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SCIENTIFIC LETTER

Non-invasive respiratory approach at birth in newborns with mild diaphragmatic hernia

Aproximación respiratoria no invasiva al nacimiento en recién nacidos con hernia diafragmática leve

Dear Editor:

Congenital diaphragmatic hernia (CDH) is a birth defect resulting from the abnormal development of the diaphragm that allows the abdominal viscera to move up into the thoracic cavity. This condition is associated with varying degrees of pulmonary hypoplasia, pulmonary hypertension, and cardiac dysfunction, factors that largely determine neonatal morbidity and mortality. Its incidence is estimated at 1 in 2000–4000 births.

Currently, most cases are diagnosed prenatally, which allows for appropriate prognostic stratification. This is chiefly based on the observed/expected lung area to head ratio (O/E LHR) and the position of the liver (intrathoracic or intraabdominal).[1] Based on these criteria, cases can be classified as mild, moderate, or severe; this classification has prognostic and therapeutic implications. For example, fetoscopic endoluminal tracheal occlusion may be considered in fetuses with moderate or severe CDH.[2]

Traditionally, postnatal management guidelines have recommended, based on expert opinion, elective intubation in the delivery room to prevent gastric and bowel distension associated with noninvasive ventilation, which could further compromise lung function.[3,4] However, the European guidelines published in 2015 already recognized a subset of patients with favorable prognostic characteristics who could benefit from initial management based on spontaneous breathing, thereby avoiding elective intubation.[4] In recent years, several single-center studies have reported favorable outcomes with this strategy in carefully selected cases.[5,6]

The criteria proposed for identifying newborns who are candidates for conservative management include: mild CDH (O/E LHR $\geq$ 45%), left-sided location, intraabdominal liver, gestational age (GA) $\geq$ 37 weeks, and absence of associated major anomalies. In these patients, initial respiratory support may prioritize maintaining spontaneous breathing under close clinical monitoring.

The Hospital Sant Joan de Déu is a leading tertiary care center for the prenatal diagnosis and management of pregnant women carrying fetuses with CDH, including the option of treatment with fetoscopic endoluminal tracheal occlusion. Over the past 10 years, the neonatal unit has managed a total of 90 cases of CDH. In 2022, our hospital implemented a specific protocol for conservative respiratory management in the delivery room for patients who met the aforementioned prenatal criteria.

Since the introduction of this protocol in 2022, 7 of the 31 newborns with a diagnosis of CDH managed in our hospital met the criteria for this approach and were initially managed with a spontaneous breathing strategy in the delivery room. Table 1 summarizes the clinical characteristics and outcomes of these patients.

As can be seen in the table, of the seven patients who met the criteria, only one had to be intubated in the delivery room after failure of IPPV. Of the other six, two underwent elective intubation for surgery, and the rest required intubation at different times prior to surgery due to progressive respiratory deterioration, with increased oxygen requirements and work of breathing. None of the patients developed pneumothorax or other complications attributable to the delay of intubation. Likewise, there was no evidence of severe hemodynamic deterioration attributable to the initial conservative management, although one of the patients required vasoactive support and subsequently ECMO due to pulmonary hemorrhage, likely secondary to an infection by *Klebsiella pneumoniae* in the postoperative period.

In conclusion, prenatal risk stratification allows the individualization of initial respiratory management of newborns with CDH, reserving immediate intubation for moderate or severe cases. In carefully selected patients, an initial strategy based on spontaneous breathing may allow avoiding or delaying invasive mechanical ventilation, as we did not observe any acute complications attributable to delayed intubation in this case series. Most patients had mild or moderate pulmonary hypertension and required minimal pulmonary vasodilator or vasoactive support before surgery. Although all patients were assessed with point-of-care echocardiography after being admitted to the neonatal unit, our current protocol does not consider the use of these

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Table 1 Respiratory management and clinical outcomes of newborns with CDH who were initially managed with spontaneous breathing in the delivery room.

GA, biological sex, and birth weight (g)	GA at diagnosis	Prenatal risk stratification	Initial respiratory management in the delivery room	Preoperative respiratory management	Echocardiogram on admission. Need for inotropes prior to surgery. Pulmonary vasodilators prior to Sx	Type of defect and Sx	Postoperative respiratory outcomes	Discharge (days of life)
40^{+0} Female 2940	35 wk	Left-sided CDH O/E LHR 65%	NIV (IPPV)	OTI at 1 HOL in NICU due to respiratory deterioration.	Bidirectional ductus shunt. Left-right PFO. Infrasystemic PH. Dopamine. Nitric oxide	Type A defect. Sx at 3 DOL. Suture	Extubation 3 days post Sx, NIV 4 days. HFNC 4 days. iNO 5 days	26
39^{+4} Male 3256	34 wk	Left-sided CDH O/E LHR 85%	NIV (IPPV)	NIV (PC), Elective OTI for Sx	Ductus and PFO left-right shunt. Infrasystemic PH. No inotropes. No nitric oxide	Type A defect. Sx 12 HOL. Suture.	Extubation a few hours after Sx. HFNC 15 days	18
39^{+5} Male 3690	29 wk	Left-sided CDH O/E LHR 70%	NIV (IPPV)	NIV (PC), OTI at 24 HOL in NICU due to respiratory deterioration	Ductus and PFO left-right shunt. Iso-to-infrasystemic PH No inotropes. No nitric oxide	Type B defect. Sx 3 DOL. Gore-tex mesh	Accidental extubation 12 h after Sx. NIV 7 days	17
38^{+1} Female 2945	left lower lobe CPAM at 20 wk; CDH at 35 wk	Left-sided CDH O/E LHR 55%	NIV attempted. Required OTI a few minutes after entering the delivery room due to respiratory deterioration with hypoxemia.	OTI until procedure	Ductus and PFO left-right shunt. Isosystemic PH Dobutamine 24 h No nitric oxide	Type B defect. Sx 2 DOL. Gore-tex mesh.	Extubation 2 days post Sx. NIV 4 days. HFNC 4 days	17
38^{+6} Female 2500	30 wk	Left-sided CDH O/E LHR 55%	NIV (CPAP)	OTI due to respiratory deterioration at 12 h	Bidirectional ductus shunt. PFO left-right shunt. Isosystemic PH. No inotropes No nitric oxide	Type B defect. Sx 2 DOL. Suture	Extubation 6 days post Sx. NIV 3 days. HFNC until 18 DOL	33

Table 1 (*Continued*)

GA, biological sex, and birth weight (g)	GA at diagnosis	Prenatal risk stratification	Initial respiratory management in the delivery room	Preoperative respiratory management	Echocardiogram on admission. Need for inotropes prior to surgery. Pulmonary vasodilators prior to Sx	Type of defect and Sx	Postoperative respiratory outcomes	Discharge (days of life)
38^{+6} Male 2730	21 wk	Left-sided CDH O/E LHR 60%	NIV (IPPV)	OTI due to respiratory deterioration at 12 h	Ductus shunt, preferentially right-left. PFO left-right shunt. Suprasystemic PH. Mild MR. Epinephrine No nitric oxide	Type B defect. Sx 4 DOL. Suture	Extubation 3 days post Sx, reintubation 48 h later, and ECMO 10 days post Sx due to pulmonary bleeding with probable infectious etiology *(Klebsiella pneumoniae*)	84
36^{+6} Female 2730	29 wk	Left-sided CDH O/E LHR 60%	NIV (initially IPPV, transport with CPAP)	NIV (CPAP), Elective OTI for surgery	Ductus and PFO left-right shunt. Infrasystemic PH. No inotropes. No nitric oxide	Type B defect. Sx 2 DOL. Suture and Gore-tex mesh	Extubation 2 days post Sx. NIV until 7 DOL	22

Abbreviations: CDH, congenital diaphragmatic hernia; CPAP, continuous positive airway pressure; DOL, days of life; ECMO, extracorporeal membrane oxygenation; GA, gestational age; HFNC, high-flow nasal cannula; HOL, hours of life; iNO, inhaled nitric oxide; IPPV, intermittent positive pressure ventilation; NICU, neonatal intensive care unit; NIV, noninvasive ventilation; O/E LHR, observed/expected lung area-to-head ratio; OTI, orotracheal intubation; PC, pressure control; PH, pulmonary hypertension; PFO, patent foramen ovale; Sx, surgery.

tools to predict failure of conservative management in the delivery room. In this regard, the incorporation of functional parameters from heart or lung ultrasound examinations could, in the future, help identify neonates at increased risk of requiring intubation at an early stage, optimize monitoring and select candidates for a spontaneous breathing-based strategy. Still, prospective multicenter studies are needed to better define the safety and long-term benefits of conservative management based on spontaneous breathing.

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Conflicts of interest

The authors have no conflicts of interest to declare.

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