Journal of Rawalpindi Medical College (JRMC); 2007; 11(1): 14-17

Effect of accumulated Stomach Gas due to Positive Pressure Ventilation in Children on Oximetery Values

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Abstract

Background: **To determine that the removal of stomach gas in children, undergoing positive pressure ventilation with face mask, helps in improving the arterial oxygen saturation.**

Methods: **This was a quasi-experimental study whose procedures were performed at Combined Military Hospital, Lahore and Mardan, from May 2005 to Nov 2006. Fifty children scheduled for surgery were included. Age range of patients was between 06 months to 02 years. Patient status was American Society of Anaesthesiologists I and II. All were 'nil by mouth' for the past 4-6 hours. In 25 cases undergoing positive pressure ventilation, the stomach gas was removed by nasogastric tube (Group A). In the other 25 cases the stomach gas was not removed (Group B). Oximetery was done during the conduct of anaesthesia. Average value of each case was determined and the data compared and analyzed.**

Results: **80% of patients in whom stomach gas was removed showed 100% oxygen saturation (SPO_2) and the remaining 20% patients had 99% saturation. Whereas the group in which stomach gas was not removed, 48% patients showed 100% saturation, 32% patients had 99% and 20% patients had 98% oxygen saturation.**

Conclusion: **Positive pressure ventilation with face mask in children can cause gaseous distension of the stomach. Removal of this gas can help improve the oxygen saturation.**

Introduction

Paediatric patients differ from adults in many respects. These differences are significant and can lead to changing responses to environmental factors, to drugs and to procedures carried out by surgeons and anaesthesiologists. Inhalation induction is mostly performed in the children. This is followed by short acting non-depolarizing muscle relaxant, intermittent positive pressure ventilation (IPPV) by a facemask, intubation and maintenance of anaesthesia. IPPV after muscle relaxation with a face mask, may lead to collection of gases in the stomach[1, 2] which can exert mechanical pressure on the diaphragm causing its cephalad shift[3]. This reduces the functional residual capacity (FRC) due to partial basal atelectasis, which can hamper the gaseous exchange across the alveolar capillary membranes[4] thereby affecting the arterial oxygen saturation reflected by Oximetery readings. Removal of stomach gas after intubations in infants and young children by appropriate size nasogastric tube improves the arterial oxygen saturation[5].

Patients and Methods

This was a quasi-experimental study whose procedures were performed at Combined Military Hospital, Lahore and Mardan, from May 2005 to November 2006.

Inclusion criteria were age from 6 months to 2 years, patient status American Society of Anaesthesiologists (ASA) I or II, nil by mouth for 4 to 6 hours and absence of a congenital anomaly.

Exclusion criteria were age less than 6 months and greater than 2 years, ASA III or IV, nil by mouth less than 4 hours and presence of a congenital anomaly.

Regarding group description and sampling technique, the technique devised was non-probability convenience sampling. Patients were divided into two groups on the basis of even and odd numbers i.e. from number 1 – 50, all the odd numbers were taken as group A (1-3-5-7----49) and all the even numbers were taken as group B (2-4-6-8----50). Thus group A and B, each had 25 patients respectively.

Table 1: Comparison of Oximetery Values

Group A		Group B	
S. No.	**% of O2**	**S. No.**	**% of O2**
1	100%	2	99%
3	100%	4	100%
5	99%	6	100%
7	100%	8	99%
9	100%	10	98%
11	100%	12	100%
13	100%	14	100%
15	100%	16	99%
17	100%	18	100%
19	99%	20	98%
21	100%	22	100%
23	99%	24	99%
25	100%	26	100%
27	100%	28	100%
29	100%	30	99%
31	100%	32	100%
33	100%	34	98%
35	100%	36	100%
37	99%	38	100%
39	100%	40	100%
41	100%	42	98%
43	100%	44	100%
45	100%	46	99%
47	100%	48	98%
49	99%	50	99%

In Group A, after inhalation induction, muscle relaxation, IPPV and intubations, the stomach gas was removed by a feeding tube (nasogastric tube) of appropriate size (FR 6 to 10) and the surgery proceeded with.

In Group B, after inhalation induction, muscle relaxation, IPPV and intubations, stomach gas was not removed, and the surgery proceeded with. Patients were maintained with 50% Oxygen in Nitrous Oxide with 0.5 % halothane and IPPV carried out. Pulse Oximetery, blood pressure, electrocardiography and temperature monitoring was done.

In Group A, after securing the airway with endotracheal tube, feeding tube of the appropriate size was passed through the oro-pharynx applying gentle aspiration by means of a syringe, causing deflation of the stomach. Feeding tube was removed afterwards and the oximetery values noted from the time of induction to recovery at 10 minute intervals. At the end a mean value was derived for that particular case.

In Group B, after securing the airway with the an endotracheal tube, the stomach gas was not deflated, and the oximetery values were noted from the time of induction to recovery at 10 minute intervals and at the end a mean value was derived for that particular case.

Data of the Oximetery values of the two groups were collected. Independent sample t- test for data analysis was used. Comparison of Oximetery values of the two groups was done and data collected.

Table 2: Group Statistics

	Whether stomach gas removed	N	Mean	Std. Deviation	Std. Error Mean
Oximetery Values	Yes	15	1.20	0.41	0.11
	No	15	1.47	0.64	0.17

Results

Regarding results of group A (n = 25), 80% of patients (20) had SPO_2 = 100% while 20% of patients (5) had SPO_2 = 99% and none had SPO_2 = 98% (Table 1).

In group B (n = 25), 48% of patients (12) had SPO_2 = 100% while 32% of patients (8) had SPO_2 = 99% and 20% of patients (5) had SPO_2 = 98%.

Table 3: Independent Sample Test

Oximetery values	Levene's test for equality of variances		t-test for equality of means						
	F	Sig.	t	D f	Sig (2 tailed)	Mean difference	Std. error difference	95% Confidence interval of difference	
								Lower	Upper
Equal variances assumed	6. 38	.017	1.35	28	0.186	-27	.20	- 67	.14
Equal variances not assumed			1.35	23.9	0.188	-27	. 20	- 67	.14

Group statistics, independent sample tests, case processing summary and cross tabulation of the two groups is summarised in Tables 2 and 3.

Regarding data analysis and interpretation of Oximetery, mean value of group A was 1.20 where as that of group B was 1.47 with resultant STD error mean of 0.11 and 0.17 respectively which showed difference in the Oximetery values affected by placement of the nasogastric tube. Whereas by applying independent sample " t " test for equality of means revealed no difference in t values, so the 95% confidence interval of the difference was also same in both the groups which shows that difference in Oximetery values can be rendered insignificant.

Discussion

The paediatric patient differs in many ways from the fully developed adult. The changes that occur in the neonatal period and infancy are continuous and significant. In anaesthesia this leads to gradually changing responses to environmental factors, to drugs and to procedures carried out by anaesthetists and surgeons[4]. The rate of change varies with age, tending to be more rapid in the early infancy and in different organs.

An important difference is the relatively greater (2-2.5 times) surface area to body weight ratio of the infants compared to older children and adults. The relationship of the surface area to body weight affects the comparative measurements of physiological functions such as metabolic rate and resting oxygen consumption[6].

Resting oxygen consumption is 6-8ml/kg/min in the neonate, 5-6ml/kg/min in the infant and 3-4ml/kg/min in the adult. In early infancy the number of alveoli are 20 million which increase to 370 million at the age of 8 years. The alveoli are shallow having surface area of 0.4mm square, and do not reach the average adult size of 1.0mm square until adolescence. Bronchi in the children have proportionately more bronchial glands which may cause inflammation and edema in infants. Trachea size is smaller, lack of bucket handle movements limit chest expansion. Consequently the diaphragm is more important in ventilation in small children [7].

Paucity of type I fibers in the intercostals muscles and diaphragm, reduces FRC. Closing volume is > FRC therefore PaCo2 and Oxygen reserve are decreased than the older children. This combined with increased oxygen consumption causes small children to become hypoxemic rapidly in hypoxic situations.

As adequate ventilation depends on diaphragmatic movements [7] anything that inhibits diaphragmatic descent will cause hypoventilation.

Abdominal distention with gas can seriously impair inspiration and has been known to precipitate respiratory failure in conditions such as viral bronchiolitis. Positive pressure ventilation through gas mask if not done properly, may introduce large amount of gas into the stomach.

Conclusion

Inhalation induction followed by muscle relaxation and IPPV with a face mask can lead to gaseous distention of the stomach which can affect the arterial oxygenation saturation especially if proper technique is not followed. It becomes more significant if the infant or young child is suffering from some degree of respiratory disorder.

The removal of stomach gas can have a beneficial effect in these patients.

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