Case Report

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Anaesthetic Management of a Neonate with Right Sided Congenital Diaphragmatic Hernia

Anaesthesia Section

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ABSTRACT

Neonates who are born with CDH suffer from sub-stantial morbidity and mortality. Modalities of treatment are said to influence outcome, apart from pre-natal and post-natal factors. Reports from developed countries have described improved survival with High Frequency Oscillatory Ventilation (HFOV), Extra Corporeal Membrane Oxygenation (ECMO) and inhaled Nitric Oxide (NO). Many centres in developing countries lack these neonatal advanced care facilities and outcome is expected to be different. In this case, we have focused on anaesthetic management of RCDH in a 5–day–old neonate, by using conventional ventilation.

Keywords: Congenital diaphragmatic hernia, Ventilator care strategy

CASE REPORT

A 5–day–old female baby weighing 2 kg was brought to the Emergency Room (ER) of our hospital by the mother, with complaints that the baby was crying excessively and that she was not feeding since past 2 days. The baby was delivered at home by a trained birth attendant and she cried immediately after her birth. The mother had not undergone any antenatal checkups during her pregnancy.

In the ER, the baby was in severe respiratory distress, with a Respiratory Rate (RR) of 80/min and oxygen saturation (SpO_2) of 70% on room air. Systemic examination showed decreased air entry on right side, apex beat shifted to left and a scaphoid abdomen. ABG showed pH: 7.28, partial pressure of oxygen(PaO_2)–54 mm Hg and partial pressure of carbon dioxide($PaCO_2$) -55mm Hg. The baby was immediately intubated with a size 3.0 endotracheal tube. A nasogastric tube was placed. The chest X-ray showed subnormal lung expansion on right, herniated bowels, with air and fluid in right hemi-thorax . Chest and other mediastinal structures were shifted to left and there was no liver herniation. A diagnosis of RCDH was made and it was confirmed with X-ray Gastrografin. The baby was shifted to neonatal intensive care unit (NICU) for ventilator support. The initial ventilator settings were pressure control (PCV) mode of ventilation, inspiratory pressure(P_{insp}) -15 cm H_2O, peak end expiratory pressure (PEEP) -4 cmH_2O and inspired fraction of oxygen(FiO_2) -1.0. ECHO showed a patent ductus arteriosus with a right to left shunt and pulmonary artery pressure of 45mmHg. Circulatory support was provided with inj Dopamine, along with maintanance fluid. Surgery was planned after pre-operative stabilization of the baby.

After 2 days of ventilation, pre–ductal and post–ductal arterial blood gas (ABG) sampling was done. The PaO_2 was 68mmHg (pre-ductal) and 60mmHg (post-ductal) and SpO_2 was 92%(pre-ductal) and 88%(post-ductal) at FiO_2 of 0.4. The baby maintained normal haemodynamic parameters with no circulatory support. As the pre-operative stabilization goals were achieved, the case was accepted for surgery. A written and informed consent for surgery was obtained from the parents and the case was shifted to operation theatre with ambu ventilation and oxygen (O_2) supplementation. The baby was ventilated with 100% O_2, as the facility to provide air was not available in our anaesthesia machines.

The stomach was decompressed by naso gastric tube suction and inj Fentanyl 10mcg and inj ondansetron 1mg were given. Monitors like those of Electro Cardio Gram (ECG), Non-Invasive Blood Pressure (NIBP), 2 pulse oximeters (pre–ductal and post-ductal) and temperature were connected. Baseline readings of HR- 122/min, BP -78/44mmhg, SpO_2 -92% and a temp of 37ºC were noted. A precordial stethoscope and a urinary catheter were placed. Anaesthesia was maintained with sevoflurane 2% and inj atracurium (bolus dose of 1mg and maintenance dose 0.01mg/kg).

A right sub–costal incision was made, with the baby in supine position. Bowel loops in right hemithorax were identified and reduced. The defect in right hemidiaphragm was closed. The duration of surgery was 1hr, 45min. The intra-operative blood loss was 20ml and urine output was 10ml. Intra-operative fluid management with Isolyte P was done as per Holliday Segar's formula.

Controlled ventilation was continued in the post–operative period with PCV mode, $P_{insp.}$ 12cm H_2O, PEEP- 3cm H_2O, FiO_2 -0.4.Post-operative analgesia was provided with inj fentanyl infusion at 1mcg/kg/hr.

There were no episodes of hypotension, hypoxia and hypothermia in the intra and post–operative periods. Chest X–ray was done in the post–operative period it showed, showed improved air entry into right lung.

The baby was successfully extubated on 3rd post-operative day and she was discharged on the 7th post–operative day.

DISCUSSION

CDH is associated with high mortality. Survival rates of only 50% have been reported in centres using conventional ventilation for management of CDH [1]. Large volume CDH studies are limited, as they had only small numbers of RCDH patients.The available data which have compared the management and outcome of R CDH vs LCDH are inconsistent. R CDH carries disproportionately high mortality and morbidity. The factors affecting LCDH survival, like associated cardiac anomalies, a need for ECMO, time to repair, cannot be extrapolated to R CDH survival [2,3]. R CDH has high ECMO utilization and it experiences greater relative benefit from ECMO [4]. ECMO facilities were not available at our hospital.

We adopted the ventilator care strategy which was first described by Wung and colleagues in 1995 in term infants with persistent foetal pulmonary circulation and severe respiratory failure, to manage our case. Their aims were to obtain adequate tissue oxygenation and

to minimize barotrauma. They demonstrated an increase in survival and a decrease in use of ECMO, with the use of this respiratory care strategy [5]. We achieved these aims by gentle ventilation using PCV mode of ventilation, by limiting peak pressures to less than 25 cm H_2O and by permissive hypercapnnia ($PaCO_2$levels between 45 -60mmHg, 50mmHg in our case) [6].

Since 1980s, delayed surgeries have become a widely accepted strategy for treatment of CDH, after Sakai et al., reported the worsening of cardiopulmonary function following early surgical repair [7]. The optimal timing has still not been universally accepted. The mean age of repair varies between 4.5 and 8.5 days after birth [8]. Our case was operated on the 8th day after birth.

The goals of pre-operative stabilization are normal haemodynamic variables, with no circulatory support and minimum difference in pre /post ductal oxygen saturation [9]. These were achieved in our case, as the baby maintained blood pressure appropriate for gestational age without any inotropic support. The difference in pre/post–ductal oxygen saturation was 4%.

The intra-operative goals of anaesthetic management, which were set for our case were 1) gentle ventilation with respiratory rates of 40 -80/min and small tidal volumes to maintain $ETCO_2$ 35-45 and low airway pressure, 2) avoiding an increase in Pulmonary Vascular Resistance (PVR), leading to right to left shunting, by avoiding hypoxia, hypothermia, hypotension and pain 3) avoiding a decrease in Systemic Vascular Resistance (SVR). FiO_2 could not be adjusted on our anaesthesia machine.

We managed the immediate post–operative period with assisted mechanical ventilation and fentanyl infusion for pain management. There were no episodes of hypoxia, hypotension and hypothermia. Hydroelectrolyte and acid base balance were well-maintained, which are the factors that increase PVR and cause reversal of shunt.

CONCLUSION

The responsibility of managing a neonate with CDH is challenging. There is no protocol of standardized postnatal treatment guidelines for management of RCDH. Many centres in developing countries lack advanced neonatal care facilities, but the use of conventional ventilation at these centres has shown good results.

REFERENCES

[1] Bhat YR, Kumar V, Rao A. Congenital diaphragmatic hernia in a developing country *Singapore Med J.* 2008 ;49(9):715.
[2] Fisher JC, Jefferson RA, Arkovitz MS, Stolar CJ. Redefining outcomes in right congenital diaphragmatic hernia *J Pediatr Surg*. 2008 Feb; 43 (2):373-79.
[3] Hedrick HL, Crombleholme TM, Flake AW, Nance ML, von Allmen D, Howell LJ, et al. Right congenital diaphragmatic hernia: Prenatal assessment and outcome. *Pediatr Surg*. 2004 Mar;39(3):319-23.
[4] Bryner BS, Kim AC, Khouri JS, Drongowski RA, Bruch SW, Hirschl RB, et al. Right-sided congenital diaphragmatic hernia: high utilization of extracorporeal membrane oxygenation and high survival *Pediatr Surg*. 2009 May; 44(5):883-7.
[5] Wung JT, Sahni R. Congenital diaphragmatic hernia: Survival treated with very delayed surgery, spontaneous respiration and no chest tube: *J Paediatric Surg.* 1995;30:406.
[6] Bagolan P, Casaccia G. Impact of a current treatment protocol on outcome of high risk congenital hernia. *J Paediatric Sur.* 2004; 39: 313.
[7] Sakai H, Tamura M, Hosokawa Y, Bryan AC, Barker GA, Bohn DJ. Effect of surgical repair on respiratory mechanics in congenital diaphragmatic hernia. *Journal of Paediatrics*. 1987; 111(3):432–38.
[8] Rohana J, Boo NY, Thambidorai CR. Early outcome of congenital diaphragmatic hernia in a Malaysian tertiary centre. *Singapore Medical Journal*. 2008; 49(2): 142–44.
[9] Reiss T, Schaible L, van den Hout. Standardized postnatal management of infants with congenital diaphragmatic hernia in Europe: The CDH EURO Consortium Consensus. *Neonatology.* 2010;98:354-64.

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