital with a history of abdominal distension and scrotal swelling for the past 3 days. There was no history of fever or vomiting. Bowel and bladder habits were normal. On examination, the vitals were normal with the temperature, blood pressure, and capillary refill times within normal limits. The abdomen was mildly distended, and soft on palpation, and normal bowel sounds were present on auscultation. Crepitations were felt on palpation over the lower chest wall, abdomen, and thigh. Birth history revealed that the child was delivered at 35 weeks of gestation by cesarean section with a birth weight of 2170 gm. APGAR scores were 8 and 9 at 1 and 5 minutes respectively. The infant had been admitted to the NICU in another hospital with respiratory distress syndrome and was managed with noninvasive positive pressure ventilation.

On presentation to our hospital, a chest X-ray was requested which showed normal lung fields, and no evidence of pneumothorax or pneumomediastinum. Free intra-abdominal air was noted (Fig. 1). CECT chest and abdomen were performed to rule out the possibility of hollow viscus perforation. Air pockets were noted in the subcutaneous plane of the chest (Fig. 2), and the abdominal and pelvic wall extending into the scrotum and upper thigh (Fig. 3), suggestive of surgical emphysema. Moderate free air in the peritoneal cavity including the perihepatic region (Figs. 4A and B). The laboratory results were within normal range except for positive C-reactive protein.

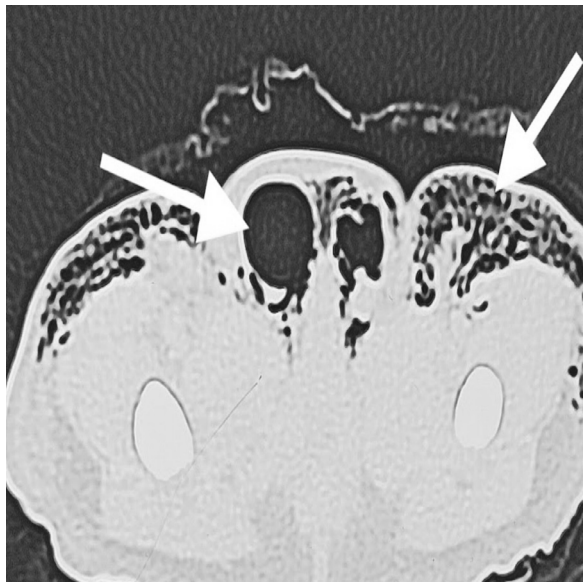

Fig. 3 – Axial CT pelvis lung window showing air in bilateral scrotal sacs, scrotal wall, and thigh (white arrow).

Considering the history of respiratory distress treated with positive pressure ventilation in the absence of clinical and paraclinical signs of peritonitis provisional diagnosis of benign pneumoperitoneum was made. The child was managed

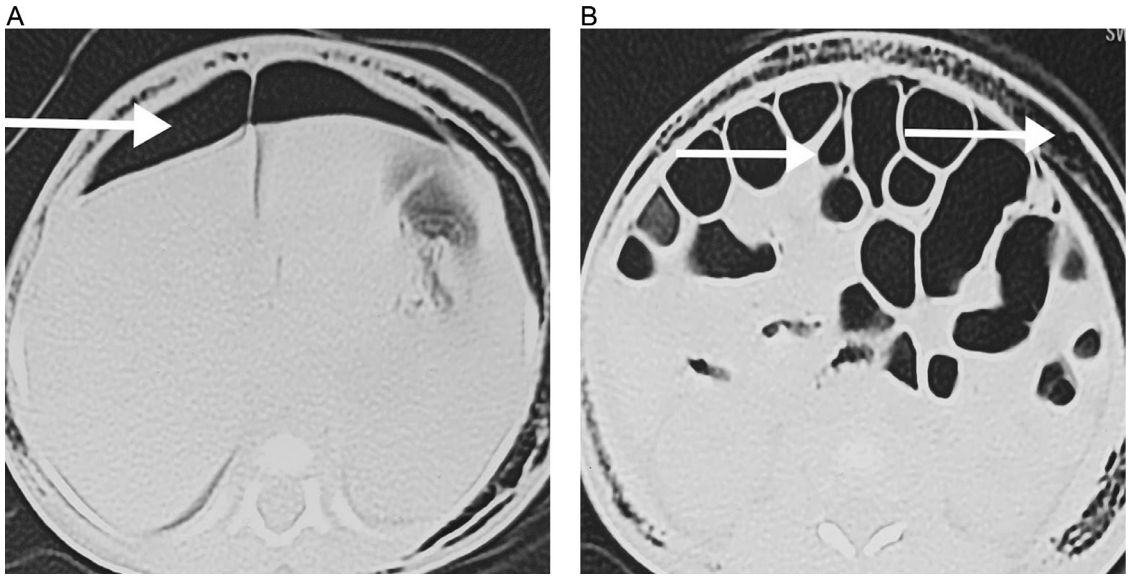

Fig. 4 – (A)Axial CT abdomen lung window showing a moderate amount of free air in the perihepatic region (white arrow). (B) Axial CT abdomen lung window showing a moderate amount of free air in the peritoneal cavity (white arrow) and subcutaneous tissue.

conservatively in the NICU with close monitoring. The symptoms improved and abdominal girth decreased gradually over 2 weeks without any complications and was discharged from the hospital.

Discussion

The pneumoperitoneum is defined as the presence of free air in the peritoneal cavity outside the alimentary tract. The causative agents may be categorized into spontaneous, iatrogenic, traumatic, or miscellaneous [3]. Majority (almost 90%) of cases of spontaneous pneumoperitoneum are caused by perforation of gastric or duodenal ulcers once postoperative causes are excluded [4]. In preterm neonates, the most common cause is necrotizing enterocolitis [5]. Khan et al. [6] reported cases of pneumoperitoneum in 89 neonates, 51% of which were due to necrotizing enterocolitis, 49% unrelated to necrotizing enterocolitis, and 7% with no apparent cause with benign pneumoperitoneum. Hence, radiographic evidence of free air under the diaphragm is considered the hallmark of hollow viscus perforation which requires prompt surgical intervention. Pneumoperitoneum can be demonstrated radiographically in 55%-85% of patients with perforation [7]. Following strict patient positioning and imaging protocol in left lateral decubitus for 10-20 minutes and additional upright for 10 minutes, as little as 1-2 ml of free air can be detected [8]. Minority of cases of pneumoperitoneum may be caused by benign conditions that do not require immediate surgical intervention termed as benign or nonsurgical pneumoperitoneum.

Besides hollow viscus, extra-alimentary intraperitoneal air may arise from the thorax, abdomen, and female genital tract. Thoracic causes include positive pressure ventilation, associated pneumothorax/pneumomediastinum, chronic obstructive airway disease, asthma, cardiopulmonary resuscitation, barotrauma, thoracic trauma, scuba diving, and rarely pulmonary sepsis. In neonates, there is a significant association of pneumoperitoneum with respiratory distress especially when ventilatory support has been applied. The physiology basis of the air leak phenomenon from ruptured lungs was first described by Macklin [9]. Intrathoracic pathologies raise the intra-alveolar pressure and air enters into the interstitial tissue along the perivascular and peribronchial sheaths of the lung resulting in pulmonary interstitial emphysema and then into mediastinum. Air then dissects along the esophagus and aorta into the retroperitoneum. Finally, the air via diffusion or rupture of the peritoneum results in pneumoperitoneum. Normally, the abdominal pressure exceeds intrathoracic pressure during inspiration and expiration. Raised intrathoracic pressure reverses this gradient and at pressures $>$ 40 cm H_2O results in interstitial emphysema, $>$ 50 cm H_2O results in pneumoperitoneum, and pressure exceeding 60 cm H_2O results in both pneumoperitoneum and surgical emphysema [10]. The alternative pathways for air may be the aortic and oesophageal hiatus, via congenital defects, or from a pleuroperitoneal fistula.

In the pediatric population, pneumoperitoneum occurs in 1%-3% of infants who are mechanically ventilated [11]. Leonidas et al. [12] had identified 9 cases of pneumoperitoneum in 222 mechanically ventilated newborns, 4 of them had no apparent bowel perforation and 2 had negative laparotomy for rupture of bowel. Mechanical ventilation causes air leaks due to the shear mechanism in the nonuniform lung during rapid changes in airway pressure during phasic change in ventilation [5].

The abdominal causes of benign pneumoperitoneum include pneumatosis cystoides intestinalis and coli, postlaparo-

tomy, postprocedure, and postendoscopy. Postoperative pneumoperitoneum usually persists for 3-7 days and decreases with time. A CT scan may demonstrate pneumoperitoneum in up to 23% of patients 3 weeks postoperatively [13]. Since the female genital tract communicates with the peritoneal cavity via fallopian tubes, pneumoperitoneum may be caused by instrumentation, pelvic examination, pelvic exercise in the knee-chest position, vaginal douching, oro-genital insufflation, and coitus [2,10]. Certain drugs such as steroids, nonsteroidal anti-inflammatory drugs, and immunosuppression can predispose to pneumoperitoneum.

The presence of pneumothorax and pneumomediastinum immediately before or simultaneously with pneumoperitoneum may suggest benign spontaneous pneumoperitoneum but this may not always be present [14]. Careful history and clinical examination to exclude features of peritonitis along with optimal use of plain radiography and water-soluble gastrointestinal contrast studies is essential to exclude perforation and recognize nonsurgical pneumoperitoneum [7]. Benign pneumoperitoneum is a surgical dilemma and treatment must be individualized. Most of these patients are managed conservatively with close monitoring.

Conclusion

The presence of pneumoperitoneum is not always a surgical emergency but may be an incidental or innocuous finding. Benign pneumoperitoneum may be caused by various thoracic, abdominal, and gynecological conditions. Neonates with respiratory distress receiving ventilatory support may develop benign pneumoperitoneum which is managed conservatively after excluding the possibility of GI perforation. Knowledge of this condition helps reduce the need to perform unnecessary emergency laparotomy.

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Ethical approval

This case report did not require review by the ethical committee.

Patient consent

Written informed consent was obtained from the patient for publication of this case report and accompanying images. A copy of the written consent is available for review by the Editor-in-Chief of this journal on request.

Author contributions

Sasmita Tuladhar: Conceptualization, as mentor and reviewer for this case report and for data interpretation. **Shailendra Katwal:** Contributed in performing literature review and editing. **Hari Om Joshi:** Contributed in writing the paper and reviewer for this case. All authors have read and approved the manuscript.

Registration of research studies

Not applicable.

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