The Role Of Modified Ventilatory Index In Defining The Prognosis In Surgical And Non-Surgical Pediatric Patients

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Citation

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Abstract

Background/aim: Many indexes including the Modified Ventilatory Index (MVI) are used to define the prognosis in congenital diaphragmatic hernia (CDH). However , there is not much data in the literature about the use of this index on defining the prognosis in problems other than CDH. In this study we investigated the role of MVI in defining the prognosis in surgical and non-surgical pediatric patients.

Patients and method: The patients in the study are classified into three groups. Group-I: Patients with CDH, Group-II: Patients without CDH — surgical treated and Group-III: Patients without CDH - medicaly treated. 74 patients were analysed retrospectively according to their age, sex, weight, APGAR scores and MVI results. Early and late MVI results were recorded. MVI was calculated as the factors of PIP, ventilation frequency, and PCO_2 (MVI= PIP*PCO_2*ventilation frequency/1000).

Results: Male: female ratio was 25:12. Fourty three of the patients were discharged from hospital and 31 of the patients died. Mean birthweight was 2610 gr (1060-3790). Thirty of the patients were in Group-I, 18 of the patients were in Group-II, and 26 of the patients were in Group-III. The mean APGAR scores were in survivors 7 (4-9) and in non-survivors 3 (1-7) in Group-I. The MVI was 38.8 in survivors and 114.3 in non-survivors in this group. The difference between the MVI of the survivors and non-survivors was found statistically significant. The mean MVI was calculated as 33.1 and non-survivors had a mean MVI of 33.2 in Group-II. In Group-III the APGAR scores were 6 (3-8) in survivors and 3,7(2-5) in non-survivors. The mean MVI was calculated as 66.7 in survivors and the non-survivors had a mean MVI of 72.1 in this group. There was no statistically significant difference between the MVI scores of survivors and non-survivors in Group-II and III.

Conclusion: In this study we conclude that MVI is a good criteria to define the prognosis in CDH. However it has no value in defining the prognosis in non-surgical cases.

INTRODUCTION

First use of the mechanical ventilation (MV) in neonates was in the late 1960's. The field of neonatal ventilation made dramatic advances in the 1970's. However, MV of the neonate is a complex and highly invasive procedure. MV provides alveolar ventilation which means pulmonary ventilation, adequate oxygenation of all the tissues and vital organs, carbon dioxide removal and reduction of the work of breathing ([1,2,3,4,5])

Many methods and indices were described to determine preoperative care and medication, prognosis in infants with CDH. Modified Ventilatory Index (MVI) can also bee used in these purposes ([6,7,8,9,10]). The surgical pediatric patients without CDH and the non-surgical pediatric patients also may require MV. There are a few studies in the literature about the use of MVI on defining the prognosis of these patients. In this study, we investigated the role of MVI on defining the prognosis in surgical and non-surgical pediatric patients.

PATIENTS AND METHOD

74 patients who underwent mechanical ventilation in our pediatric surgery depertment and our pediatric intensive care unit were evaluated. The patients were classified into three groups. Patients with CDH were in Group-I. Patients without CDH-surgical treated were in Group-II. Patients without CDH-medicaly treated were in Group-III. These patients were analysed retrospectively according to their age, sex, weight, APGAR scores and MVI results. MVI scores (3-4

hours after entubation) and late MVI scores (6-12 hours after entubation) were compared. MVI was calculated as the factors of PIP, ventilation frequency and partial CO_2 (MVI= PIP * PCO_2 * ventilation frequency / 1000). General condition and peripheral circulation of the patients, the grade of respiratory distress, pH, PO_2, PCO_2 in arterial blood gas sampling took into consideration to institude mechanical ventilation. Before intubation, arterial blood gas sampling were obtained. Preintubation ph, PO_2 and PCO_2 were also compered. For statistical comparison Mann Whitney-U Test was used.

RESULTS

74 patients (50 boys and 24 girls) were evaluated. Group-I consists of 30 patients (40,5%), Group-II consists of 18 patients (24,3%) and Group-III consists of 26 patients (35,2%). Fourty three of the patients (58%) were discharged from hospital and 31 of the patients (42%) died.

In Group-I, 22 patients (73,3%) were boys and 8 patients (26,7%) were girls. 16 of these patients (53,3%) were discharged from hospital and 14 of them (46,7%) died. Mean birthweight was 2865 gr (2050-3790). Mean APGAR scores were 7 (4-9) in survivors and 3 (1-7) in non-survivors. The MVI was 38,8 (16-77) in survivors and 114,3 (48-210) in non- survivors (Table I). The difference between early and late MVI of the survivors and non-survivors was found statistically significant (p<0,05). Mean pH was 7,32 (7,15-7,49), mean PCO_2 was 50,2 (37-68), mean PO_2 was 55,44 (34-85) in survivors. Mean pH was 7,13 (6,9-7,28), mean PCO_2 was 60,6 (48-88), mean PO_2 was 38,23 (22-57) in non- survivors. The difference between pH and PO_2 of the survivors and non-survivors was found statistically significant (p<0,05). There was no statistically significant difference PCO_2 of the survivors and non-survivors (p>0,05).

Figure 1

Table I: Distribution of MVI scores in patients with CDH * operated before 6th hour, ** died before 6th hour.

	MVI scores in survivors			MVI scores in non-survivors	
No	early MVI	late MVI	No	early MVI	late MVI
1	47	29,2	1	60	119,7
2	25	31,9	2	119	143,5
3	53	40,8	3	93,6	186,5
4	31,9	39,5	4	48	75
5	59	36	5	61	- **
6	52	- *	6	80,6	146,8
7	34	45,2	7	98,5	210,16
8	34,3	29,6	8	140	97
9	41	32	9	67,1	170
10	58,5	39,4	10	121,9	112
11	58,8	32,9	11	101,5	118
12	27,7	35,5	12	120	132
13	54	35	13	81,5	94
14	77	44	14	136	- **
15	16	12			
16	30	20			
Mean	43.5	33.8	Mean	94.9	133.7
	38.8			114.3	

In Group-II, There were 18 patients. 13 patients (72,2%) were boys and 5 patients (27,8%) were girls. 10 of these patients (55,6%) were discharged from hospital and 8 of them (45,6%) died. There were 5 patients with esofageal atresia (27,7%), 3 patients with intestinal perforation (16,6%), 1 patient with intestinal atresia (5,6%), 1 patient with Hirschsprung's disease (5,6%) in survivors. There were 3 patients with esofageal atresia (16,6%), 2 patients with gastroschisis (11%), 1 patient with omphalocele (5,6%), 1 patient with intestinal atresia (5,6%), 1 patient with long-lasting joundice in non-survivors. Mean birthweight was 2736 gr (1450-3700). The APGAR scores which were not known clearly were not evaluated in this group. The MVI was 33,1 (12-85) in survivors and 33,2 (18-59) in non-survivors (Table II). The difference between early and late MVI of the survivors and non-survivors was found statistically insignificant (p>0,05). Mean pH was 7,3 (7,0-7,4), mean PCO_2 was 47 (26-67), mean PO_2 was 44 (25-89) in survivors. Mean pH was 7,1 (6,8-7,18), mean PCO_2 was 43 (32-67), mean PO_2 was 36 (25-89) in non-survivors. There was no statistically significant difference pH, PCO_2, PO_2 of the survivors and non-survivors (p>0,05).

Figure 2

Table II: Distribution of MVI scores in the surgical patients without CDH

	MVI scores in survivors			MVI scores in non-survivors	
No	early MVI	late MVI	No	early MVI	late MVI
1	-	21	1	59	27
2	14	14	2	18	18
3	-	46	3	52	-
4	85	36	4	-	36
5	12	12	5	48	-
6	18	16	6	-	14
7	33	-	7	21	18
8	34	27	8	42	48
9	54	46	9		
10	23	70	10		
Mean	34,2	32	Mean	40	26,3
	33,1			33,2	

In Group-III, There were 26 patients. 15 patents (57,7%) were boys and 11 patients (42,3%) were girls. 17 of these patients (65,4%) were discharged from hospital, 9 of them (34,6%) died. There were 4 patients with respiratory distress syndrom (15,4%), 3 patients with meconium aspiration (11,5%), 2 patients with respiratory distress syndrom and congenital pneumonia (7,7%) in non-survivors. There were 10 patents with congenital pneumonia (38,5%), 4 patients with respiratory distress syndrom (15,4%), 2 patients with meconium aspiration (7,7%), 1 patient with pneumothorax (3,8%) in survivors. Mean birthweight was 2230 gr (1060-3200), the mean APGAR scores were 6 (3-8) in survivors and 3,7 (2-5) in non-survivors. The MVI was 66,75 (19-187) in survivors, 72,1 (24-133) in non-survivors (Table III). The difference between early and late MVI of the survivors and non-survivors was found statistically insignificant (p>0,05) in this group. Mean pH was 7,22 (7,0-7,4), mean PCO_2 was 57 (27-86), mean PO_2 was 41 (25-66) in survivors. Mean pH was 7,2 (6,8-7,4), mean PCO_2 was 43,8 (23-24), mean PO_2 was 54,6 (28-88) in non-survivors. There was no statistically significant difference pH, PCO_2, PO_2 of the survivors and non-survivors (p>0,05).

Figure 3

Table III: Distribution of MVI scores in the medicaly treated patients

	MVI scores in survivors			MVI scores in non-survivors	
No	early MVI	late MVI	No	early MVI	late MVI
1	54	48	1	71	58
2	46	63	2	61	48
3	47	19	3	133	121
4	42	63	4	48	81
5	62	84	5	52	43
6	51	24	6	42	24
7	37	32	7	78	66
8	187	125	8	124	105
9	165	181	9	174	68
10	112	80			
11	49	23			
12	42	29			
13	60	27			
14	66	68			
15	56	69			
16	61	40			
17	105	53			
Mean	73	60,5	Mean	76	68,2
	66,75			72,1	

DISCUSSION

Mechanical ventilation is used in the neonatal intensive care unit as a supportive treatment ([1,2]). The most common reasons for beginning MV are defective lung maturation becouse of the prematurity and respiratory distress in relation to neonatal pneumonia ([4,11]). There are a few studies in the literature about the using MV at the surgical pediatric patients, as these patients mostly tretated in pediatric neonatal intensive care units. Our previous study showed that surgical pediatric patients who had CDH (77,1%), defects of abdominal wall (45,1%), anomalies of the gastrointestinal system (23%) required frequently MV. These patients were treated in the NICU of the Pediatric Surgery Department.

The success of mechanical ventilation therapy is directly related to knowledge of fetal circulation, pulmonary physiology, pathophysiology of neonatal pulmonary diseases, physiopathology of surgical diseases requiring MV and the ventilatory response of the newborn surgical patient undergoing MV. The clinicians must also correlate the type of ventilation to the physiology of the lung and to the severity of the disease. In addition, they must understand the basic mechanical principles of the spesific ventilator in use. Beneficial effects of ventilatory therapy are dependent on skill and experience in management of mechanical ventilator. All of these subjects supports obtaining successful results of mechanical ventilation therapy and lowering complication rate of MV.

Many parameters were defined in determining the prognosis of surgical and non-surgical pediatric patients requiring MV. The parameters which are used to determine treatment and prognosis in CDH are also included in those. Arterial pH, preductal and postductal PO_2 are used in CDH ([7,12]). Main indices related to ventilation parameters are the criteria of Bohn, ventilatory index (VI), Red Cross Formula, Oxygenation Index (OI) and modifications of these parameters ([8,9,13,14,15]). These indices are used to define indications of extracorporeal membrane oxygenation (ECMO) and the prognosis in patients with CDH. MVI which is used in patients with CDH is not used in surgical pediatric patients without CDH and non-surgical pediatric patients. There is no data in the literature about the use of MVI in these patients. In our study, pH, PO_2, PCO_2 levels of three groups (Group-I: Patients with CDH, Group-II: Patients without CDH-surgical treated, Group-III: Patients without CD- medically treated) are compared. In three groups, early and late MVI scores of the survivors and non-survivors are also compared. There was statistically significant difference between survivors and non-survivors with regard to pre-entubation pH, PO_2 levels were concerned, no difference with regard to PCO_2 in Group-I. There was no difference with regard to pH, PO_2, PCO_2 levels in Group-II and Group-III.

A different study in the literature demonstrated that survival rate was 91% if MVI score was under 40 in patients with CDH ([9]). We founded in our previous study; if MVI score was below 40, survival rate was 100%, if MVI score was above 80, all patients died ([10]). In this study, there was statistically significant difference between the early and late MVI scores of the survivors and non-survivors in Group-I. It means that MVI is a good prognostic parameter in patients with CDH. In spite of this data, there was no statistically difference the early and late MVI scores in Group-II and Group-III. MVI was not reliable prognostic parameter in these two groups.

CONCLUSION

In our study, we concluded that MVI is a good prognostic criteria in patients with CDH. However, it has no value in the surgical patients without CDH and the medicaly treated patients.

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