Pneumothorax in neonates: Complication during endotracheal intubation, diagnosis, and management

Sir,

Neonatal pneumothorax is a life-threatening condition associated with a high incidence of morbidity and mortality. Its incidence in the Neonatal Intensive Care Unit (NICU) is reported as 1-2% and over 40% in the presence of respiratory distress syndrome. It is more common in ventilated neonates. Mortality rates have varied from 20% to 38%. Predisposing factors identified in the NICU are male sex, low birth weight neonates, prematurity, neonate born by cesarean section, the presence of respiratory distress syndrome, and meconium aspiration requiring resuscitation after birth. However, perioperative pneumothorax in neonates is an uncommon event, and that occurring during endotracheal intubation has not been reported. If not suspected, it can lead to unwarranted interventions and increasing morbidity including cardiovascular collapse from lack of appropriate treatment.

We present two cases of intraoperative pneumothorax in neonates occurring during endotracheal intubation. Use of transillumination of the neonatal chest facilitated early diagnosis in one neonate, whereas delay in diagnosis in the other neonate necessitated resuscitative measures for cardiovascular collapse.

A 3-day-old neonate, born at 35 weeks gestation, weighing 1.28-kg, with dysmorphic facial features, was scheduled for repair of a lumbosacral meningomyelocele. Due to the potential for a difficult airway, an inhalation induction was performed with 6% sevoflurane in 100% oxygen. Laryngoscopy revealed a grade 3 (Cormack and Lehane classification) glottic view. Rocuronium 1 mg was then administered intravenously. A 2.5 mm reinforced endotracheal tube (ETT) was railroaded over a bougie (single use 5 CH Portex Tracheal Tube Introducer, SIMS Portex, Hythe, Kent, UK) into the trachea to a depth of 8 cm at the gums after an unsuccessful attempt with a styletted ETT. Correct placement was confirmed by auscultation of equal bilateral breath sounds. Shortly after, $\text{SpO}_2$ decreased to 92%. Repeat chest auscultation revealed decreased breath sounds on the left side. Withdrawal of the ETT by 1 cm, decompression of the stomach and suctioning of the ET tube did not improve the oxygen saturation. The $\text{SpO}_2$ continued to decrease to 85% with increasing peak airway pressures. The baby was reintubated with a 2.5 mm ETT to rule out any obstruction in the ETT. As the diagnosis of pneumothorax was being considered, the baby’s heart rate decreased to <80/min. Chest compressions were initiated, and adrenaline, 10 mcg was administered intravenously. A needle thoracocentesis was performed with a 22 g butterfly needle in the second left interspace midclavicular line with immediate improvement in heart rate and $\text{SpO}_2$. A formal chest drain was subsequently inserted. The baby was transferred back to the NICU. The meningomyelocele was closed uneventfully 2 days after resolution of the pneumothorax.

A 34-week-old newborn, weighing 2-kg, was scheduled for repair of gastrochisis a few hours after birth. Anesthesia was induced with sodium thiopentone, fentanyl, and atracurium. The baby’s trachea was intubated with a 3.0 mm uncuffed ETT to a depth of 8.5 cm at the gums. Auscultation revealed equal bilateral breath sounds. The baby was hand ventilated with a Jackson-Rees circuit during surgery to help better manage changes in airway pressures when the bowel loops were returned to the abdomen. Intraoperatively, $\text{SpO}_2$ decreased to 88%, which improved to 97-98% when the ETT was suctioned and withdrawn to 8 cm at the gums. The baby
remained hemodynamically stable during surgery. At the end of surgery, the ETT was exchanged over a bougie, to ensure, it was not blocked by a mucous plug in view of the intraoperative desaturation. Immediately after, ventilation became very difficult, and breath sounds were reduced on the right side. Transillumination of the thorax revealed a large right tension pneumothorax. Needle thoracocentesis was performed with a 24 g butterfly needle inserted anteriorly into the second right intercostal space in the midclavicular line. Oxygen saturation improved to 99%. A formal chest drain was then inserted. The baby was returned to the NICU.

Neonatal pneumothorax is a life-threatening condition associated with a high incidence of mortality and morbidity.[1] Perioperative pneumothorax in neonates is not a common occurrence. It is a recognized complication of certain procedures such as subclavian or jugular line insertion or laparoscopic surgery. There are few case reports describing perioperative pneumothorax in neonates in unusual circumstances. Reports by Glaisyer and Way identified no specific causes, but in 2 of the 3 cases, the trachea was re-intubated using a bougie.[6] In the reports by Sabar et al.[7] and Iannoli et al.,[8] pneumothorax occurred during flexible fiberoptic bronchoscopy performed before repair of a tracheoesophageal fistula and as a result of a kink in the reservoir tube of a Jackson-Rees circuit, respectively. Pneumothorax is associated with a range of clinical findings including unequal chest expansion, decreased breath sounds, chest hyper-resonance on percussion, decrease in blood pressure, heart rate and oxygen saturation, as well as a narrowing of the pulse pressure.[1] Chest X-ray is the gold standard for diagnosing pneumothorax in the nonemergent situation. Transillumination of the neonatal chest is a technique widely used in NICUs to confirm the diagnosis of pneumothorax, but most anesthesiologists may not be familiar with this technique.[9] A high intensity transilluminating portable light source with a flexible fiberoptic light probe is used. With ambient light dimmed, the probe is placed just superior to the nipple on the supine neonate’s chest. It is then lifted and placed inferior to the nipple. The transilluminating light can be applied as long as necessary to each side of the chest since the probe remains cool. A pneumothorax appears as a translucent area in the chest cavity. Lung parenchyma is opaque. With a massive pneumothorax, the entire affected hemithorax lights up. The thinness of the neonate’s chest and the very low density of air provide optimal conditions to detect pulmonary air leaks by transillumination in neonates. Figure 1 demonstrates a pneumothorax as seen as with transillumination. Transillumination is most beneficial in detecting a sudden, life-threatening pneumothorax, which requires immediate therapy. This technique may be more readily available in the operating room than a chest X-ray. Recently, ultrasonography has also been utilized in adults to diagnose pneumothorax.[10] There is no literature of its use in the pediatric population. In case 2, early diagnosis with transillumination guided treatment before hemodynamic instability occurred. Once a diagnosis of tension pneumothorax has been made, prompt treatment should be undertaken to prevent serious morbidity and mortality. In an unstable patient, rapid treatment usually necessitates needle thoracocentesis with a small gauge needle in the second intercostal space midclavicular line or fifth intercostal space midaxillary line. This is then followed by a formal chest drain.

In both our cases, there was a series of events that occurred before a diagnosis of pneumothorax was made. These included endotracheal intubation over a bougie, desaturation, suctioning the ETT, difficult ventilation and increasing airway pressure. Pneumothorax may have occurred due to trauma from the bougie or during suctioning of the ETT or due to fluctuations in positive pressure during transition periods between clinical interventions.

A pattern of multiple clinical interventions including an apparent need to re-intubate, intubation using an adjunct like a bougie, ETT suctioning and increasing airway pressures during the perioperative period must lead to a high index of suspicion for a pneumothorax. Transillumination can aid in early diagnosis and treatment to prevent morbidity associated with this potentially fatal complication.

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Conflicts of interest
There are no conflicts of interest.
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