

## Comparison of Gastric pH in Emergency versus Elective Caesarean Sections

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### Abstract

**Background:** The volume of the gastric fluids and the gastric pH both are affected during pregnancy and surgery. The gastric fluid volume and pH are also affected by the mode of surgery (elective caesarean section and emergency caesarean).

**Objective:** The predetermined aim of this study was to compare the gastric fluid pH in emergency with elective caesarean sections.

**Method:** The study was conducted in Divisional Headquarters Teaching Hospital, Mirpur, Azad Kashmir and the sample population was consisted of 150 patients. The sample was divided into two groups, the patients with emergency caesarean section and elective caesarean section group. The gastric volume and gastric pH were detected in both groups of the study.

**Results:** The group of the patients in the emergency caesarean section showed lower gastric pH value ( $2.16 \pm 0.64$ ) and the gastric acid volume was ( $26.33 \pm 10.59$ ). In comparison, the gastric pH value for elective caesarean section was ( $4.56 \pm 1.28$ ) and gastric acid volume was ( $11.65 \pm 4.37$ ) respectively. The results were found to be significant at p-value  $<0.05$ .

**Conclusion:** The results of the study concluded that gastric volume was significantly higher and gastric pH was significantly lower in emergency caesarean section as compared to elective caesarean section.

**Keywords:** Gastric fluid volume; Gastric pH; Elective caesarean section; Emergency caesarean section

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### Introduction

Pregnancy is the condition that represents physiological adaptations, few adaptations become evident during first trimester of delivery while few of them remain persistent after the delivery. Pregnancy is the state that affects the functions of almost all body systems including gastrointestinal (GI) tract. The changes in physiology of GI tract includes the decrease in pH of the gastric fluids, gastric emptying and volume of the gastric fluids [1,2]. This whole condition is referred as gastro-esophageal reflux disease or GERD [3]. The exacerbation of the gastric symptoms occurs due to anxiety, labor pains, and opioids etc. [4-7].

Both the central and peripheral overlapping of the neural, paracrine and hormonal pathway controls the secretion of gastric acid from the parietal cells. The increased release of gastric acid may cause gastroduodenal injury while less production interfere

the absorption of calcium, iron, vitamin B<sub>12</sub> several drugs and may also pre-dispose the patients to enteric infections. There are many factors that are associated with the variation of acid secretion due to food intake. Therefore, it is essential to have an understanding of these factors in order to have the precise knowledge pathophysiology [8].

The effects of these factors may lead to increased risks of aspiration and vomiting which may lead to pneumonitis. The word aspiration is the mis-direction of the oropharyngeal and gastric contents into larynx and lower respiratory tract. The nature, frequency and quantity of aspirated material may results in variety of pulmonary syndromes. The syndrome includes the Mendelson's syndrome or aspiration pneumonia which occurs due to the aspiration of the gastric contents and aspiration pneumonia which is bacterial infection and caused by the aspiration of oropharyngeal secretions. This is the reason that any

conditions causing the increased gastric acid volume, decreased gastric pH or the disruption in the defense mechanisms may lead to any of these syndromes [9].

The term caesarean section is used to represent delivery of the baby by uterine or abdominal incision. The caesarean section is used for the maternal and fetal health, and safe delivery. The caesarean section may also be termed as emergency section or elective section. This is carried out after the age of viability which is 24 weeks. In the case of caesarean section, general or spinal anesthesia is more suitable [10].

Anesthesia is related to many factors and these factors may affect the GI physiology. During immediate pre-operative period, the food intake can affect the gastric emptying and also produces pronounced effect to enhance gastro-esophageal reflux [11]. Furthermore, at the time of induction of anesthesia, the cricoid pressure may decrease the lower esophageal sphincter tone [12]. These factors may act as the factors that may cause a high risk to the pregnant woman to develop regurgitation and aspiration which may present as pneumonitis. The pH and the volume of aspirated gastric content affect the severity of pneumonitis. The magnitude of the pH in case of emergency caesarean section is  $4.9 \pm 1.1$  and for elective caesarean section, the mean value is  $3.11 \pm 1.17$  [13].

The gastric volume of 25 ml or more and gastric pH of 2.5 or less is associated with the increased risk of developing pneumonitis in the parturient. Thus, it is recommended for all parturient, especially those with emergency caesarean section to have prophylaxis against pulmonary aspiration and regurgitation [14]. A figure expressing the acidity or alkalinity of a solution on a logarithmic scale on which 7 is neutral, lower values are more acid and higher values more alkaline. The pH is equal to  $-\log_{10}c$ , where c is the hydrogen ion concentration in moles per liter.

Emergency caesarean section is carried out in the cases when there is an immediate threat to the life of fetus or woman, and if the health of fetus or mother is compromised. The emergency CS is also carried out in cases when there is a need of early delivery. The elective caesarean section is carried out before the onset of labor for specific clinical indications.

The rationale for choosing this topic is that the literature review of evidence based studies has revealed that there is no study that has compared the pH and volume of gastric contents between pregnancy and elective caesarean section. Therefore, this study was conducted to understand the association between caesarean section and gastric pH and volume of gastric contents. The other rationale of this study was to appreciate the importance of aspiration prophylaxis group.

## Objective

The predetermined aim of this study was to compare the gastric fluid pH in emergency versus the elective caesarean sections.

## Materials and Methods

This theory was based on hypothesis that the pH of gastric

fluid in elective caesarean is higher than the pH of emergency caesarean section. This study was based on the cross-sectional methodology and the setting for this study was operation theatre of Divisional Headquarters Teaching Hospital, Mirpur, Azad Kashmir. The sample size was consisted of 150 cases that were divided into two equal groups. The first group consisted of 75 cases which were elective while second group consisted of 75 cases of emergency caesarean section. Confidence level of the study was 95% while the control of study was estimated as 80%. The magnitude i.e. mean  $\pm$  SD of the pH in emergency caesarean was taken  $4.9 \pm 1.1$  while for the elective caesarean section, it was  $3.11 \pm 1.17$ . Non-probability purposive sampling technique was used in the study.

## Inclusion and exclusion criteria

There were some inclusion and exclusion criteria that were used for the selection of sample. The inclusion criteria for the study was the patients that belong to the age group 20-40 years and all of the patients were ASA II. The patients that were going through the normal gestational period were included in the study and all caesarian cases were those that were conducted by using general anesthesia. Duration of the surgery was from 30-90 minutes and for the sample collection, patients were kept in the supine position during anesthesia.

Exclusion criteria for the study was the patients that had some pathology, for instance, achalasia of esophagus, diaphragmatic hernia, peptic ulcer, etc. The patients with difficulty of the anticipated intubation, morbid obesity and gastro-esophageal reflux and Zollinger-Ellison syndrome were excluded from the study.

## Data Collection

Patients that met the inclusion criteria of the study were subdivided into emergency and elective patients. The caesarean groups were labelled as emergency and elective and each group consisted of 75 patients. The mandatory monitoring for the measurement of pulse, blood pressure, capnography etc. were carried out. Pulse oximetry, capnography, ECG and non-invasive blood pressure techniques were used for mandatory monitoring. After the step of pre-oxygenation, the application of general anesthesia was carried out by rapid sequence induction with 5 mg/kg thiopentone sodium which is followed by 1.5 mg/kg of succinylcholine sodium. After the induction of long acting relaxant, orogastric tube no. 16 was passed to take the gastric aspirate. If there was any difficulty in the aspiration, the manipulation in the orogastric tube was carried out for obtaining the aspirate successfully. The pH was measured by using a calibrated pH meter while for the calculation of aspirate volume, 20 ml syringe was used. The 2 mg/kg of tramadol was used as the analgesic agent and was maintained with inhalation agent in 100% O<sub>2</sub>.

## Data Analysis

The data analysis was carried out by using the "Statistical Package for Social Sciences (SPSS) version 20. Data cleaning

was carried out after its entry for the removal of illogical and missing entries. The study groups, as described earlier, were the emergency versus elective caesarean section and gastric pH was the outcome variable. The comparison of the pH value of both groups was carried out by using the t-test. The percentages, frequencies, mean and the standard variables for the pH and age were calculated by using the descriptive statistics.

## Ethical Consideration

Before conducting the study, the ethical approval was taken from the ethical committee of the hospital. Furthermore, a written consent was also taken from the patients who were fulfilling the inclusion criteria of the study.

## Results

### Patients' distribution according to age

The mean age of the patients in the emergency caesarean section group was between the 20-30 years (mean  $\pm$  SD was  $28.17 \pm 4.21$  years). Among all the patients of this group, 28% of the patients i.e. 21 patients had the age range between 20-25 years, 50.7% or 38 patients had the age range between 26-30 years. In addition, 14.6% patients (11 patients) were those who had the age between 31-35 years and 6.7% (5 patients) had age range between 36-40 years. The distribution of the patients by age is shown in **Table 1**.

In the elective caesarean section group, the mean age of the patient was found to be  $27.82 \pm 4.48$  years and the age was ranging from 20-40 years. 38.6% (29 patients) of the patient were of the age group 20-25 years and 36% patients (27 patients) had the age range of 26-30 years. Furthermore, 18.7% patients (14 patients) were 31-35 years old and 6.7% of the patients (5 patients) were having the age between 36-40 years. The result for the age distribution of elective and emergency caesarean is also shown in **Table 1**.

### Patients' distribution according to weight

The patients of the emergency caesarean group had the mean weight range of 65-98 kg (mean age= $83.5 \pm 5.99$  kg). Among all the patients, 6.7% patients (5 patients) had the weight range of 65-75 kg, 52% of the patients (39 patients) had the weight range 76-85 kg. Moreover, 40% patients (30 patients) had weight range 86-95 kg and 1.3% i.e. 1 patient had weight greater than 95 kg.

The patients of the elective caesarean group had the mean

**Table 1** Distribution of patients by age (n=150).

Age in Years	Elective		Emergency	
	No. of Patients	Percentage	No. of Patients	Percentage
20-25	29	38.6	21	28
26-30	27	36	38	50.7
31-35	14	18.7	11	14.6
36-40	5	6.7	5	6.7
Mean $\pm$ SD	$27.82 \pm 4.48$		$28.17 \pm 4.21$	
Range	20-40		21-38	

**Table 2** Distribution of patients by weight (n=150).

Weight in Kg	Elective		Emergency	
	No. of Patients	Percentage	No. of Patients	Percentage
65-75	8	10.7	5	6.7
76-85	46	61.3	39	52
86-95	21	28	30	40
>95	0	0	1	1.3
Mean $\pm$ SD	$81.9 \pm 5.49$		$83.5 \pm 5.99$	
Range	65-90		65-98	

**Table 3** Distribution of patients by pH value and gastric volume aspirated (n=150).

	Emergency Caesarean Section	Elective Caesarean Section	p-value	Significance
Mean of pH value	$2.16 \pm 0.64$	$4.56 \pm 1.28$	0.000 (<0.05)	Significant
Mean of gastric volume	$26.33 \pm 10.59$	$11.65 \pm 4.37$	0.000 (<0.05)	Significant

weight range of 65-90 kg (mean age= $81.9 \pm 5.49$  kg). There were 8 (10.7%) patients were of the weight range between 65 to 75 kg and 61.3% of patients (46 patients) had the weight range between 76 to 85 kg. Additionally, 28% patients (21 patients) had the weight between the ranges of 85 to 95 kg. There was no patient with the weight >95 kg. The result for distribution of patients with respect to weight is also shown in **Table 2**.

### Distribution of the patients by the comparison of pH value and volume of the gastric aspirate

The pH and volume of the gastric aspirate were also compared between both groups. The mean value for the pH for the patients of the emergency caesarean section was  $2.16 \pm 0.64$  and the mean for the elective caesarean group was  $4.56 \pm 1.28$ . The results were found to be significant at p-value <0.05 when the pH of both groups was compared.

The aspirated gastric acid volume of the patients was also compared. In the emergency caesarean section group, the mean gastric acid volume aspirated was  $26.33 \pm 10.59$  ml, while the mean value for elective group was  $11.65 \pm 4.37$  ml. The results of both groups were compared and it was found that emergency caesarean section volume was more than that of elective group and found to be statistically significant at p-value <0.05. The results for comparison of pH and volume of gastric aspirate are shown in **Table 3**.

## Discussion

It is evident from the literature [15-17] that the issue regarding aspiration problems and gastric acidity has been under debate for several years. The role of the gastric pH and its management has been studied by various researchers and several studies are being conducted in this regard. The present study is among the few studies that are being conducted globally to compare the gastric pH of patients from elective and emergency caesarean section

group. The review of literature has revealed that only fewer studies are conducted on this important matter of consideration.

In a study conducted by Ngwingtin et al. [18] the researchers studied 97 patients for the evaluation of changes in the volume of the gastric content and gastric pH during the state of pregnancy and labor. There were several study parameters that were used for this study and one of the basic study parameters was the measurement of gastric pH and volume of the gastric content after the induction of the anesthesia. The same parameters were also used for this study, however in the reference study, the patients were divided into 3 groups and these three groups were; group 1 consisted of 39 patients that received the treatment for elective caesarean section, group 2 included 44 patients with some elective gynecological surgery and the group 3 consisted of 14 patients who had emergency caesarean section.

The aim of the study conducted by Ngwingtin et al. [18] was to determine that whether there is any modification in the mean pH or volume of the gastric content due to pregnancy or labor. The mean values for the three groups of the study revealed that no significant differences occur between these groups. The results of this study concluded that there is no effect of the pregnancy or labor on the gastric pH. If the results of the gastric volume are considered, a significant difference was found between the group 1 and 3 at  $p < 0.01$  and similarly significant differences were observed for group 2 and 3. This study resembles current study in terms of study parameters and methods i.e. measurement of gastric volume and gastric pH. However, the results of the present study differ from the study conducted by Ngwingtin et al. [18]. This can be revealed from the fact that in the study conducted by Ngwingtin et al. [18] the gastric pH in emergency caesarean section was 2.57 while in the present study the pH was  $2.16 \pm 0.64$ . The value of the gastric pH for the elective caesarean was  $2.77 \pm 0.42$ , while in the present study; the mean gastric pH was  $4.56 \pm 1.28$  which is a huge difference from the other values. The results of both studies illustrated that gastric pH for the elective caesarean section is comparatively high. The results of the past study were of no clinical significance, however, the results of this study were found to be clinically significant.

A clinical trial was conducted by Hong et al. in which researchers found the difference of gastric pH and volume between two groups, i.e. the pregnant group and non-pregnant group. The observation of the clinical trial showed that gastric pH of the pregnant women was lower than the gastric pH level of the non-pregnant women ( $2.4 \pm 1.4$  for the pregnant women and  $3.0 \pm 1.9$  for the non-pregnant women at  $p < 0.05$ ). On the other hand, the gastric volume was found to be high for the pregnant women as compared to non-pregnant group (the value for the pregnant women was  $0.49 \pm 0.4$  mL/kg vs.  $0.24$  mL/kg for non-pregnant women at  $p < 0.05$ ). However, there was no significant difference in the serum gastrin level of the both groups ( $32.1 \pm 12.3$  vs.  $28.2 \pm 8.3$  pg/mL) [19].

Naguchi et al. [18] carried out a clinical trial for investigation of the impact of anesthesia on the gastric secretion. They used different anesthetic techniques for the measurement of gastric

volume and pH during anesthesia. In the anesthetic techniques, the halothane anesthesia was induced in three groups, enflurane anesthesia, halothane plus thoracic epidural block, halothane without premedication of atropine. The pH was increased for all age groups and more profoundly in the old age patients after the induction of halothane anesthesia. The enflurane anesthesia and halothane anesthesia with thoracic epidural block also increased the gastric pH. The anesthesia group without pre-medication of atropine, showed no significant effect on the gastric pH or the gastric acid volume. The results of this study concluded that during the halothane anesthesia, parasympathetic blockage is the basic reason for increase in the gastric pH [20].

In the present study, the volume of gastric aspiration and gastric pH were used as the outcome variables. These parameters are extensively used in several clinical trials. Stuart et al. [21] conducted a clinical trial for the comparison of different prophylactic drugs in order to find the effectiveness of these drugs in gastric pH. The sample size of the study was 384 patients and who required the emergency caesarean section with the aid of general anesthesia. The general anesthesia was received at random one of six acid prophylaxis procedures till the decision for surgery was finalized. The parameter for this study was pH level 4. The outcomes of the study have concluded that measurement of gastric pH is the universal parameter which can be used for the determination of the GI or aspiration related problems in the obstetric patients [21].

The gastric volume and pH can be used as a parameter for the measurement of risks of aspiration. The higher risks for the aspiration are the gastric pH  $< 2.5$  and gastric fluid volume  $> 0.4$  ml/kg. These are the widely accepted indicators for different clinical trials and the measurement of these parameters can be effective for the prevention of risks of aspiration [22].

There is an essential requirement to develop the guidelines and policies in the setups to reach the optimal results and parameters. These policies include the addition of some gastric pH neutralizing agents, for instance,  $H_2$  receptor blockers, antacids, or conducting aspiration of the gastric contents before emergency caesarean section.

## Limitations and Recommendations

There are some limitations of the study. The sample size of the study was small and the study was not a double blinded study. There are few recommendations regarding this study. Further evidence based studies or clinical trials should be conducted on a large sample size.

## Conclusion

The results of this study concluded that the patient undergoing emergency caesarean section had lower gastric pH as compared to the patients that had undergone the elective caesarean section. The difference between the two groups was found to be statistically significant. There is a pre-requisite requirement to conduct large multicenter clinical trials with larger sample size so that the facts concluded from this study can be proved.

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