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Case Report

Pigtail chest drain-related organ injuries in preterm neonates

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ABSTRACT

Pigtail catheters are increasingly used in Neonatal Intensive Care Units. Despite being easier to position, presumably less invasive, and non-inferior to classic trocar drains, complications related to placement have been sporadically reported. We describe 3 cases of traumatic injury to neighboring organs and structures related to pigtail catheter positioning in small preterm infants. In the absence of formal neonatal guidelines, accurate estimation of needle and guidewire depth and ultrasonography guidance may contribute to prevent such dreadful complications.

Keywords: Pigtail catheters, Trocar, Neonatal resuscitation

INTRODUCTION

Neonatal resuscitation, especially in preterm infants, frequently requires ventilation, either with mask or endotracheal tube. Pneumothorax is one of the major complications arising from positive pressure ventilation, and treatment usually involves chest drain placement in order to reduce the pleural space pressure and allow for re-expansion of the lung. Another common indication for chest drain placement is pleural effusion. Unfortunately, chest drains are associated with various complications such as infection, phrenic nerve paralysis and hemorrhage.[1] Historically, the most frequently used devices are trocar drains -disposable devices consisting of a sharp awl enclosed in a clear polyvinyl chloride (PVC) cannula1- or simple intravenous catheters. Due to traumatic complications associated with these drains, pigtail drains placed by Seldinger technique with a needle and a wire guide were developed. The force applied to insert a pigtail drain is indeed less compared to a classic trocar. Pigtail drains are efficient and easy to place and for these reasons, they are now widely used in neonatal intensive care units (NICU).[2,3] However, despite the ease of use and safety profile of pigtail drains, they are still associated with complications. Their use in preterm infants has been poorly studied and, whereas the British Thoracic Society recommended US-assisted chest catheter placement in adults is part in its 2010 guideline, there are still few -if any- pediatric guidelines.[4,5] Our purpose is to describe five cases illustrating unusual complications associated with pigtail catheter placement in preterm neonates.

CASE REPORT

Case 1

A preterm infant with antenatal diagnosis of Trisomy 21 and hydrops fetalis was delivered at 31 weeks in a level-2 unit via emergency caesarean section for acute fetal distress following amniocentesis. The infant presented with severe respiratory distress at birth, and the initial X-ray demonstrated pleural effusions predominant on the right, in addition to duodenal atresia. Emergency endotracheal intubation and surfactant administration were performed in the resuscitation room, and a pigtail chest tube was placed on the right side. The drain yielded 40 ml of clear serous fluid and was pulled back and secured since the cannula tip was too deep, though still appearing inside the thoracic space. The following day,

the fluid color changed, turning yellow to dark green. The neonate was transferred to our tertiary unit on the second day of life, as the fluid was seemingly bilious. The plain chest-abdomen radiogram showed an unusually low pigtail catheter with atypical curling, the tip pointing towards midline. An upper gastro-intestinal contrast x-ray revealed a gastro-pleural fistula, confirmed by methylene blue injected into the stomach draining via the pleural catheter, confirming the gastro-pleural fistula (Figure 1). The fistula was most likely caused by the needle inserted too low and the wire guide pushed too deep through the diaphragm, perforating the stomach. Gastric distension secondary to duodenal atresia may have contributed to the pathogenesis. After drain removal, the fistula resolved spontaneously, supporting its traumatic nature.

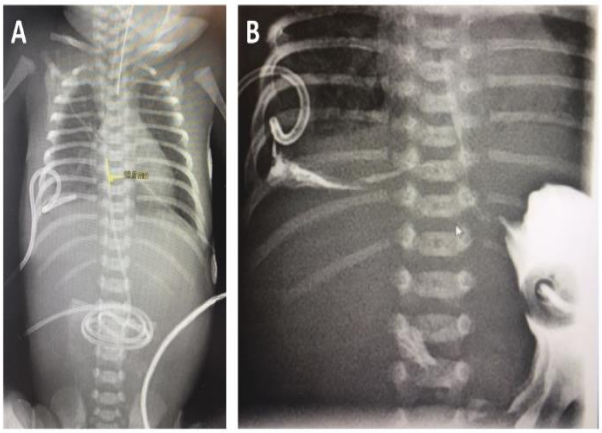

Figure 1: (A) Case 1 chest radiogram showing a right-sided chest tube placed at T9 level, unusally curled, with the tip pointing towards midline; (B) upper gastrointestinal tract contrast radiogram revealing a gastro-pleural fistula.

Case 2

A 25-week twin delivered by caesarean section for chorioamnionitis presented with respiratory distress syndrome requiring intubation and surfactant administration. A few hours later, oxygen requirement acutely increased and a right-sided tension pneumothorax was diagnosed. A pigtail drain was placed without any apparent adverse event. However, the pneumothorax persisted despite the apparently correct drain position and appropriate ventilation. The chest tube was removed and two extra drains were temporarily placed, but pneumothorax persisted and respiratory support remained significant, raising the suspicion of a pulmonary breach (Figure 2). Medical pleurodesis was attempted using surgical fibrin cement (Tisseel®) but was unsuccessful. Surgical exploration confirmed the presence of a pulmonary breach that was sutured, and the infant recovered well. Lung perforation likely occurred during insertion of the initial chest drain.

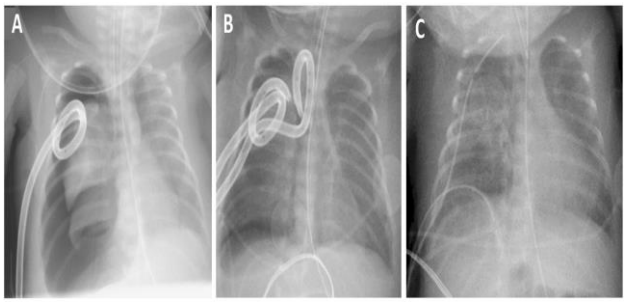

Figure 2: (A) Case 2 chest radiogram showing a right-sided chest tube placed at T5-T6 level; (B) persistence of free-air in the right pleural space despite chest tube in proper position; (C) persisting pneumothorax after chest tube removal.

DISCUSSION

Complications related to pigtail chest drain placement in infants are poorly described in the literature and whilst these newer drains are considered to be less traumatic than conventional drains, it is important that practitioners are aware of the potential complications.

Pigtail chest drain insertion is typically easy to perform in preterm infants and does not require an entry point incision. However, small-size neonates are more prone to organ damage if the needle or the guidewire are inserted too low, advanced too far, or at the incorrect angle. In infants with deep subcutaneous edema, it may be very difficult to determine the optimal insertion depth. Roberts et al describe complications of pigtail chest drain placement such as hemothorax and hepatic perforation reporting significantly more complications in patients under 5 kg than in larger children.[6] Reed et al reported that beside the apices of the lung being a classic site of injury, pericardial breaches occur. Injuries may not be clinically detected at the time of placement, and complications may be seen in the following days, or on post mortem examination.[1] Pleuro-pericardial communication and lung transection have been reported as a consequence of insertion.[7,8] Accurate estimation of the desired depth of needle, guidewire or drain insertion may be challenging. To our best knowledge, in most commercially available kits, insertion needles, guidewires and catheters lack graduation marks. Placement verification by plain antero-posterior x-ray may have limitations, as shown in this series. Pigtail catheters are designed to curl. If they appear to be straight or atypically curved, the tip is likely to be within a solid structure and mispositioned.

None of the pigtail drains described in this case series were placed under ultrasonography (US) guidance. According to Lewis et al, real-time US-guided pigtail chest drain placement is associated with high success rates and better outcome variables; shorter duration of drains in situ, decreased hospital stay, less need for a second drain, fewer surgical interventions and lower rates

of complications, even though they reported a broncho-pleural fistula in one case.[9] When readily available, point-of-care US may facilitate prompt diagnosis of pneumothorax and obviate chest tube placement.[10] However, US-guided placement requires an effective training program in order to ensure practioners' proficiency, and the use of point-of-care US is still restricted to few NICU's.

CONCLUSION

Small preterm infants are prone to injuries of lungs and adjacent organs during pigtail chest drain placement. In order to reduce complications, strict attention to anatomical landmarks and accurate verification of catheter positioning are critically important. A proposed technique is to estimate the anticipated insertion depth of the needle and mark it with a sterile-strip, so that the needle cannot be advanced beyond this mark. Point-of-care US-guided placement may be valuable in order to reduce such complications and verify proper placement of the catheter, since plain antero-posterior radiography has intrinsic limitations. Close monitoring of vital signs before, during and after placement is also mandatory in order to detect sooner catheter mispositioning and potentially dreadful complications.

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