

## CONGENITAL DIAPHRAGMATIC HERNIA IN A TWO-DAY-OLD NEONATE: ANAESTHETIC MANAGEMENT AND CHALLENGES

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### ABSTRACT

#### INTRODUCTION

Congenital diaphragmatic hernia in a neonate is a challenging task to any anaesthesiologist. CDH occurs due to an early developmental defect that results in the extrusion of intra-abdominal organs (i.e. stomach, small intestines, spleen, liver) into the thoracic cavity. In 85% of the cases it is left sided. This leads to lung hypoplasia, pulmonary hypertension, and pulmonary arteriolar dysregulation/reactivity. Historically, CDH was considered to be a surgical emergency and aggressive hyperventilatory strategies with high peak inspiratory pressures were employed to improve survival. But recent multicentre studies have shown the beneficial effect of conservative low volume ventilation with low inflation pressures and permissive hypercapnia. We present to you the successful management of a two day old neonate with this ventilation strategy.

#### KEYWORDS

Congenital Diaphragmatic Hernia, Neonate, Anaesthesia.

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**INTRODUCTION:** Congenital diaphragmatic hernia(CDH) is an anomaly that occurs in 1 in approximately 3000 live births.<sup>1</sup> More than 85% are left sided and the commonest form is the classic posterolateral or Bochdalek hernia.<sup>2</sup> Gross was the first person who reported a series of successful repairs in 1946 with 100% survival and over the next 40 years, CDH was considered the quintessential neonatal surgical emergency.<sup>3</sup> Since then, despite advances in neonatal intensive care, anaesthesia, and surgery, the overall survival rate has remained just around 50%.<sup>4</sup>

**CASE REPORT:** We present to you a two-day-old neonate weighing 2.9 kg who was crying excessively on being fed. The baby was delivered by spontaneous vaginal delivery and cried immediately after birth. On physical examination, the baby was in respiratory distress with heart rate of 150/min, respiratory rate of 64/min and oxygen saturation of 80% in room air with mild cyanosis. Air entry was diminished on the left side of the chest and heart sounds were more pronounced on the right side. However, no bowel sounds were heard in the chest on auscultation. The abdomen was soft, mildly scaphoid and peristalsis was present. Multi detector CT (MDCT) of the thorax revealed multiple air-filled spaces of varying sizes and shapes with morphology of bowel loops in the left hemithorax extending across the midline to the posterior aspect and showing intra-abdominal

communication through focal defect in the left hemidiaphragm. A diagnosis of left side CDH was made and posted for emergency surgery.

In the OT, standard monitors were connected including SpO<sub>2</sub>, ECG, skin temperature probe and paediatric BP cuff was placed in the thigh. Aspiration of the stomach contents was done preoperatively. Preoxygenation was done with 100% O<sub>2</sub> for 5 minutes. Since the previous intravenous line was not functioning properly, the baby was first induced with O<sub>2</sub> with sevoflurane and then IV line was secured with 24G cannula. The baby was given 2.5 mcg inj. fentanyl for analgesia. The baby was intubated awake with size 3.5 mm uncuffed ETT and ventilated with Jackson-Rees circuit. Inj. atracurium was given after the tube placement was confirmed by bilateral chest auscultation and detection of ETCO<sub>2</sub>. A precordial stethoscope was placed to hear the heart sounds and detect dislodgement of the tracheal tube. Maintenance was done with O<sub>2</sub>, atracurium and sevoflurane. ETCO<sub>2</sub> was monitored and maintained between 45-55 mm of Hg with gentle hand ventilation. Supplementary analgesia was provided with Inj. Paracetamol 20 mg in IV fluid. A left subcostal incision was made with the baby in supine position. Small bowel loops, spleen and part of the large bowel herniating into the left thoracic cavity was reduced and the diaphragmatic defect was repaired. Duration of surgery was about 2 hours during which the patient was normothermic and haemodynamics and oxygen saturation was maintained. 20 mL intraoperative blood loss was replaced with Isolyte-P. Controlled ventilation was continued into the post-operative period in paediatric surgery ICU. Analgesia was maintained with fentanyl infusion. He was initially put on SIMV mode on ventilator with PEEP of 4 cm H<sub>2</sub>O and FiO<sub>2</sub> of 50%. Peak inspiratory pressure (PIP) was

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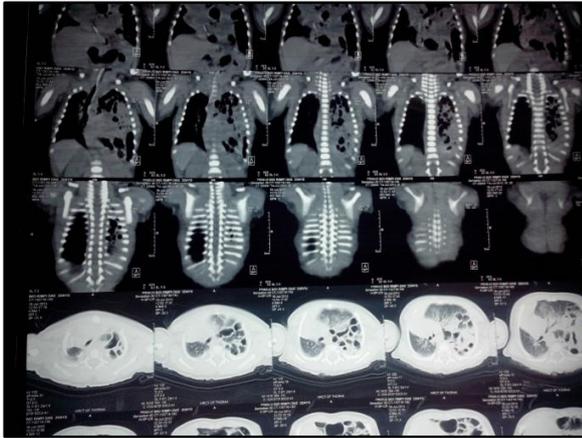
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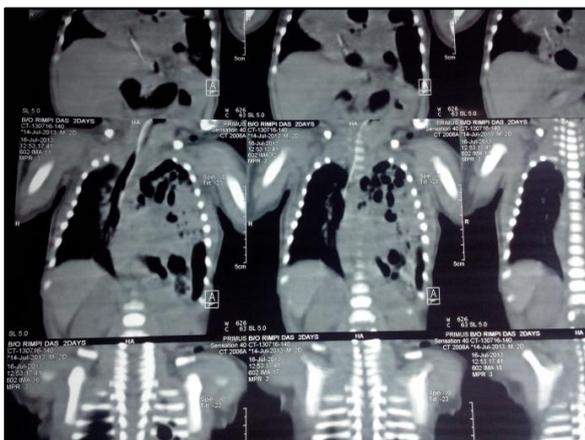
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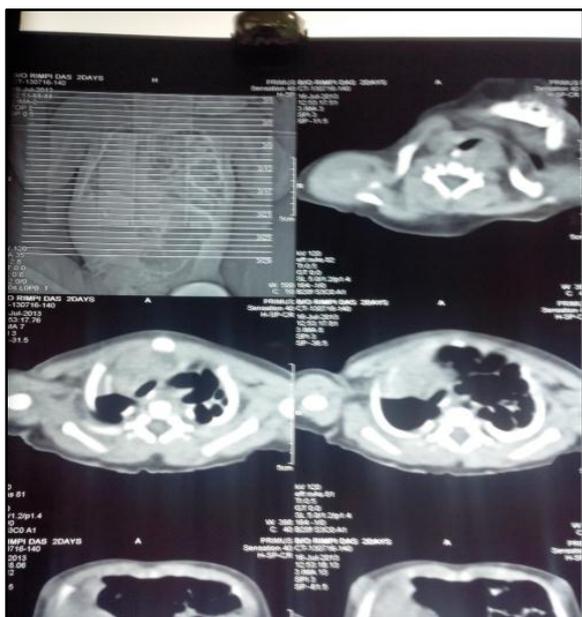
kept between 20-25 cm H<sub>2</sub>O. On day 2, he was put on pressure support ventilation (PSV) with decrease in the FiO<sub>2</sub> to 40%. The baby was successfully extubated on the fourth post-operative day with saturation of 96-98% with O<sub>2</sub> via face mask, heart rate of 170/min and respiratory rate of 30/min. Post-operative chest x-ray showed improved compliance of the left lung. The baby was discharged on the 11<sup>th</sup> postoperative day.



**Fig. 1**



**Fig. 2**



**Fig. 3**

**DISCUSSION:** The main problem with CDH is the herniation of abdominal viscera into thoracic cavity which leads to pulmonary hypoplasia due to compression by the viscera on developing lungs which in turn leads to pulmonary hypertension. To improve ventilation high-frequency oscillatory ventilation (HFOV), Extracorporeal Membrane Oxygenator (ECMO) and pulmonary vasodilators are used.<sup>5</sup> While joint studies between Toronto and Boston have shown no survival benefit between the two interventions (HFOV and ECMO), many centres now reserve ECMO for rescue therapy for infants who have failed other means of ventilation (Bohn, 2006).<sup>6</sup> The role of inhaled nitric oxide use is controversial in this regard.<sup>7</sup>

There is difference of opinion on the emergency nature of the surgery with Breaux CW, et al (1992) advising correction of the defect to be carried out as early as possible<sup>8</sup> while Yao FS et al(2003) opining that repair of the hernia is not a surgical emergency unless the contents of hernia are incarcerated.<sup>9</sup> Langer JC et al (1988) opined that early surgery decreases thoracic compliance which in turn leads to worsening of the condition due to barotraumas and persistent foetal circulation from high pressure ventilation. Many other works agree with this finding and therefore advocate stabilisation by mechanical ventilation, paralysis, pulmonary vasodilators and ECMO before surgery.<sup>10</sup>

In our case; however, decision to operate was taken as the patient was stable haemodynamically and to achieve maximum possible lung expansion at the earliest. ECMO was not available in our setup.

The goals of anaesthesia are prevention of hypoxia, acidosis, hypotension and hypothermia which lead to increase in pulmonary vascular resistance (PVR). The idea is to avoid increase in PVR which may cause reversal of shunt. The patient was induced with oxygen and sevoflurane. Preoxygenation was done with 100% O<sub>2</sub> for 5 minutes to increase the FiO<sub>2</sub>. Gastric decompression was done preoperatively.

Normothermia was maintained inside the OT to prevent excessive oxygen consumption and opioids (fentanyl) were used to provide analgesia as well as to minimise sympathetic overactivity.

Intubation was done awake and positive pressure ventilation was avoided to prevent stomach or bowel lumen inflation.

We used low tidal volumes with permissive hypercapnia and limiting the peak pressures to less than 25 cm of H<sub>2</sub>O in line with the ventilatory strategies described by Boloker, et al (2002)<sup>11</sup> and Bagolan P, et al (2004).<sup>12</sup> The ETCO<sub>2</sub> was maintained between 45-55 mm of Hg. N<sub>2</sub>O was avoided as it may aggravate the gastric and bowel loop distension.

Electrolyte and acid-base balance was well maintained by taking occasional arterial blood gas samples. Normotension was maintained throughout the procedure.

Postoperatively, the intraoperative ventilatory strategies were continued with spontaneous ventilation, permissive hypercapnia and low peak inspiratory pressures (<25 cm of H<sub>2</sub>O) as suggested by Boloker, et al.<sup>11</sup>

**CONCLUSION:** Anaesthetic management of a neonate with CDH is a challenging task for any anaesthesiologist. While historical survival rates of these patients hover around 50%, newer studies have reported survival rates as high as 75% with decreased use of ECMO. What is common in these case series is the increasing use of low volume tidal ventilation with permissive hypercapnia and limiting the peak pressures to less than 25 cm of H<sub>2</sub>O, which seems to have a good prognostic outcome.

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