Original Article

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Prediction of Length of Postoperative Ventilation in CDH Survivors; Preoperative and Operative Variables

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Background/Purpose: The period taken for complete weaning from ventilation in cases of repaired congenital diaphragmatic hernia (CDH) varies greatly. We tried to relate the endo-tracheal tube removal time (ETTRT) in these cases with the different variables; both preoperative and operative.

Materials & Methods: This is a retrospective study of cases of CDH survivors managed by the authors over the period from January 2003 till February 2010. The preoperative variables included gestational age, gender, birth weight, Apgar score, the time of intubation, the ventilation strategy, the presence of a significant PDA in the ECHO study and the time-lapse till surgery. The operative variables (all by laparotomy approach) included the side of the hernia, the herniated contents, the presence of a sac, the insertion of a chest tube and the degree of abdominal wall stretch required. The successful weaning from ventilation and ETTRT were classified into two groups; ≤ 7 days and > 7 days postoperatively.

Results: During the study period, 26 cases were included (21 Males and 5 females). The ETTRT ranged from 2 to 23 days (mean=7.7 ±7.15). Among the variables studied; the statistically significant ones (P value < 0.05) were Apgar score at 1 minute (preoperatively) and the need for "vigorous" abdominal wall stretch (operatively).

Conclusion: Apgar score of less than 8 at 1 minute; preoperatively, and the need for "vigorous" abdominal wall stretch; operatively, were associated with delayed weaning from ventilation in CDH survivors. This could have a predictive value in the management of these cases.

Index Word: Congenital diaphragmatic hernia, Mechanical ventilation weaning, Endo-tracheal tube removal.

INTRODUCTION

The period taken for complete weaning from ventilation in cases of repaired congenital diaphragmatic hernia (CDH) varies greatly. Many studies have been devised to predict the severity and the survival of such cases [8-14,17-20]. However, the prediction of the duration of postoperative ventilation, and subsequent weaning, was much less studied. We tried to relate the endo-tracheal tube removal time (ETTRT) in these cases with the different preoperative and operative variables.

PATIENTS AND METHODS

This is a retrospective chart review of cases of CDH survivors managed by the authors over the period between January 2003 and February 2010. Our

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protocol was to begin with pressure- cycle ventilation using a combination of rates between 40- 60 bpm and peak airway pressures between 24 to 30 cm H2O. The goal was to achieve preductal PO_2 more than 60 torr (SaO2 90% to 100%) and a PCO_2 of less than 60 torr. If this failed to achieve these goals, high-frequency oscillatory ventilation was used. In the postoperative period, continuation of the ventilation support, antibiotics and parenteral nutrition were the routine with gradual weaning from ventilation as tolerated by the baby and according to the blood gases analyses, *keeping PO2 levels above 80 torr and PCO2 less than 35 tor*r.

The preoperative variables included gestational age, gender, birth weight, Apgar score, the time of intubation, the ventilation strategy required (Conventional Vs High frequency according to the protocol mentioned), the presence of a significant PDA (with persistent fetal circulation) in the ECHO study, the time-lapse till surgery (our protocol: not less than 48 hours-old with preductal PO2 more than 60 and PCO2 less than 60 torr with SaO2 above 90% or until these parameters were achieved) . The operative variables *(all by laparotomy approach*) included the side of the hernia, the herniated contents, the size of the defect, the presence of a sac, the insertion of a chest tube (if there was uncontrolled air leak) and the degree of abdominal wall stretch required to accommodate the reduced viscera (If viscera were reduced with no increase in the mean airway pressure (MAWP), we considered it *"mild-moderate"* stretching. We defined stretching as *"vigorous"* If it was required because of an increase in the MAWP after reduction of the viscera. If stretching failed to keep MAWP under 25 mmHg, the plan was to close the skin only leaving the baby with a ventral hernia).

We did not used ECHMO nor NO because they were unavailable.

Cases were divided into two groups according to their ETTRT *(whether less or more than the mean duration; groups I & II respectively).*

Statistical Analysis was done using SPSS ® ver. 11 (Chicago, Il, USA). Where appropriate, data were represented as mean ± SD. *Chi*-square test of significance was used to compare the qualitative data. P value < 0.05 was considered significant.

RESULTS

During the study period, we operated on 30 CDH cases. Four cases died postoperatively (survival rate 87%). The survivors (26 cases) included 21 males and 5 females. The ETTRT ranged from 2 to 23 days *(mean=7.7 ±7.15 days)*. Accordingly, the successful weaning from ventilation and ETTRT were classified into two groups; ≤ 7.7 and > 7.7 days postoperatively *(groups I&II respectively)*.

Among the variables studied; the statistically significant ones *(P value < 0.05*) were Apgar score at 1 minute *(preoperatively)* and the need for *"vigorous"* abdominal wall stretch *(operatively)*. Table 1 summarizes the different findings

DISCUSSION

The survival rate of cases of CDH has increased over the last two decades. The factors contributed to this change were many, but frequently attributed to minimizing lung injury and adhering to center-specific criteria for ECMO [1].

In the earlier days, CDH was regarded as a surgical emergency and postnatal care was mainly directed towards early repair of the defect [2]. The 1990s, however, saw improved survival rates from 'delayed' surgical repair, i.e. after 2 or 3 days of "physiologic stabilization" with a 'gentle' ventilation strategy [3-6,16]. This period presumably allows for resolution of pulmonary hypertension [7].

Several studies have been proposed to determine the chances of survival. The lung-to-head ratio (LHR) [8-12], the intra-thoracic position of the liver [11] and *recently*, the fetal lung volume (FLV) [13,14] have all been proposed as prenatal predictors of survival.

In the postnatal period, there have been many attempts to assess the severity of CDH. These have included X-ray assessment of contra-lateral lung size and the degree of blood gas derangement [17-19]. A big study showed that the most significant predictors of outcome were the 5-minute Apgar score and the birth weight [20]. However, the prediction of the duration of postoperative ventilation and subsequent weaning was much less studied. Such prediction could have value in the care plan of such challenging cases.

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Table1 Endo-tracheal tube removal time in relation to different preoperative &operative factors in CDH survivors

			Group I (12) No.	%	Group II (14) No.	%	X^2
Gestational age:		≤34 w	4	33.3	9	64.3	2.46
		> 34 w	8	66.6	5	35.7	
Gender:		- Males	10	83.3	11	78.5	0.77
		- Females	2	16.6	3	21.5	
Birth weight	-	> 2 kg	6	50	9	64.3	0.48
	-	≤ 2kg	6	50	5	35.7	
Apgar Score:	-	1 min:					
		≥8	9	75	4	28.5	5.56[@]
		<8	3	25	10	71.5	
	-	5 min:					
		≥8	7	58.3	8	57	0.002
		<8	5	41.6	6	43	
Intubation time[a]	-	In the DR/OR	5	41.6	9	64.3	1.3
	-	Beyond the DR/OR	7	58.3	5	35.7	
Ventilation type[b]	-	HF needed	4	33.3	9	64.3	2.46
	-	HF not needed	8	66.6	5	35.7	
PDA (ECHO)[c]	-	Present	4	33.3	6	43	0.26
	-	Absent	8	66.6	8	57	
Age at Surgery	-	≤ 3 days	5	41.6	9	64.3	1.3
	-	> 3 days	7	58.3	5	35.7	
The side of the defect	-	Left	9	75	12		0.40
	-	Right	3	25	2	85.7	
						14.3	
herniated contents[d]	-	The stomach	4/9	44	6/12	50	0.49
(left side, n = 21)	-	The liver	4/9	44	5/12	41.6	0.17
Hernial sac:	-	Present	5	41.6	6	42.9	0.002
	-	Not present	7	58.3	8	57.1	
The hernia defect	-	Well developed posterior lip	7	58.3	7	50	0.17
			5	41.6	7	50	
	-	Weak Posterior lip					
Chest tube inserted:	-	Yes	8	66.6	7	50	0.69
	-	No	4	33.3	7	50	
Abdominal wall Stretch required: [f]	-	Vigorous	3	25	9	64.3	3.98[@]
	-	Mild-moderate	9	75	5	35.7	

Group I &II: extubation time : ≤ & > 7 days postoperatively respectively, [a]: whether or not intubation was required urgently in the delivery room or the operation room, [b]: the baby could not be stabilized preoperatively without high frequency ventilation, [c]: significant patent ductus arteriosus with reversed flow, [d]: only in the left side hernias(9 group I, 12 group II), [e]: weak posterior lip even after dissection; no mesh required in any case, [f]: abdominal wall stretch required to reduce the eviscerated contents and close primarily; Mild-Moderate: viscera reduced with no increase in Mean Airway Pressure (MAWP), Vigorous: stretching required to decrease an increased MAWP after viscera reduction ; no ventral hernia was left in any case, [@]: Statistically significant ($\chi^2 > 3.84$ correlates to a P value < 0.05)

Some authors advise certain protocols for ventilator weaning [22], however, others showed no difference between children randomized to a ventilator weaning protocol or no protocol [23]. *Regardless,* the level of ventilatory support needed and subsequent weaning are mainly determined by the degree of pulmonary hypoplasia present [21].

Our study aimed at correlating the degree of lung hypoplasia present to clinical factors that could be objectively assessed. Some factors showed direct relationship with the timing of weaning from ventilation and finally ETTRT. Low 1-minute Apgar score; *preoperatively* and the need for vigorous abdominal wall stretch to be able to reduce the viscera; *operatively,* were associated with later weaning and relatively delayed ETTRT (P <0.05). These factors might be reflection of the degree of lung hypoplasia; whether *physiologically,* as expressed by the low Apgar score at 1 minute, or *anatomically* by the amount of viscera herniated and subsequently interfering with the lung development.

The number of our cases is relatively low, however, it is agreed that the progress in CDH management in general is hampered by the relative low number in over 80% of centers. [15].

CONCLUSION

Among the different variables studied; Apgar score at 1 minute of less than 8 ; *preoperatively*, and the need for significant abdominal wall stretch; *operatively*, were associated with longer ventilation time and delayed weaning in the CDH survivors. This could have a predictive value in their management. In addition, there were undoubtedly other factors that could have predictive values. A larger controlled multicenter study is required .

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