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Original Research Article

Prediction of Neonatal Morbidity in Survivors with CDH in Relation to Post-Operative Intravesical Pressure and LHR

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ABSTRACT

Aim: was to evaluate an indicator that predicts the postoperative course, once other indices have predicted survival and fitness for surgery
Material and method: Thirty consecutive cases that underwent repair of congenital diaphragmatic hernia from April 2012 to July 2015 were studied prospectively. The preoperative and postoperative intravesical pressures were measured in all patients in the operating room. The patients were catheterized with a 6F infant feeding tube. The abdomen was opened through an upper abdominal transverse incision. The diaphragmatic defect was identified, contents were reduced and the defect closed. The abdominal wall was stretched to increase the volume of the abdominal cavity. The peritoneum was closed. The bladder pressure was measured as recommended by the World Society for Abdominal Compartment Syndrome (WSACS). Morbidity was evaluated in terms of the number of days of post operative ventilation.
Results: Using LHR and postoperative ventilation days as continuous variables, the Pearson's correlation coefficient was found to be -0.574 (r) which was significant. There exist a moderately positive and moderately high relationship between the number of days of post-operative ventilation and bladder pressure.
Conclusion: Postoperative intravesical pressure and lung to head circumference ratio (LHR) are valuable factors in the prediction of neonatal morbidity in survivors with congenital diaphragmatic hernia (CDH).
Keywords: Hernia, CDH, LHR

INTRODUCTION

Congenital diaphragmatic hernia (CDH) was first described in the late 17thcentury, by Riverius. [1] In 1946, Gross was the first surgeon who successfully operated on a newborn with congenital diaphragmatic. [2] The incidence of congenital diaphragmatic hernia varies between 1 in 2000 to 1 in 5000 live births. The mortality rate of CDH remains high (40-80%). [3] In the most cases herniation of abdominal viscera into the thoracic cavity prevents normal growth and development of ipsilateral lung and the mediastinal shift contribute to hypoplasia of the contralateral lung. There is a decrease in both number and size of the respiratory units and a corresponding decrease in the pulmonary vascular bed. [4] Wiseman and MacPherson (1977) classified Congenital Diaphragmatic Hernia into 4 groups based on the period at which it had occurred in relation to the pulmonary development. [5] The babies presenting with symptoms within 24 hours

of life have more mortality as compared to those presenting at a later age. The diaphragmatic hernia is accompanied by pulmonary hypoplasia, [6] lung immaturity, [7] and left heart hypoplasia, [8] leading to Persistent pulmonary Arterial hypertension of the newborn (PPHN). [9] Due to these factors the treatment of CDH has become challenging. The severity pulmonary hypoplasia and presence of associated congenital malformations affects the prognosis of CDH. [10]

The earlier and more the herniation of bowel into the chest occurs, the more severe will be the pulmonary hypoplasia and the lesser the development of the abdominal cavity. Once the hernial contents are reduced into the abdomen, a smaller abdominal cavity will have higher intraabdominal pressure. Measurement of abdominal pressure via vesical pressure will indicate the severity ventilatory compromise due to pressure on the contralateral diaphragm from the reduced bowel leading to its reduced movements. These will predict the postoperative course. Aim of the study was to find an indicator that will predict the postoperative course, once other indices have predicted survival and fitness for surgery.

MATERIALS AND METHODS

Thirty consecutive cases that underwent repair of congenital diaphragmatic hernia from April 2012 to July 2015 were studied prospectively fulfilling the following criteria: all newborns who were diagnosed antenatally to have diaphragmatic hernia and in whom LHR was measured, who underwent open surgical procedure.

All babies were admitted to NICU ventilated for a period ranging from 1 to 15 days, till the pulmonary vasculature stabilized and patients were free of episodes of pulmonary hypertension and FiO2 requirement came to less than 70%, before they were taken up for surgery.

Exclusion criteria: Neonates diagnosed to have CDH at birth, who underwent thoracoscopic repair or babies who needed ventral hernia creation were excluded from the study.

Ethical clearance: Ethical clearance was obtained from the local hospital ethics committee for conducting this study in favor of doing thesis submission to National Board of Examination

Sample size calculation: The sample size was calculated using the standard formula for the prevalence of Congenital Diaphragmatic Hernia (CDH) and the estimated sample size was 38.

Measurement: The preoperative and postoperative intravesical pressures were measured in all patients in the operating room. The patients were catheterized with a 6F infant feeding tube. The abdomen was opened through an upper abdominal transverse incision. The diaphragmatic defect was identified, contents were reduced and the defect closed. The abdominal wall was stretched to increase the volume of the abdominal cavity. The peritoneum was closed. The bladder pressure was measured as recommended by the World Society for Abdominal Compartment Syndrome (WSACS). [4] After emptying the bladder, normal saline was instilled into the bladder with a volume of 1 ml/kg. The feeding tube was held vertically up and the height of the column of saline from the midaxillary line at the level of iliac crest was measured at the end of expiration. All pressures were noted in centimeters of saline. (1.36 cm of saline equals 1 mm of mercury).

Morbidity: was evaluated in terms of the number of days of post operative ventilation. For purposes of analysis the sample of patients were divided into different sub groups as below

a) Bladder pressure into 3 groups- P1 with pressure <10cm of saline, P2 with pressure 10-15cm of saline and P3 with >15cm of saline.

b) Post operative ventilation into 3 groups: V1 with 1-3 days, V2 with 4-6 days and V3 with more than 6 days.

c) LHR into 2 groups- L1 with LHR 1 to 1.4, and L2 with LHR > 1.4.

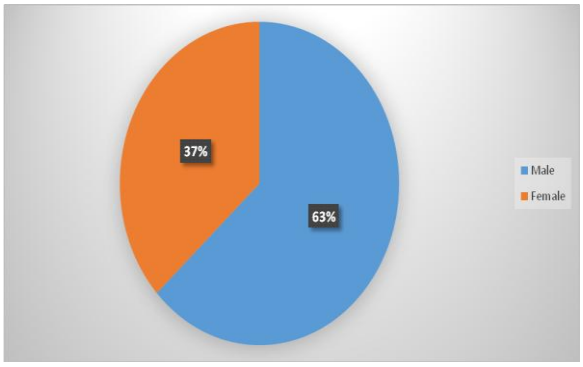
Statistical analysis: Data so collected was tabulated in an excel sheet, under the guidance of statistician. The means and standard deviations of the measurements per group were used for statistical analysis (SPSS 22.00 for windows; SPSS Inc, Chicago, USA).For each assessment point; data were statistically analyzed using factorial ANOVA. Difference between two groups was determined using student t-test as well as chi square test and the level of significance was set at p <0.05. Pearson's product moment correlation co-efficient (r) was calculated to find out the extent of relation between the bladder pressure and the number of days of postoperative ventilation. Correlation co-efficient (Pearson's product moment was also calculated to find out the extent of the relationship between postoperative ventilation days and change in bladder pressure from pre-operative value to post operative value.

RESULTS

The study included newborns who were operated at ages ranging from 1 to 8 days with a mean age of 4.1 days. The study had 38 (N) newborns out of which 63% (n=24) were males and 37% (n=14) were females (graph 1).In our study, 89% (n=34) of patients had left sided diaphragmatic hernia with the rest 11% (n=4) were right sided diaphragmatic hernia.

The hypothesis of the study was that there will be no significant mean difference in the number of postoperative ventilation days between the 2 groups of LHR. In order to test this hypothesis, the patients were divided into two groups based on lung to head ratio (LHR) - group 1 with LHR 1-1.4 and group 2 with LHR >1.4. The post operative ventilator days were taken as a continuous variable. An independent samples t-test was applied, which showed a 't' value of 4.98, which was significant at p value of 0.001 (table 1).

Using LHR and postoperative ventilation days as continuous variables, the Pearson's correlation coefficient was found to be -0.574 (r) which was significant at p value of <0.05 (table 2).



Graph 1: Gender distribution of the study subjects

Table 1: Mean days of post-operative ventilation according to LHR

LHR Groups	Mean days of post-operative ventilation	t value	p value
1-1.4	6.61	4.98	0.001
>1.4	3.85		

Table 2: Pearson Correlation between VENT and LHR

Variables	Pearson Correlation	p value
VENT and LHR	-.574	.001

Table 3: Mean distribution of post-op ventilation (days) according to blood pressure

Bladder pressure (cm of saline)	N	Mean post-op ventilation (days)	SD
<10	15	3.60	0.289
10-15	15	5.67	0.615
>15	8	7.13	0.398
Anova test		11.78	
p value		0.001	

Table 4: Coefficient of correlation: post op bladder pressure vs. days of ventilation

Variables	Coefficient of correlation (r)	p value
Ventilatory days and Bladder pressure	+0.683	0.001

Table 5: Change in bladder pressure vs. post op ventilation days

		VENT	DELTA_P
Days of post op vent	Pearson Correlation	1	.375*
	Sig. (2-tailed)		.020
	N	38	38
DELTA_P	Pearson Correlation	.375*	1
	Sig. (2-tailed)	.020	
	N	38	38

Table 6: Pearson's Chi-Square test

	Value	df	p value
Pearson Chi-Square	13.098	2	.001
Likelihood Ratio	14.575	2	.001
Linear-by-Linear Association	12.440	1	.001

Based on postoperative bladder pressure the sample of patients was divided into three groups for purposes of analysis: Group 1 with bladder pressure <10cm of

saline, Group 2 with 10-15cm of saline and Group 3 with >15cm of saline. The mean number of days of post operative ventilation in each group was tabulated. Null hypothesis was rejected and inferred that there is a significant mean difference in the number of post operative ventilation days among the different bladder pressure groups (Table 3).

Table 4 revealed that there exist a moderately positive and moderately high relationship between the number of days of post-operative ventilation and bladder pressure.

Table 5 revealed that the correlation co-efficient was 0.375 which was significant at p value of 0.005. This shows that there exist a positive relationship between the number of days of post-operative ventilation and the extent of change in bladder pressure. However, there is a lesser association between Δp (r=0. 375) and days of ventilation than the postoperative bladder pressure value alone (r=0. 6.83).

It was hypothesized that there was no significant association between LHR and extent of postoperative bladder pressure. Pearson's Chi square value was 13.098 (df=2) which is significant at p value of 0.001. Hence, the above null hypothesis was rejected at 0.001. Hence, it was inferred that there is an association between LHR groups and bladder pressure groups (table 6).

DISCUSSION

Epidemiological surveys, record a higher incidence of CDH in females, whilst other reports cite a higher frequency in males. Our study had 24 males and 14 females, showing a higher male frequency (male: female:: 1.7:1).

Ninety percent of CDH occurs on the left side (3). Our study had 89% left sided CDH, which agrees with previous studies. All the patients had undergone non emergent repair of CDH after haemodynamic stability. The mean age at surgery was 4.21days. Wunget al [11] found the mean at surgery was 4.2 days after birth. However, this depends on the center of care, the selection criteria, and also the associated co-morbidities. In our study, the mean age at surgery corresponds to the previous studies.

Lipshutz and coworkers [12] reported that LHR less than 1.0 was associated with 100% mortality, and a ratio greater than 1.4 was associated with 100% survival. Intermediate values were associated with 38% to 61 % survival. Laudy et al [13] confirmed the same. Importantly, this study also showed that the predictive value of LHR was independent of gestational age at the time of measurement.

Our study had 20 out 38 patients with LHR >1.4 and 18 patients with LHR 1-1.4. There is a significant mean difference between the 2 groups with respect to postoperative ventilation days (table 1). Patients with LHR of 1-1.4 had a higher mean number of post operative ventilator days (mean=6. 61 days) when compared to those with LHR >1.4 (mean of 3.85 days). The correlation coefficient was -0.573 (at p = 0.001). A similar study conducted taking into observed/expected LHR to number days of ventilation was done Cannie M et al [14] in 2008 and found that the o/e LHR was significantly associated with the duration of assisted ventilation (r = −0. 3596, P <0.001). Our study supports this.

Our study showed that there was a significant mean difference in the number of postoperative ventilation days among the bladder pressure groups (F =11. 783, p at 0.001). Previous studies showed the same at p of 0.016.

Furthermore, our study showed that the mean post-operative ventilator days of patients with bladder pressure <10cm of saline was significantly lower than those >10cm of saline. But, there was no significant mean difference in ventilation days between groups who had pressures of 10 to 15cm of saline and those with >15cm of saline. Hence it can be inferred that postoperative bladder pressure of 10cm serves as a yardstick for assessing the number days for assisted ventilation during the postoperative period. The mean days of

postoperative ventilation for postoperative bladder pressure were 3.6 days.

The statistical correlation (r=0. 3) for change in bladder pressure (from preoperative status) to the number of postoperative ventilation days was not as strong for bladder pressure calculated post operatively alone (r=0. 6). This may due to the fact that the pulmonary hypoplasia due to the herniated bowel as already occurred.

The study showed significant association between LHR and post-operative bladder pressure with 34% of sample size having LHR>1.4 (good prognosis) and bladder pressure <10cm. The Pearson's Chi square test also showed a significant association (p at 0.01). No other supportive studies could be found in the literature to support the same.

CONCLUSION

Postoperative intravesical pressure and lung to head circumference ratio (LHR) are valuable factors in the prediction of neonatal morbidity in survivors with congenital diaphragmatic hernia (CDH). There is a moderately high correlation between LHR and post-operative intravesical pressure. A post-operative intravesical pressure of 10cm of saline can be used as a tool to predict the need for assisted ventilation and the associated morbidity.

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