A STUDY TO DETERMINE THE EFFICACY OF 0.3M SODIUM CITRATE AS AN ANTACID PROPHYLAXIS AGAINST ASPIRATION PNEUMONITIS IN OBSTETRIC PATIENTS UNDERGOING ELECTIVE CEASEREAN SECTION UNDER GENERAL ANESTHESIA

Dissertation submitted

In partial fulfillment for the award of

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CERTIFICATE

This is to certify that this dissertation titled "**A STUDY TO DETERMINE THE EFFICACY OF 0.3M SODIUM CITRATE AS AN ANTACID PROPHYLAXIS AGAINST ASPIRATION PNEUMONITIS IN OBSTETRIC PATIENTS UNDERGOING ELECTIVE CEASEREAN SECTION UNDER GENERAL ANESTHESIA**" has been prepared by **Dr. SUJARITHA. T**, under my supervision in the Department of Anesthesiology, Government Kilpauk Medical College, Chennia-10 during the academic period 2010-2013 and is being submitted to the Tamil Nadu Dr.MGR Medical University, Chennai-32 in partial fulfillment of the University regulation for the award of Degree of Doctor of Medicine (M.D Anesthesiology) and her dissertation is a bonafide work.

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DECLARATION

I**, Dr. SUJARITHA.T**, solemnly declare that the dissertation , **"A STUDY TO DETERMINE THE EFFICACY OF 0.3M SODIUM CITRATE AS AN ANTACID PROPHYLAXIS AGAINST ASPIRATION PNEUMONITIS IN OBSTETRIC PATIENTS UNDERGOING ELECTIVE CEASEREAN SECTION UNDER GENERAL ANESTHESIA"** is a bonafide work done by me in the Department of Anesthesiology and Critical care, Government Kilpauk Medical College, Chennai-10 under the guidance of **Prof. S. GUNASEKARAN, M.D., D.A., D.N.B**, Professor and HOD, Department of Anesthesiology, Government Kilpauk Medical College, Chennai-10.

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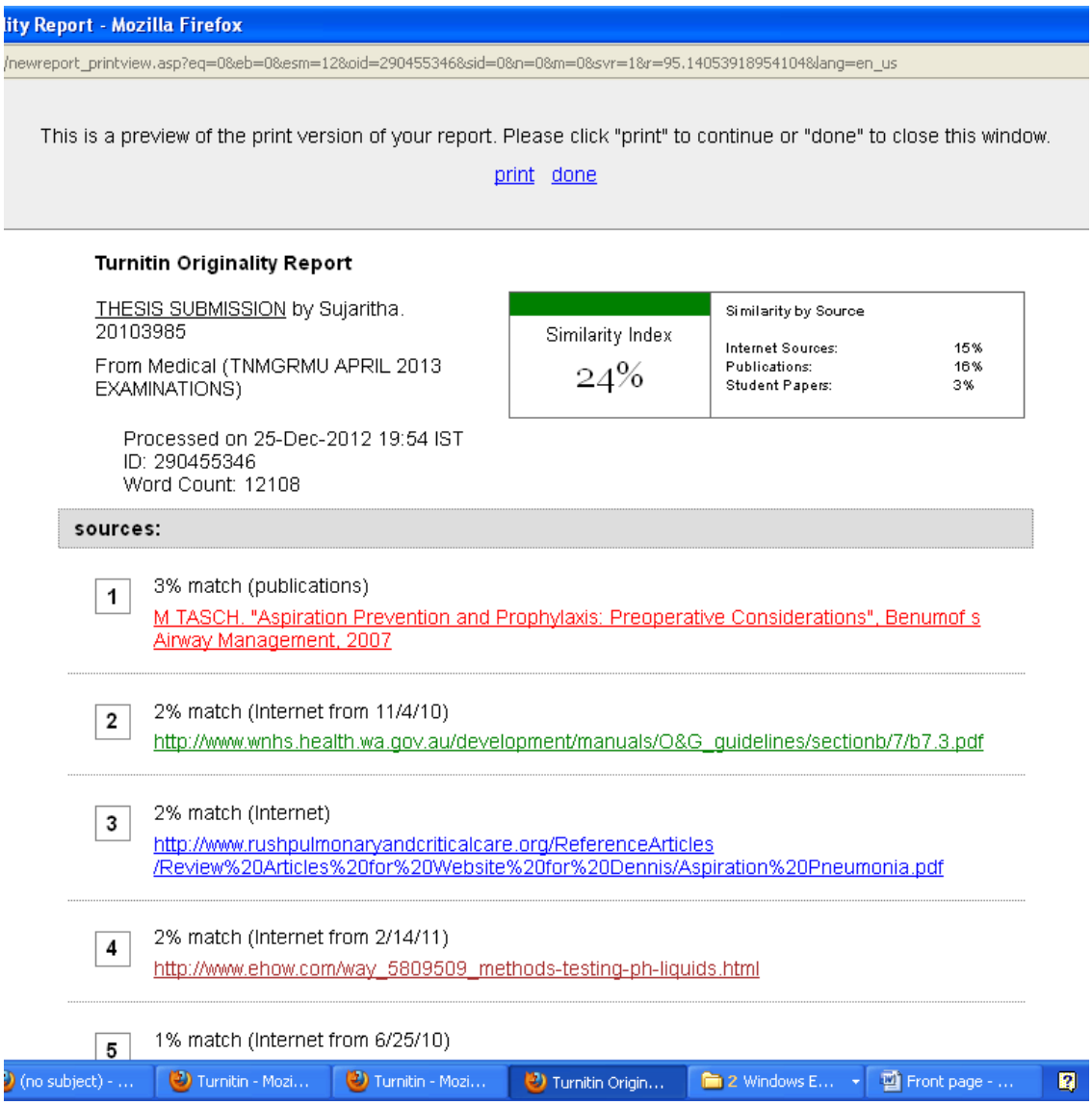

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CONTENTS

1. INTRODUCTION

Pulmonary aspiration of gastric contents in patients undergoing surgical procedures under General anesthesia still remains one of the common intra operative complications. This carries even more greater significance in emergency scenarios where the preoperative fasting guidelines are not met with. The obstetric subset of patients still carries even more increased risk of pulmonary aspiration, since they have delayed gastric emptying time and reduced LES tone and hence, they are considered always as full stomach.

In UK, the recent maternal mortality auditing report shows that, majority of deaths resulting from anesthetic events in the peri-operative period are found to be associated at the time of induction of general anesthesia. This is thought to result from two major causes, inhalation of gastric contents (aspiration) and failure to intubate the trachea, resulting in cardiac arrest. Aspiration occurs in 1 in every 3000 cases of anaesthesia and accounts for 10% - 30% of the deaths related with anaesthesia. Studies regarding perioperative aspiration in general surgical population in US shows incidence of 1/3216, morbidity of 1/ 16576 & mortality of 1/71829 [3].

As it has been shown that acid aspiration causes chemical pneumonitis, various methods are used to reduce the pH and volume of the stomach contents [1].

Particulate antacids, e.g Aluminium hydroxide and Magnesium trisilicate, were used until they themselves were implicated in causing a chemical reaction in the lungs of animals [1]. Hence, particulate antacids should be avoided in the perioperative setting. This led to the use of non-particulate antacids. Of all the non particulate antacids, the most popular is 0.3 mol sodium citrate. This drug is specially useful in neutralizing of gastric acid especially during emergency surgical procedures under general anesthesia.

The risk of pulmonary aspiration is severe when the gastric content has a pH< 2.5 and a volume > 25ml. It has been proven that, when administered as a single dose before the induction of anesthesia 0.3 molar sodium citrate is effective in elevating gastric pH above 3.5 in all patients[2]. The risk of acid pneumonitis should aspiration occur, would therefore be minimized. In Indian scenarios, not much of studies or reviews are there regarding the administration and efficacy of sodium citrate as antacid prophylaxis.

Hence this study was carried out with an aim to establish the efficacy and to encourage the routine use of 0.3 molar sodium citrate, especially in the obstetric population. In this study, pH of gastric content samples before and after sodium citrate administration are measured with aid of a digital pH meter and is used to determine the efficacy of 0.3M sodium citrate.

2. PHYSIOLOGY OF GASTRIC ACID SECRETION

Food is generally presented to the stomach in small soft boluses, prepared in the mouth by chewing and moistened by saliva, containing mucins and ptyalin. As a result of its large capacity, the stomach is capable of accommodating a significant quantity of food without a large increase in intragastric pressure. Its main function is to maintain an environment where its digestive enzymes can commence protein digestion and to move food at a controlled rate via the pyloric sphincter into the duodenum. The major issues for gastric physiology are the nature and control of gastric secretion and the methods of controlling motility and gastric emptying. Not surprisingly, the system is integrated with considerable overlap in control of both functions.

Gastric secretion:

Normal volume of gastric secretion is 2–3 L/day . There are three types of cells:

1. *Chief or peptic cells in the antrum, which secrete proteolytic proenzymes called pepsinogens.* To avoid cellular damage, they are inactive until they enter the gastric lumen, where in the acid pH they are cleaved to form active pepsins that hydrolyse proteins.
2. *Parietal cells, which secrete hydrochloric acid and intrinsic factor.* The latter is important for the absorption of vitamin B12 in the terminal

ileum. Hydrochloric acid secretion requires the production of H_2CO_3 in the cell interior, catalysed by carbonic anhydrase. The secretion of H^+ is an active process involving a proton pump working against a 3 million-fold concentration gradient between the cell and gastric lumen and in which K^+ is exchanged. It produces a gastric pH of between 1 and 3, which kills bacteria, allows the activation of pepsin, and is optimum for its function (active at pH < 3.5). As acid secretion increases after eating, it is accompanied by an increase in pH of gastric venous blood (alkaline tide), with bicarbonate entering the blood in active exchange for chloride ion. This is mirrored, however, by bicarbonate secretion in pancreatic juices such that the body pH remains stable.

3. *Mucous cells, which secrete mucin.* This secretion is alkaline, has a protective role for mucosal cells, and may lubricate the gastric lumen. Inhibition of prostaglandin function disrupts mucin production, leaving gastric cells vulnerable to gastric acids.

Secretions	**pH**
Saliva	6-7
Gastric fluid	1.0-3.5
Bile	7-8
Pancreatic fluid	8.0-8.3
Small intestine	6.5-7.5
Colon	7.5-8.0

3. GASTRIC pH ANALYSIS[30]

The pH of a substance is a measure of its hydrogen ion activity which determines whether it is acidic, neutral or alkaline.

Methods – Various methods have been used in measuring the pH of body fluids.

1. Litmus Paper

Litmus paper is a small strip of specially chemical impregnated paper. The paper strip is made by dipping and treating it in a combination of dyes. So, while these strips are used for testing, the dyes change color according to the pH of the medium in which they are tested in. On testing the paper in Acidic liquids with a pH of less than 7, the paper turns red. Alkaline liquids (pH more than 7) change it to blue or purple. Litmus paper strips are used for estimating the relative pH of liquids roughly, but it does not indicate accurate values. Method - Measurement is made by briefly dipping the end of an unused strip in the testing liquid and allowing it to dry. The color change is then noted based on the acidity or alkalinity.

2. Field Kit

A field kit consists of a empty, clean container into which a sample liquid is placed, and a bottle of indicator solution. A few drops of the

indicator solution are placed in the sample, and the pH is determined by the change in color of the liquid. Because different indicator solutions perform better at certain pH levels, a variety of kits is available for different ranges. The accuracy of the field kit depends on the narrowness of the indicator solution's range.

3. Probe and Meter

This is the most accurate and widely used common means of measuring pH. In this method, the pH is measured by a lab device called a probe and meter, otherwise called, a pH meter. The probe consists of a electrode made of glass, through which a small voltage is passed. The meter, a voltmeter, measures the electronic impedance across the glass electrode and displays pH in terms of units, by conversion of volts. Measurement is made by submerging the probe in the liquid till the mark given, until a reading is registered by the meter. A pH meter has to be calibrated with two standard liquid solutions of known pH before testing the liquid every time. As this method needs large volumes of 40-50ml of gastric aspirate, its routine clinical use is not always feasible.

4. Digital pH meters:

Digital pH meters are used for measuring and display of the pH of liquids and semi-solids. In this type of digital pH meters, a probe is

incorporated that reacts with the liquid being measured. Then, the internal electronics to read the output signals from the probe and it displays the result. These meters are more reliable and accurate than the other types like test strips or liquid reagents. As this requires only15-20ml of gastric aspirate and the results are displayed instantaneously, this method has been used widely. Moreover it is of cheaper cost, portable, easily available.

Other non-invasive methods in common are by using electrical impedance tomography and pH sensitive radio telemetric capsule.

The pH meter used in this study for evaluating the pH of gastric aspirate is a hand held pen like digital PH meter shown below An useful instrument to perform quick pH measurements - simply remove the black protective cap (shown below), switch on and dip the probe into the liquid to be tested and pH value is indicated in form of the LCD digital display. The reading is calibrated with the buffer solutions, whose pH is known.

Picture of Digital pH meter

Model : Hanna HI-96106 Champ pH Tester- used in our study.

4. PHYSIOLOGY OF NAUSEA AND VOMITTING

Nausea is an unpleasant subjective sensation of impending vomiting and is sometimes associated with epigastric discomfort. Vomiting is an active process under the control of the vomiting centre, and involves the active muscular expulsion of stomach contents in a reflex that, like swallowing, involves carefully timed respiratory and peristaltic responses.

The vomiting centre lies in the dorsal part of the lateral reticular formation in the medulla oblongata of the brainstem. It receives inputs from a variety of sources, including the cerebral cortex, which can produce vomiting associated with emotion and unpleasant somatic sensations. The predominant receptor types are dopamine, serotonin (5-HT3), and acetylcholine. The chemoreceptor trigger zone (CTZ) is located in what is known as the area postrema in the floor of the fourth ventricle and relays to the vomiting centre. It represents the major area of input into the vomiting centre. Lying outside the bloodbrain barrier, it is sensitive to chemical stimuli from drugs such as opioids and bloodborne toxins. The most prevalent receptor subtypes in the CTZ are dopamine, acetylcholine, and serotonin.

The act of vomiting, initiated by the vomiting centre, involves integration of respiratory, peristaltic and vascular reflexes involving a

number of cranial nerves (5th, 9th, 10th, and llth) and spinal nerves supplying the abdominal musculature. It is often preceded by pallor, increased heart rate, salivation, and sweating. A deep inspiration accompanies closure of the glottis and inhibition of further respiration. Descent of the diaphragm and repeated contraction of abdominal muscles raises intragastric pressure, and retrograde contractions of the stomach and small intestine force gastric contents into the oesophagus as the lower oesophageal sphincter relaxes. This retching manoeuvre precedes relaxation of the upper oesophageal sphincter, which allows food to be expelled in the act of vomiting.

PULMONARY ASPIRATION IN THE PERIOPERATIVE SCENARIO

Pulmonary aspiration of gastric contents is considered to be one of the most dreaded and worst complications of anesthesia. Pulmonary aspiration is defined as a constellation of clinical features resulting from the inhalation by the patient or the passive introduction of oropharyngeal or gastric contents into the larynx and lower respiratory tract.[5] Prevention of aspiration by identification of patients at risk, preoperative fasting, drug treatment and various anesthetic maneuvers are cornerstones of safe anesthetic practice.

5. PATHOPHYSIOLOGY OF PULMONARY ASPIRATION

When gastric contents get aspirated into the lungs, the resultant pulmonary damage will manifest based on the quantity and quality of the contents aspirated. The pulmonary reactive injury after gastric aspiration comes under 3 groups:

1. Particle related,
2. Acid related
3. Bacterial [8].

Pathophysiology of Aspiration[4]

1. Aspiration of particulate matter :

   Obstruction of airway due to edema

   Acute inflammation

   Granuloma formation

2. Aspiration of acid :

   Infiltration of neutrophils at that site

   Pulmonary edema

   Damage to alveolar mucosa

   Depletion of type I pneumocytes

   Reduced surfactant and alveolar collapse

3. Alveolar-capillary membrane disruption
4. Fluid leakage from capillaries in pulmonary bed
5. Bacterial infection- due to translocation of organisms from oropharyngeal secretions

Food particles which are very miniscule that they enter the distal airway to initiate a foreign body reaction characterized by acute or subacute inflammation and eventually formation of granuloma in chronic period. The aspiration of particulate antacids like aluminium or magnesium hydroxides produces an adverse reaction similar to the above[9].

A study by Kennedy et.al in rats showed a biphasic pattern of pulmonary mucosa injury after aspiration of acid. [3] The peak in the phase one occurs at around 1-2 hrs after aspiration and it is due to the direct, caustic nature of the gastric contents and a low pH of the aspirated contents on the alveolar–capillary cells. The second phase, which peaks at 4-6 hours, is caused due to the inflammatory infiltration of polymorphic cells, across the alveolar barrier into the alveolar space and into the interstitial area , suggesting features of acute inflammation.

MECHANISM OF BRONCHOALVEOLAR INJURY :

The mechanisms proposed by which the pulmonary injury occurs after gastric aspiration, has been mediated by a variety of numerous inflammatory cells, inflammatory mediators, cellular adhesion factors. It is also aided by an array of enzymes cyclooxygenase , Tumor Necrosis Factor- alpha, interleukin – 6, 8, and lipoxygenase enzyme products, and various reactive oxygen species.[11]

RISK FACTORS FOR PULMONARY ASPIRATION [4] :

Patients likely to have gastric contents of increased volume or acidity, elevated intragastric pressure, or decreased tone of the lower esophageal sphincter (LES) are considered to be at increased risk for perioperative pulmonary aspiration. These patients have dysphagia due to neurological causes, gastroesophageal sphincter incompetency, or anatomical abnormalities of the upper alimentary tract. The risk is higher in elderly persons (dysphagia & gastroesophageal reflux). Also, in old age there is poor oral care, resulting in colonization by pathogens, including *Pseudomonas aeruginosa*, and *Staphylococcus aureus.* In 40-70% patients with stroke,"silent aspiration" occurs.

1. Regurgitation or vomiting

   During the period of hypotension

   Increased intragastric volume and pressure

   Decreased lower esophageal barrier pressure

   Lower esophageal sphincter incompetency

2. Incompetent and ineffective protective reflexes of the larynx

   Neurological disorders (lower cranial nerves palsy)

   Depressants of the Central nervous system

   Neuromuscular causes and myopathies

   Debilitaed patients and critically ill.

   Elderly patients due to debility or advanced age(obtunded airway reflexes)

Among this, the pregnant patient is at increased risk of aspiration because of increased frequency of gastro-oesophageal reflux and delayed gastric motility and gastric emptying [5, 6].

DETERMINANTS OF MORBIDITY:

The main factors which play a role in morbidity are the critical volume and pH of gastric contents and the type of particulate content in the aspirate.

1. CRITICAL VOLUME AND pH :

Initial stages of experimental studies in animals by Teabeaut emphasized the importance of the pH of the gastric contents aspirated, the severity of pneumonitis being related to increased acidity of aspirate . Subsequently, Roberts and Shirley[5] "arbitrarily defined the patient at risk of aspiration as that patient with at least 25 mL of gastric juice of pH below 2.5 in the stomach at delivery" . **A** further study by James et al. demonstrates mortality rate of 90% in rats after aspiration of gastric contents, 0.4 mL kg-' at pH of 1.0.

Later studies by Rocke D A et al, suggests enough evidence to change the "at risk" criteria to a pH less than 3.5 and gastric volume of more than 50 mL. They also tell that by using newer critical value criteria, it will allow us to focus less on attempts at targeting to get small residual gastric volumes and focus more on pH correction through H_2 blockers and antacids.

2. PARTICULATE MATTER :

The volume and acidity of aspirated gastric contents are not considered the only determinants of the clinical sequel when gastric contents get aspirated into the trachea. Since the analysis of studies by Bond and coworkers, it has been emphazised that aspiration of gastric fluid containing particulate antacids can cause severe aspiration pneumonitis,

even when pH is at near 7.0. It can present pulmonary edema and hypoxemia requiring mechanical ventilatory support in the immediate postoperative period

CLINICAL FEATURES :

Patients who have aspirated the gastric might manifest with various signs and symptoms. Most of the patients in this group present with only cough or an inspiratory wheeze, and some persons may have what is called as a 'silent aspiration'. It presents as a arterial hypoxia and desaturation along with radiologic features of aspiration.

In the most extreme cases, they might present with intense wheezing with bilateral rales, severe cough, shortness of breath (dyspnea). Sinus tachycardia, cyanosis, hypoxemia and pulmonary edema, hypotension. Finally, there is a rapid progression to severe acute respiratory distress syndrome and death ensues.[12]

Warner et.al did an analysis on 67 patients who got accidentally aspirated while under anesthesia.[3] Among these, forty two (63%) patients had no features of aspiration. Among the remaining twenty five who manifested symptoms, 13 patients were given mechanical ventilatory support for more than 6 hours duration. Four patients succumbed to death.

DIAGNOSIS OF PULMONARY ASPIRATION:

Asymptomatic aspiration of gastric contents can occur during sleep in 45% of individual and in 70 % persons who are unconscious. The risk factor even more goes up in obese, obstructive sleep apnea and in pregnancy. Clinical signs like dyspnea, tachycardia, low grade fever, wheezing, diffuse rales suggest aspiration[13].

A chest radiograph can be useful in diagnosing aspiration pneumonitis; however, in patients who aspirate and have an uncomplicated clinical course, 8% may have normal chest radiographs throughout their hospitalization. In almost one third of aspiration cases, the initial chest radiograph does not represent the full extent of lung involvement, and the findings on the chest film will worsen before improvement is seen.

No particular distribution of lung injury on the chest radiograph is diagnostic of aspiration pneumonitis. Both the right and left lungs may be affected, and any lobe of the lungs may be involved. Likewise, the characteristics of the infiltrates noted on the chest film are not diagnostic. Small, irregular lung infiltrates are generally observed; however, mixed infiltrates are seen and may be misinterpreted as acute processes superimposed upon chronic processes, or even as two distinct disease processes.

The earliest clinical findings reflective of the pulmonary aspiration of gastric contents are those of altered pulmonary function. Following aspiration, reflex laryngospasm and bronchospasm result because of chemical and physical irritation of the airways. Surfactant activity decreases with the ensuing rapid development of airway and alveolar injury and fluid exudation. Intrapulmonary shunting develops, and hypoxemia results. With increasing damage to lung tissue, lung compliance decreases.Invasive investigations may confirm aspiration, such as broncho alveolar lavage, fiberoptic bronchoscopy.

Fiberoptic bronchoscopy is considered the gold standard for diagnosing a suspected case of aspiration. Broncho alveolar lavage and protected brush specimen are useful diagnosing ceses of nosocomial pneumonia. Less invasive methods like chest X-ray and radio scintigraphy are also helpful.

Percutaneous needle aspiration and open lung biopsy offer definitive diagnosis but are associated with high complication rates. Bronchoscopy examination after aspiration shows erythematous changes at the major bronchial carina [18]. Diffuse infiltrates or consolidation of dependent pulmonary segments is seen in the radiography.

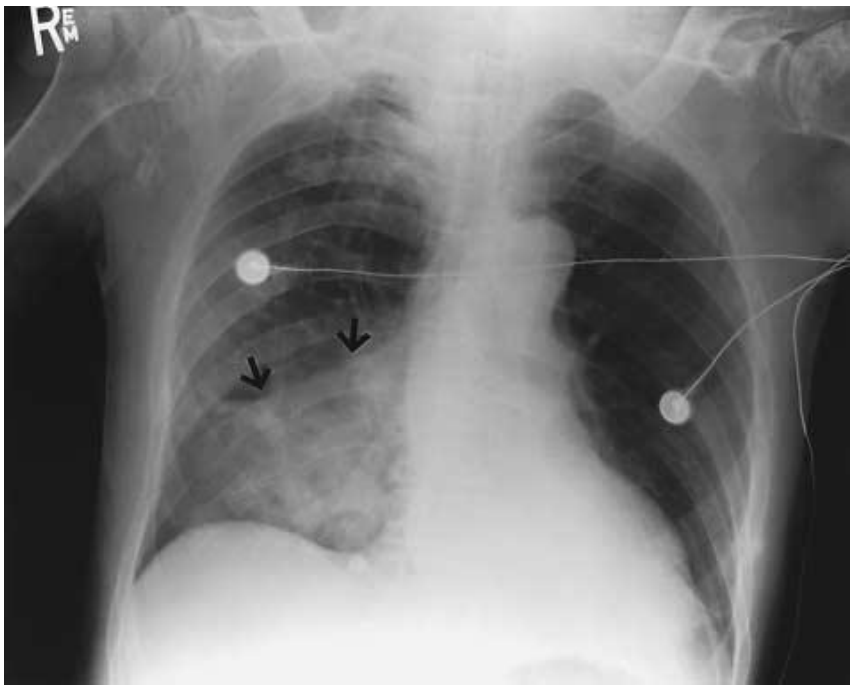
Radiographically visible[14] infiltrates are almost evident within several hours and resolves by the next 48-72 hours. An increasing intensity of the infiltrates denotes super added infection or retained secretions. Foreign body aspiration in children can be diagnosed by ventilation –perfusion imaging.

The radiographic evidence of an infiltrate in specific bronchopulmonary segment can vary depending on the patient position. In patients in recumbent position, the posterior segment of upper lobes and the apical segment of lower lobes are commonly involved, whereas in patients who aspirate in semirecumbent or upright position, the basal segments of lower lobes are affected.

Thus in short, unless the aspiration event is witnessed or the tracheal suction yields gastric contents or enteral feeds, no modality is confirmatory for diagnosing a case of aspiration.

SEQUELAE OF PULMONARY ASPIRATION:

1. Aspiration pneumonitis
2. Aspiration pnumonia.
3. Community acquired pneumonia.
4. Acute Respiratory Distress Syndrome.
5. Pulmonary edema.



Anteroposterior Radiograph of the Chest, Showing Air-Space Consolidation (Arrows) in the Right Lower Lobe- suggestive of aspiration pneumonitis.

DIFFERENTIATING ASPIRATION PNEMUONITIS AND ASPIRATION PNEUMONIA :

Aspiration pneumonitis also well known by the term Mendelson's syndrome is a chemical induced injury of the pulmonary mucosa caused by the inhalation of sterile gastric contents which is acidic in nature.

Aspiration pneumonia is an infectious process caused by the inhalation of oropharyngeal secretions that are colonized by pathogenic bacteria.

Pulmonary aspiration of pharyngeal liquids is fairly common and usually is without sequelae.[13] However, when this aspiration exceeds a certain frequency or volume (as mentioned above) and contains pathogenic organisms, aspiration pneumonia results. Aspiration pneumonia is not to be confused with aspiration pneumonitis, which results from chemically induced damage to lung tissue. Aspiration pneumonia is caused by a bacterial infection and is the cause of at least 10% of community-acquired pneumonias.[16]The infective organisms are Pseudomonas sp, Enterobacter sp, Klebsiella sp, Actinobacter sp, and methacillin-resistant Staphylococcus aureus.

MANAGEMENT OF PULMONARY ASPIRATION :

Aspiration Pneumonitis:

The upper airway including the oropharynx and hypopharynx needs to be thoroughly suctioned after a witnessed aspiration. Endotracheal intubation is considered as a protection for patients who are unable to protect their airway from secretions[16]. Antibiotic therapy should be considered for patients with aspiration pneumonitis failing to clear within next 48 hours after aspiration[17]. Empirical antibiotics coverage is appropriate for patients who aspirate gastric contents and in patients with small intestinal obstruction or other causes which may be associated with

bacterial colonization in stomach. In this case, the sterile gastric contents become infective[17].

Steroids have been in use since a long time for the management of aspiration pneumonitis. But, on the other hand some of the controlled trials on steroids did not demonstrate a special benefit of high-dose corticosteroids in patients with the acute respiratory distress syndrome. This implies that the administration of corticosteroids cannot be routinely recommended in all patients with aspiration.[18]

Aspiration Pneumonia:

Antibiotic therapy is indicated in patients with aspiration pneumonia. The choice of antibiotics should depend on the setting in which the aspiration occurs as well as the patient's medical and surgical comorbid illness. However, when indicated antibiotic agents acting against gram-negative spectrum like fluoroquinolones, third-generation cephalosporins, and piperacillin are used[16,17].

PREVENTION OF ASPIRATION:

GENERAL MEASURES:

Because diagnosis and treatment may be quite difficult, prevention of aspiration pneumonitis is important. When intubation is required, the duration of intubation and ventilation must be as brief as clinically possible.

Airway contamination should be minimized, and suctioning of the airway must be conducted in a sterile manner. Antibiotic use should be minimized to reduce the emergence of resistant strains. When tube feeding is administered, gastric distension is avoided. Good oral hygiene is necessary, and patients should be maintained in a semierect position (≥30 degrees), with the head of bed elevated whenever possible to reduce passive regurgitation [19].

Methods[22] to Reduce Risk of Regurgitation and Pulmonary Aspiration

1. Minimize Intake
    a. Adequatepreoperative fasting
    b. Clear liquids only if necessary
2. Increase gastric emptying

    Prokinetics (e.g., metoclopramide)
3. Reduce gastric volume and acidity
    a. Nasogastric tube aspiration
    b. Nonparticulate antacid (e.g.,0.3.M sodium citrate)
    c. H_2-receptor antagonists (e.g., ranitidine)
4. Airway management and protection during anesthetic induction and intubation :
    a. Cricoid pressure(Sellick's maneuver)
    b. Cuffed endotracheal intubation- provides better airway seal

c. ProSeal laryngeal mask airway- it has got a gastric drainage port and the cuff provides better seal when compared to classic LMA

1. PREOPERATIVE FASTING GUIDELINES FOR ELECTIVE SURGERY- ASA- 2011[20] :

Food Material	Minimum Fasting Period required
Clear liquids	2 hours
Breast milk	4 hours
Nonhuman milk	6 hours
Infant formula	6 hours
Light meal	6 hours
Fatty, heavy meals	8 hours

These recommendations, as given in American Society of Anesthesiologists- Fasting guidelines 2011, are applicable in all healthy patients posted for elective surgical procedures.

2. PREINDUCTION NASOGASTRIC TUBE ASPIRATION :

When a patient who is at increased risk for periop aspiration comes for surgery, the stomach can be emptied, by introducing and suctioning through an orogastric or a nasogastric (NG) tube[4].But, the presence of a gastric tube interferes with the integrity and function of the lower esophageal sphincter of the gastroesophageal junction and this is going to

augment the gastro esophageal reflux by its action as a "wick."[21] Further, the presence of a foreign body (nasogastric tube) in the pharynx could also interfere with laryngoscopy. These considerations supports the removal of the gastric tube before induction.

Hardy and colleagues did a study in 24 patients, by measuring the volume of gastric contents aspirated through an 18 F Salem Sump tube, then came to a conclusion "that the amount of aspirated gastric fluid… is a very reliable estimate of the volume of contents present in the stomach during the time of induction" and that suctioning in the naso gastric tube "could also be an effective method to empty the liquid contents of the stomach, prior to giving anaesthesia."

3. CRICOID PRESSURE :

It is given during anaesthetic induction and intubation. As described by Sellick[23] in 1961, "this maneuver results in the temporary passive occlusion of the upper end of the oesophagus by giving backward pressure of the cricoid cartilage(the only cartilage in the larynx which forms a complete ring), against the bodies of the cervical vertebrae. Extension of the neck and applying pressure over the cricoid cartilage obliterates the oesophageal lumen at the level of the body of the fifth cervical vertebra.

This occlusive force or pressure is maintained until intubation of trachea and inflation of the cuff of the endotracheal tube is completed."

By following this maneuver , the lumen of the esophagus is nearly occluded, but the patency of tracheal lumen is maintained by the completely circular nature of the cricoid cartilage.[22] Early cadaveric studies showed that correctly applied cricoid pressure was effective in preventing gastric fluids under 100 cm H2O pressure from leaking into the pharynx, thus preventing aspiration[22].

4. PHARMACOLOGICAL METHODS OF REDUCING THE GASTRIC VOLUME AND ACIDITY[4] :

An wide and impressive range of pharmacologic interventions are now implicated in promoting gastric emptying, inhibit GER, and reduce the acid content of gastric fluids. These drugs have been in use since a long time with an established record of safety and helps in converting the more acidic gastric fluid to less damaging to the lungs. However, because of the limited incidence of clinically significant perioperative cases of actual aspiration, it may not be possible to demonstrate statistically that the use of these agents actually improves patients' outcomes. In reference to gastric prokinetic drugs, antacids, and inhibitors of acid secretion, the ASA task force used the same phrasing, "the routine preoperative use of [such medications] … in

patients who have no apparent increased risk for pulmonary aspiration is not recommended." Chemoprophylaxis is only an adjunct to and not a substitute for otherwise sound clinical practice[4].

A. DRUGS TO INCREASE GASTRIC MOTILITY-METOCLOPRAMIDE:

It increases rate of gastric emptying, also an antiemetic which increases the lower oesophageal sphincter tone. Metoclopramide increases the amount of acetylcholine released at post-ganglionic terminals. It is a central dopamine antagonist and raises the threshold of the CTZ. It also decreases the sensitivity of the visceral nerves that carry impulses from the gut to the emetic centre. It is relatively ineffective in motion sickness and other forms of centrally mediated vomiting.

After I.V. administration, it showed an accelerated gastric emptying in elective cesasrean section and also in established labour. When prokinetic drugs were compared alone with placebo in pregnant women, there was no statistically significant difference identified in 'risk of aspiration' although it reduces risk of aspiration when combined along with H2 receptor antagonists. Adverse effects – Extrapyramidal effects (1%) consist of dystonic effects including akathisia, oculogyric crises, trismus, torticollis and opisthotonos.

B.REDUCTION OF GASTRIC ACIDITY & VOLUME:

1. Neutralization of secreted gastric acid
    a) Particulate antacids-aluminium & magnesium hydroxide
    b) Non particulate antacid-0.3 molar sodium citrate.
2. Inhibition of Gastric Acid Secretion
    a. H2-Receptor Blockade
    b. Proton Pump Inhibition

ANTACIDS:

Antacids are mainly divide into particulate and non-particulate antacids. Particulate antacids are those containing magnesium or aluminum. They are more commonly found to be associated with more severe pnemonitis, should aspiration occur. With respect to aspiration prophylaxis, clinical use is now confined to non-particulate antacids like 0.3 molar sodium citrate. Particulate antacids are commercially freely available and they are as effective as sodium citrate in buffering capacity. But, clear antacids mix much more effectively with the gastric contents than particulate ones[25]. Laboratory evidence in studies [26] also indicates that particulate antacids can produce significant pulmonary mucosal damage when aspirated.

H_2 BLOCKERS:

This group of drugs act by reducing gastric acid secretion by H2 receptor antagonism. Ranitidine is a highly selective H2 blocker, which when given orally, causes a sustained reduction in acid secretion[24]. The intravenous mode of administration has been more extensively studied and it is found to have a faster onset of action. In emergency general anesthesia for ceaserean section, *Tripathi et al* found all patients had a gastric pH >2.5 and volume < 25ml by 45min after 50mg of iv ranitidine. Ranitidinre will not neutralize the already secreted gastric acid whereas 0.3M sodium citrate is effective here. It is also shown that combining 0.3molar sodium citrate and iv ranitidine is more effective than ranitidine alone.

PROTON PUMP INHIBITORS:

In this group of agents, Omeprazole is the drug which is most elaborately studied. It is given orally or iv at 40mg, 80mg doses. When given orally, omeprazole alone is not as much effective as it is when given along with sodium citrate. In setting of emergency LSCS, a single dose iv omeprazole 40mg results in same results of pH >2.5 and volume < 25ml as like ranitidine. The intravenous formulations of esomeprazole, lanzoprazole and pantoprazole have characteristics similar to those of the oral drugs. When given to a fasting patient, they inactivate acid pumps that are actively secreting.

ANTIEMETICS- 5HT3 RECEPTOR ANTAGONISTS :

They have potent antiemetic properties, mediated through central 5-HT_3-receptor blockade in the vomiting center and chemoreceptor trigger zone. They also act by blockade of peripheral 5-HT_3 receptors on extrinsic intestinal vagal and spinal afferent nerves. Ondansetron, granisetron, and dolasetron have a half-life of 4–9 hours, given oral,iv. Palonosetron is a newer intravenous agent that has greater affinity for the 5-HT_3 receptor and a long serum half-life of 40 hours. These drugs are effective in controlling PONV (postoperative nausea and vomiting).

6. PHARMACOLOGY OF NON-PARTICULATE ANTACID- 0.3 MOLAR SODIUM CITRATE

Sodium citrate is considered to be one among the most effective medications used for immediate neutralization of the acidic gastric contents[26]. Hence, this drug appears to be equally effective in emergency and elective cases, done under either regional or general anesthesia[27].

Mechanism of action and dosage:

Sodium citrate is the salt of a weak acid. When given orally, it gets mixed and combined in the stomach with hydrochloric acid, a strong acid,. This reaction produces sodium chloride and citric acid, a weaker acid, which acts as a buffer increasing the intragastric pH.

The formulation used in this study is AmbNPA® - available as 30ml solution containing sodium citrate IP 500mg, citric acid monohydrate IP 334mg per 5ml of solution. It is given as single dose of 30ml just 10-20 minutes prior to induction of anesthesia, is effective in increasing the gastric fluid pH above 2.5. There is no 'lag time' in the onset of action of sodium citrate as seen with H_2 blockers[22].

This drug is mainly exerts its effect by acting on the fluid already present in the stomach. It has become a reasonable option in emergency

situations (assuming patients takes medication orally) [22]. In addition, they do not produce pulmonary damage, should aspiration occur. Its effect usually starts immediately after administration, lasting for about 60-180 minutes[2, 26].

Two studies were done using continuous measurement of intra gastric pH in pregnant term woman, which showed the sodium citrate neutralizes the gastric acid immediately, but the factor that influences the duration of action is the gastric emptying. Sodium citrate in combination with effervescent ranitidine cause a rapid increase in gastric pH and maintain the pH >2.5 for about 14hr when given orally after induction general anesthesia[32].

Side Effects:

Citrate when given together along with particulate antacids, increases the intestinal absorption of aluminium salts by its reaction with them and formation of aluminium citrate. Aluminium citrate is more absorbable and soluble, thus resulting in increased serum concentrations of aluminium. This may lead to features of aluminium accumulation such as encephalopathy and toxicity, especially in chronic renal failure patients, where there is an already existing abnormality in electrolyte handling.

Contra indications:

1. Patients who are advised on sodium restriction in diet.
2. Severe renal impairment.

Potassium citrate and citric acid oral solution are contraindicated in patients with acute dehydration like diarrhea or vomiting, anuria, hyperkalaemia, severe myocardial damage or heat cramps

Special precautions:

Patients with low urine output leading to aluminium retention, congestive cardiac failure, hypertension, renal dysfunction, pulmonary oedema, pedal and facial edema or hypertensive disorders and toxaemia of pregnancy.

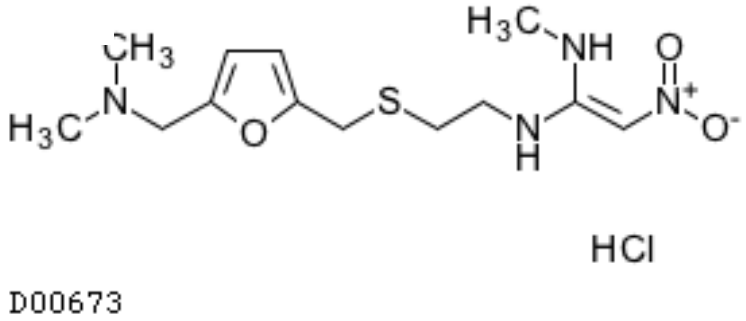
Drug interactions:

Concurrent usage of antacids with other drugs is common. The scope for antacid-drug interaction is mainly dependent upon the physical and chemical properties of antacid given. In particulate antacids, the intragastric release of free magnesium and aluminum ions has high effects on gastrointestinal function and on drug pharmacokinetics. Antacid-drug interactions may also occur in accordance with the changes in gastrointestinal motility or alterations in gastric acid pH.

Direct adsorption onto the gastric mucosa may cause reduced bioavailability of the drug. The clinical evidences in the recent times, would suggest that antacids do interact in a remarkable way with certain drugs of the cephalosporin, fluoroquinolone, nonsteroidal anti-inflammatory drug (NSAID) and group of drugs. Notable interactions are also seen with ketoconazole, tetracycline, quinine and glucocorticoids. These interactions are taken into serious account in patients with cardiac disease, sepsis, or inflammatory syndromes.

7. PHARMACOLOGY OF RANITIDINE

Ranitidine reversibly and competitively blocks histamine at H_2 receptors, particularly those in gastric parietal cells, leading to inhibition of gastric acid secretion.



D00673

Ranitidine HCl is a white to pale yellow, crystalline substance that is soluble in water. It has a slightly bitter taste and sulfurlike odor.

Each tablet, for oral administration, contains 168 mg or 336 mg of ranitidine hydrochloride equivalent to 150 mg or 300 mg of ranitidine,

Ranitidine is 50% absorbed after oral administration, compared to an intravenous (IV) injection with mean peak levels of 440 to 545 ng/mL occurring 2 to 3 hours after a 150 mg dose. Absorption is not significantly impaired by the administration of food or antacids.

The principal route of excretion is the urine, with approximately 30% of the orally administered dose collected in the urine as unchanged drug in 24 hours. The elimination half-life is 2.5 to 3 hours

INDICATIONS AND USAGE :

- Short-term treatment and maintenance therapy of active duodenal ulcer. Short-term treatment of active, benign gastric ulcer. Most patients heal within 6 weeks.

- Treatment of GERD and endoscopically diagnosed erosive esophagitis. Symptomatic relief commonly occurs within 24 hours after starting therapy with ranitidine 150 mg bd

- Prophylaxis and treatment of aspiration pneumonitis.

ADVERSE REACTIONS:

Malaise, dizziness, somnolence, insomnia, and vertigo, Constipation, diarrhea, nausea/vomiting, abdominal discomfort/ pain, Rare cases of hypersensitivity reactions (e.g., bronchospasm, fever, rash, eosinophilia), anaphylaxis, angioneurotic edema, and small increases in serum creatinine.

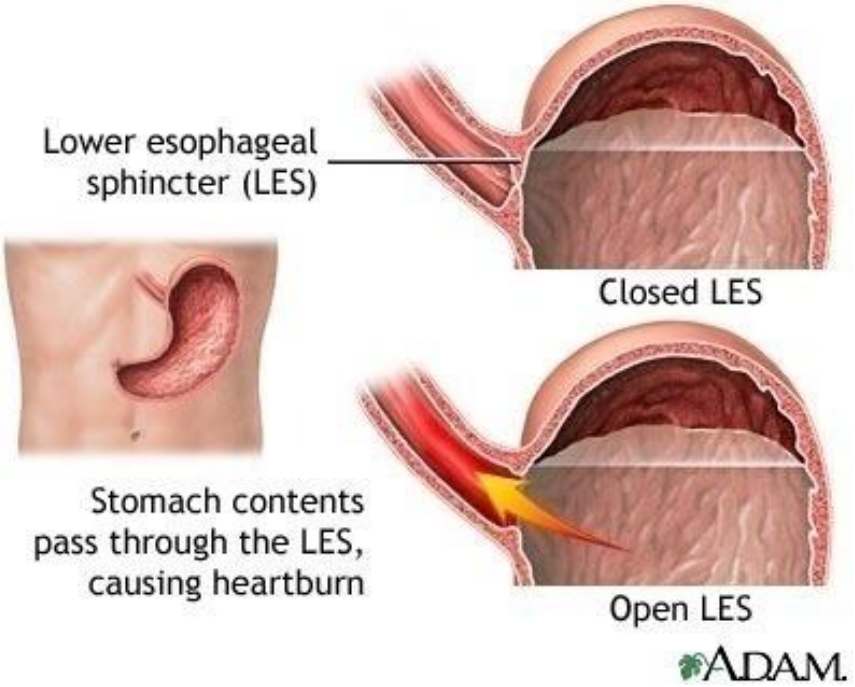
DRUG INTERACTIONS AND CONTRAINDICATIONS:

Ranitidine has been reported to bind weakly to cytochrome P-450, Increased or decreased prothrombin times have been reported during concurrent use of ranitidine and warfarin. Ranitidine tablets are contraindicated for patients known to have hypersensitivity to the drug or any of the ingredients.

8. PULMONARY ASPIRATION RISK IN OBSTETRIC PATIENTS

Mendelson was the first person to describe the entity of pulmonary aspiration of gastric contents in obstetric subset of population. He described the syndrome in 1946 and the pathogenesis associated with this syndrome[29]. He also stressed the importance of perioperative use of anti aspiration prophylaxis.

The gastrointestinal system in pregnancy undergoes various changes. The stomach is displaced upward toward the left side of the diaphragm during pregnancy. The altered position of the stomach tend to alter the position of the intraabdominal segment of the esophagus, by displacing it into the thorax. This causes a decrease in tone of the lower esophageal high-pressure zone (LEHPZ), which normally prevents the reflux of gastric contents. This displacement of the esophagus also prevents the rise in lower esophageal tone that normally accompanies an increase in intragastric pressure (IGP)[28]. Progesterone also may contribute to a relaxation of the LEHPZ.[28] The lower esophageal sphincter changes occur as early as in the first trimester.



The gastric emptying of liquid and solid materials is not altered at any time during pregnancy, as evidenced by various methods of evaluation of gastric emptying time in pregnant woman as measured by, ultrasound, acetaminophen absorption, dyedilution, and radiographic techniques. Studies of gastric acid secretion during pregnancy have demonstrated that differences in plasma gastrin levels and gastric acid secretion during pregnancy are small.

Studies in the nonpregnant and pregnant women of pH and volume of gastric contents showed no marked differences in the proportion of women who fall under the “at risk” criteria (pH <2.5, volume >25 ml) for pulmonary aspiration of gastric contents[29]. Results of nasogastric aspiration

of gastric contents in nonpregnant patients undergoing elective surgery and in pregnant women undergoing elective cesarean section have shown that patients who received no preoperative medication that would alter gastric volume or pH, approximately 80% of individuals in *each* group (pregnant and nonpregnant) had a gastric pH of 2.5 or less, approximately 50% had gastric volumes of 25 mL or greater, and 40% to 50% exhibited both a low pH and a volume of at least 25 Ml[29].

PHARMACOLOGICAL METHODS OF PREVENTING ASPIRATION IN PREGNANCY[31]:

A) DURING LABOUR

- Food and fluids may be taken during labour at the women's discretion.
- Fluids only in cases of women at high risk of requiring an operative birth.
- Avoid the use of antacids containing magnesium or aluminium (e.g. Mylanta) for symptoms of heartburn or indigestion during labour – these medication are associated with severe pneumonitis should aspiration occur.
- Inj. RANITIDINE 50mg IV six hourly for high risk cases as selected by anaesthetist in consultation with obstetric staff.

An additional dose if it is five hours since last dose when decision for operative birth/procedure made.

B) ELECTIVE SURGERY DURING PREGNANCY INCLUDING ELECTIVE CAESAREAN SECTION:

- Either Tab. RANITIDINE 150mg orally the evening prior to surgery plus 150mg orally at least one hour pre-operatively on the day of surgery.
- Or Tab. RANITIDINE 300mg orally at least one hour pre-operatively on the day of surgery. Inj. METOCLOPRAMIDE 10mg intravenously one hour pre-operatively.
- 30ml of SODIUM CITRATE mixture orally (0.3 molar solution) shall be given 20minutes prior to induction of anaesthesia

C) EMERGENCY OPERATIONS (CAESAREAN, POSTPARTUM PROCEDURES etc.)

Since the risk of aspiration in pregnancy starts from the third trimester itself, any emergency procedure during the antenatal period and postpartum period should have the following method of acid prophylaxis

- Inj. RANITIDINE 50mg IV as soon as possible after notification if not previously on oral ranitidine.

- Inj. METOCLOPRAMIDE 10mg IV as soon as possible after notification.
- 30ml of SODIUM CITRATE mixture orally (0.3 molar solution) shall be given 20minutes prior to induction of anaesthesia.

9. REVIEW OF LITERATURE

STUDIES RELATED TO ASPIRATION IN THE PERIOPERATIVE PERIOD:

1. MENDELSON STUDY: AMERICAN JOURNAL OF OBSTETRICS AND GYNAECOLOGY, 1946

In this remarkable study, Curtis Lester Mendelson analyzed and presented the remarkable article entitled "Aspiration of gastric contents into the lungs under obstetric anaesthesia". He found out aspiration in 66 cases out of 43,000 pregnancies. This equals to a notable incidence of about 1 in 660 pregnancies. Nowadays the occurrence is much lower, but it still represents the most common cause of anaesthetic death in pregnant woman.

2. ROBERTS et al 1974:

He did a pioneering study on the usage of sodium citrate as antacid prophylaxis in obstetric subset of patients and arrived at the conclusion that it can be a effective regimen when compared with the existing anti-aspiration pharmacological interventions. Base on their studies, they formulated that Volumes of gastric aspirates in excess of 0.3 to 0.4 ml/kg or 20 to 25 ml may be potentially hazardous sand causes aspiration pneumonitis, if inhaled.

3. F.M. MESSAHEL, A.S. AL-QAHTANI: PULMONARY ASPIRATION OF GASTRIC CONTENTS IN ANESTHESIA: A REVIEW OVER 5-YEAR PERIOD - *The Internet Journal of Anesthesiology*. 2009 Volume 19 Number 1.

This study did an analysis of the incidence, morbidity and mortality of pulmonary aspiration during administration of anesthesia in an institute. The database of anesthetic related events were examined to collect the details of 12828 patients who were administered general anesthesia during the 5-year period following application and adoption of stringent guidelines for the prevention of aspiration in the preoperative period.

It included details of patients who got regurgitation and aspiration of gastric contents during the course of the anesthetic and in the immediate recovery period. Among this, 451 patients suffered aspiration (3.5% of total), out of them 95 (21.1%) were elective and 356 (78.9%) were emergency. Out of these, 80 patients (17.7%) aspirated at induction and 371 (82.3%) at extubation.

STUDIES RELATED TO 0.3MOLAR SODIUM CITRATE

4. **SODIUM CITRATE PRETREATMENT IN ELECTIVE CESAREAN SECTION PATIENTS- Dewan Dm, Floyd H M, Thistle wood J M, Bogard TD , Spielman FJ.**

Term pregnant woman, 32 in number who underwent elective ceaserean section randomly divided into 3 groups. Group1 got no antacid, group 2 -30 ml of 0.3 molar sodium citrate <60mts preoperatively, group 3- 30 ml of 0.3 molar sodium citrate >60mt preoperatively. Immediately after delivery, the stomach was emptied. Mean pH of the gastric aspirate was measured in the three groups were 1.8± 2.7, 5.0± 1.5, and 2.7±1.2, respectively. Gastric fluid pH was found to be markedly high in group 2, compared with other two groups. All patients in group 1, 90% in group 2 and 50% in group 3 had a gastric pH <2.5. in group 2, none had both pH of less than 2.5 and volume > 25 ml**.** They came to a conclusion that sodium citrate effectively rises gastric pH when given < 60 minutes prior to induction.

5. **GASTRIC FLUID pH IN PATIENTS RECEIVING SODIUM CITRATE Oscar J. Viegas, MD, Ram S. Ravindran, MD, and Carol A. Shumacker,**

In 30 patients undergoing elective surgery, they did an analysis of pH of gastric fluid after giving sodium citrate. Following induction of anaesthesia & intubation of these patients, the gastric fluid was aspirated and the pH was measured. Out of them, 5 persons who had been given 5 ml of sodium citrate 5 to 20 minutes before induction of anesthesia were found to have a mean pH of 6.2 ± 0.8. In the control group of 5 patients, who did not receive sodium citrate had a mean pH of 2.1 ± 1.4. The sodium citrate given increases the gastric pH and this would result in decreased pulmonary mucosal damage, should aspiration occur.

6. **USE OF SINGLE DOSE OF SODIUM CITRATE AS A PROPHYLAXIS AGAINST ACID ASPIRATION IN OBSTETRIC PATIENTS UNDERGOING CAESAREAN SECTION. Lim SK, Elegbe EO. Med J Malaysia. 1991** :

The effectiveness of sodium citrate as antacid prophylaxis was studied in 3 groups of 20 patients each. Group I (control) received no antacid. Group II(elective caesarean section) and Group III (emergency caesarean section) were given 30ml of 0.3M sodium citrate immediately after their entry into the operation theatre. The gastric content was aspirated

and pH analysis was done just after induction of anaesthesia and at the end of surgery before extubating the patient. Sodium citrate was found to increase the gastric fluid content pH to much higher range in Group II and III patients as compared with the control group.

7. SODIUM CITRATE: AN ALTERNATIVE ANTACID FOR PROPHYLAXIS AGAINST ASPIRATION PNEUMONITIS. By J Wrobel, T C Koh, J M Saunders Anaesthesia and intensive care (1982).

In this study, about 107 general surgical patients who underwent elective and emergency procedures were divided into two groups. The test group received 5 ml of either sodium citrate 0.3 M and the control got placebo 10 minutes before the induction of anesthesia. Gastric contents were aspirated soon after induction and intubation and the pH analysis of the samples was done. The mean pH of the gastric contents in the sodium citrate group was 5.67, and it was 3.21 for those given the placebo it (p less than 0.001). Of patients who were given sodium citrate 92% had a gastric pH above 3.0 when compared with 37% in the placebo group.

8. THE EFFECTIVENESS OF SODIUM CITRATE AS AN ANTACID- Charles P.Gibbs et al, Anesthesiology 1982 :

26 obstretric patients scheduled for emergency cesarean section were given 30 ml of sodium citrate at interval of 10-20 min before induction of anesthesia. Two gastric aspirate samples were collected- first sample at 12-50min after ingestion of antacid and second at 60-180 min. The pH of all samples were above 2.5 (mean pH- 5.7 in 1^{st} and 5.2 in 2^{nd} sample). The lowest pH were 3.2 and 1.8 respectively.

9. ASPIRATION PROPHYLAXIS FOR PREGNANT PATIENTS REQUIRING ANESTHESIA- PUBLISHED NOV 2008.

This article analysed the incidence and various risk factors involving the morbidity and mortality from aspiration. It recommends routine antiaspiration measures to be taken in all women of >18-20wks gestation, and upto 18 hours post partum. It states that particulate antacids when used for aspiration prophylaxis causes severe pneumonitis should aspiration occur. Sodium citrate 0.3M, 30ml given orally is the most efficient way of immediate neutralization of gastric contents- acts within minutes and lasts upto 1 hour. The combination of sodium citrate plus ranitidine is even more synergistic in reducing gastric acidity.

STUDIES RELATED TO COMPARISON OF 0.3MOLAR SODIUM CITRATE WITH OTHER DRUGS:

10.EFFECT OF SINGLE DOSE ORAL RANITIDINE AND SODIUM CITRATE ON GASTRIC PH DURING AND AFTER GENERAL ANESTHESIA (CANADIAN JOURNAL OF ANESTHESIA, 1995, PETER ATANASSOFF et al)

In 25 patients scheduled for elective surgery,They analysed the effect on gastric pH of the H2 blockers(R) with sodium citrate(SC) as a oral effervescent and plain sodium citrate(SC). The drugs were given by nasogastric tube placed after induction. A 24hr continuous gastric pH monitoring was done by pH electrode. Mean baseline pH were 1.3 in R+SC group and 1.2 in plain SC group. These values raised to 6.9(R+SC) and 4.9(SC) during emergence from anesthesia.. The pH remained above 2.5 for 14hrs in R+ SC group and for 6hrs in SC group. They concluded that both the drugs are effective in neutralizing gastric acid when given orally after induction. However, the action of plain SC is shortlived, and if maintenance of gastric pH of >2.5 for more than 6hrs is needed, the R + SC combination is recommended.

11.AN ORAL SODIUM CITRATE- CITRIC ACID NON-PARTICULATE BUFFER IN HUMANS(J.J.HAUPTFLEISCH AND K A PAYNE, BRITISH JOURNAL OF ANESTHESIA 1996)

This study investigated the effect on pH of the gastric pH of single dose sodium citrate(antacid) and sodium citrate dehydrate with citric acid monohydrate (buffer) in 30 neurosurgical patients for 5-7hrs duration. A control group of 10 received no antacid. The mean baseline pH- 2.64. in control group, pH increased to 4.4 at 5hr, returning to beaseline at 7 hr. In antacid group, pH raised to 6.11 at 5min and decreased to 3.7 at 7hrs. In buffer group, pH was stable at 3.80- 3.95 over 7hr.

12.BICITRA AS AN EFFECTIVE PREOPERATIVE ANTACID by Charles. P. Gibbs and Tina et al :

In this study, the analyzers used Bicitra, a commercially available, urine alkanizing solituion which contains the same amount of sodium citrate, as that of 0.3 molar sodium citrate. They determined the efficacy of Bicitra in elevating the pH of gastric contents above 2.5 in 26 patients undergoing ceaserean section in general anesthesia. The pateients were given 30ml of Bicitra just before induction, they were rotated side to side for the effective mixing of the contents with the antacid. It was found, Bicitra increased the pH in 88.5% patients. The buffering capacity (mean

pH), as determined with Bicitra is explained is less due to its low pH(4.8) Vs 8.5 with 0.3M sod citrate. This is because of the low citric acid content of Bicitra.

13.COCHRANE DATA BASE

This study did 16 meta-analyses on 23 studies that related to interventions for reducing aspiration pneumonitis., involving 2658 women undergoing cesarean section. The study reviewed the effectiveness of non-pharmacological interventions and pharmacological drugs which are in common practice to reduce aspiration pneumonitis for women who have caesarean sections. They measured the primary outcome in terms of

1. Incidence of morbidity and mortality due to aspiration pneumonitis
2. Low intragastric pH of less than 2.5, measured after induction of anaesthesia.
3. Increase of intragastric volume of more than 0.4 ml/kg or 25 ml, measured after induction of anaesthesia.

They also analyzed secondary outcomes like:

1. Incidence of nausea and vomitting during caesarean section or the postoperative period.
2. Intragastric pH above 2.5 and intragastric volume to less than 0.4 ml/kg measured prior to extubation.

They arrived at results suggesting that while administering a single agent, antacids alone are proposed to have superior efficacy than H2 blockers, which are in turn more efficacious than proton pump inhibitors for increasing gastric pH. The combination of antacids(0.3 molar sodium citrate) plus H_2 antagonists(ranitidine) was shown to be more effective than in the patients who had received no intervention, and it was a superior mode of treatment to antacids alone in the mode of rising the pH of gastric contents. It was also stated that.

The influence of treatments on gastric volume are less analyzed in studies and reported. These findings are can be applied for all term parturients undergoing caesarean section, especially under general anaesthesia. The need of antiaspiration prophylaxis in women undergoing caesarean section under regional anaesthesia is a clinical judgement to be decided on an individual patient basis. In general these treatments are relatively inexpensive and well tolerated in pregnancy. Hence their routine use is strongly considered in view of the potential benefits, as aspiration is a cause of maternal mortality, even today.

14.GASTRIC FLUID VOLUME AND pH IN ELECTIVE SURGICAL PATIENTS: TRIPLE PROPHYLAXIS IS NOT SUPERIOR TO RANITIDINE ALONE Maltby JR et al Can J Anaesth. 1990 :

They compared the effect of oral ranitidine given as a sole drug against the serial administration of metoclopramide, ranitidine, and sodium citrate on gastric aspirate volume and pH in 196 healthy, elective surgical patients. Each of the patients were randomly allotted to one of the four groups. Patients in all groups got oral ranitidine 50 mg 2-3 hr before the starting of surgery.

Those in Group 1 also received oral metaclopramide 10 mg, about one hour before the start of surgery, and sodium citrate 0.3 M 30 ml on arrival into the operating area; Group 2 received sodium citrate but no metaclopramide; Group 3 received metaclopramide but no sodium citrate. In Group 4, the patients received ranitidine drug alone.

In all groups, mean pH was greater than 5.8. Mean aspirate volumes were significantly greater in patients who received citrate (Groups 1 and 2- it was 22 and 19 ml respectively) than in patients who did not get sod citrate (Groups 3 and 4- it was 10ml and 8 ml respectively). Moreover in groups 2 and 3, one patient each had a gastric aspirate pH of less than 2.5 with volume greater than 25 ml. On arrival at these results, they concluded that

administration of single ranitidine alone has no greater significant advantage than triple prophylaxis with other drugs.

15. ACID ASPIRATION PROPHYLAXIS FOR EMERGENCY CAESAREAN SECTION by Stuart Et al, Anaesthesia. 1996:

384 patients requiring emergency Caesarean section under general anaesthesia randomly received one of six anti aspiration prophylaxis treatments. . They were given drugs-metoclopramide 10 mg, sodium citrate administered orally 0.3 M, 30 ml, intravenous administration of ranitidine 50 mg, omeprazole 40 mg, alone and in various combinations of two of these drugs. Compared with sodium citrate alone, the addition of either omeprazole ,ranitidine, or metoclopramide alone did not reduce the aspirate volume while smaller reduction in gastric volume was seen with the addition of metoclopramide and either ranitidine or omeprazole.

10. AIM OF THE STUDY

The objective of this study is to establish the efficacy of 0.3m sodium citrate, a non particulate antacid in neutralizing the secreted gastric acid- as prophylaxis against aspiration pneumonitis in obstretic patients undergoing elective lower segment cesarean section under general anesthesia.

11. MATERIALS AND METHODS

After obtaining approval from the institutional ethical committee of Govt. Kilpauk Medical College and Hospital, Chennai-10 and written informed consent, fifty term pregnant patients of ASA physical status I & II undergoing elective lower segment cesarean section under standardized general anesthesia were enrolled in the study. This study was conducted in Govt. Kilpauk Medical College and Hospital, Chennai from May 2012-August 2012.

STUDY DESIGN:

Our study was a double- blind prospective randomized control study.

DOUBLE BLINDING TECHNIQUE:

The solutions to be administered to the patients were prepared by anesthesiology assistant who prepared the solutions in such a way that both the solutions are stored in identical amber coloured bottles and labeled accordingly. The testing solution, 30ml of 0.3 molar sodium citrate was labeled SOLUTION A. The control solution, 30ml of distilled water was labeled SOLUTION B.

STUDY PERIOD:

The study period was from the time of 30minutes before induction of anesthesia up to 2 hours in the postoperative period.

OBSERVATION PERIOD:

Patients in both the groups were monitored and observed in the PACU for 24 hours for any side effects and complications.

STUDY GROUPS:

The 50 selected and assessed patients were randomly divided into two groups of 25 patients each.

GROUP A -25 patients received 30ml of testing solution A.

GROUP B-25 patients received 30ml of control solution B,

Both the solutions were kept in identical amber coloured bottles. So, neither the patient who is receiving it nor the person giving it, did not know what is contained inside the bottle.

The analyzer then allotted them into 2 groups. 25 patients who had received 30ml 0.3 molar sodium citrate were assigned to group A or study group. Remaining 25 patients who had received 30ml of distilled water were allocated to group B or control group. At the end of the surgery, after obtaining the gastric aspirate before extubation, all patients in both the

groups were given Inj. Ranitidine 50mg i.v. to protect them from the aspiration risk.

PATIENT SELECTION:

INCLUSION CRITERIA (OBSTETRIC PATIENTS):

- pts undergoing elective LSCS under general anesthesia
- pts fasting for >= 8hrs
- no use of any other particulate antacids in the preoperative period

EXCLUSION CRITERIA:

- Patients with BMI > 30
- patients with anticipated difficult airway
- patients undergoing emergency surgery
- h/o any drug use or disease which alters the gastric secretion
- h/o any drug allergy
- patient refusal for GA

MATERIALS USED IN OUR STUDY:

- Testing solution A or control solution B- 30ml in amber color bottles
- Digital pH meter
- Nasogastric tube
- 20ml syringe

- ❖ Xylocaine jelly and adhesive tapes
- ❖ Stethoscope

PARAMETERS OBSERVED IN THE STUDY:

- ❖ Baseline vital parameters- PR, BP, SpO2
- ❖ Baseline pH of gastric aspirate.
- ❖ pH of gastric aspirate – at 30 min following induction
- ❖ pH of gastric aspirate – before extubation
- ❖ Incidence of nausea and vomiting
- ❖ Incidence of pulmonary aspiration in the post op period
- ❖ Post op vital parameters.

MONITORING:

STANDARDISED GENERAL ANESTHESIA IN BOTH THE GROUPS:

- ❖ observation of baseline vital parameters
- ❖ vital parameters monitoring

  Pulse oximetry

  Non invasive bood pressure

  Electrocardiogram

  End tidal CO_2

  Urine output monitoring

Temperature monitoring

- ❖ pH measurement by digital pH meter
- ❖ premedication – Inj. Glycopyrrolate 0.2mg iv
- ❖ rapid sequence induction with Inj. Thiopentone and Inj. Succinyl choline
- ❖ cricoid pressure (Sellick's manouvere)- released after inflating ET tube cuff
- ❖ intubation with 6.5 or 7.0mm cuffed oral ET tube.
- ❖ Maintenance(along with IPPV) – before baby delivery : 50-50 of O2: N2O , after baby delivery : 67 % O2 in N2O
- ❖ Reversal of neuromuscular blockade- Inj.Neostigmine & Inj.Glycopyrrolate
- ❖ Post op monitoring and observation

CONDUCT OF STUDY:

Pre operative instructions:

All term pregnant patients were posted for elective lower segment cesarean section, after a complete medical history and examination and a proper preoperative assessment. They were explained about this study in their own language and written informed consent was obtained from them for inclusion into this study. Then, they were taken up for the study, after satisfying the inclusion and exclusion criteria.

All patients were advised overnight fasting. Patients in both the study and control groups received Tab. Ranitidine 300mg on the night before surgery. Apart from this, the patients in control group received no other non-pharmacological interventions or any form of medications for aspiration prophylaxis in the pre- or intra- operative period.

Conduct of standardized general anesthesia :

On the day of surgery, the patients were shifted to the operating theatre. In the premedication room, all the baseline vital parameters were recorded. All patients were premedicated with Inj. Glcopyrrolate 0.2mg just before induction. A good intravenous line was established with 18G venflon.

A 16 gauge naso gastric tube was introduced gently after thorough lubrication and secured, after confirming proper placement in the stomach. **The gastric aspirate was obtained, and pH of the sample was measured using a hand-held pH meter (Hanna HI-96106 Champ pH Tester).** It was taken as the baseline pH. Patients in the study group were given 30ml of 0.3 molar sodium citrate (Amb NPA) orally, about 20min prior to induction of anesthesia. Patients in the control group received 30ml distilled water, at around the same period. the study was double blinded since both

the patient and the person giving did not know which solution was present inside the amber coloured bottle.

On shifting the patient to the operating table, routine monitors – pulse oximetry, non invasive blood pressure, electrocardiogram, capnography, temperature were connected. Patients were explained beforehand, about the cricoid pressure that would be given and advised not to get panic. The patient was preoxygenated for five minutes with 100% oxygen. During the time of induction and intubation, NG tube is pulled out by 10-15cm so that the tip of NG tube lies proximal to the lower esophageal sphincter. This is to avoid aspiration risk caused by NG tube induced Lower Esophageal Sphincter incompetency and also to prevent the regurgitation occuring during Inj. Scoline administration.

Patients in both the groups were induced by Rapid Sequence Induction using Inj. Thiopentone 3mg/kg. Once the patient loses consciousness, the cricoid pressure (sellick's manouvere) was applied and maintained by a trained personnel. Inj.Succinyl choline 1mg/ kg was given, maintaining the cricoid pressure. They were intubated using 6.5 or 7mm ID size endotracheal tube, under direct larnygoscopic vision of the glottis. The cricoid pressure was released once the tracheal tube cuff is inflated. The endotracheal tube was secured after confirming bilateral equal air entry.

Following intubation, the NG tube was reinserted to the same level and secured. **The gastric contents were aspirated at intervals of 5min, 30min after induction and prior to extubation. pH of samples were analyzed using pH meter.**

Anesthesia was maintained with 50%: 50% oxygen and nitrous oxide, non-depolarizing muscle relaxant. After delivery of the baby, Inj. Pentazoscine , Inj. Syntocinon were given and anesthesia maintained with 67% nitrous oxide in oxygen. All patients maintained hemodynamic stability in the intra operative period.

The gastric aspirate was sampled before extubation and the pH ws checked. Before extubation, all patients in both the groups were given Inj. Ranitidine 50mg i.v. to protect them from the aspiration risk

The stomach contents were completely emptied before extubation. After the patient showed spontaneous breathing efforts, the neuromuscular blockade was reversed with Inj.Neostigmine and Inj.Glycopyrrolate 10µg/kg iv. All patients were extubated on table uneventful, after satisfying the extubation criteria.

The NG tube was removed, after applying constant suctioning in the recovery room after extubation.The patients were shifted to the recovery

room for monitoring for 2hrs.. Then they were moved to post anesthesia care unit for further follow up, monitoring and observation for 24 hours.

During the study period, the following parameters are measured, analyzed and compared in the test and control groups.

1. pH of gastric aspirate – Baseline(before induction of anesthesia)
2. pH of gastric aspirate – at 5 min after induction
3. pH of gastric aspirate – at 30 min following induction
4. pH of gastric aspirate – during extubation
5. The number of patients who are at high risk of aspiration (based on pH of gastric aspirate – Baseline)

STATISTICAL ANALYSIS:

- It is a randomized double blind clinical study
- Variabls were analysed with student ‘t’ test and Mann & Whitney ‘U’ test
- Sample size obtained according to previous background study.
- ‘p’ value less than 0.05 was taken as significant.

12. OBSERVATION AND RESULTS

Fifty (50) female patients in ASA I & II who are at term pregnancy, undergoing elective lower segment caesarean section under general anesthesia were selected for the study. The data & measurements obtained from the study were analyzed & tabulated using SPSS. In this study, a 'p' value of less than 0.05 was considered statistically significant and a 'p' value of less than 0.001 was taken as highly statistically significant.

Table: 1 AGE DISTRIBUTION IN STUDY & CONTROL GROUPS

GROUP	NO. OF PATIENTS	MEAN AGE	STD. DEVIATION	'P' VALUE
STUDY (GROUP A)	25	23.12	2.12	0.537*
CONTROL (GROUP B)	25	24.78	2.94	

***Not Significant (p<0.05) values are express in mean ± SD**

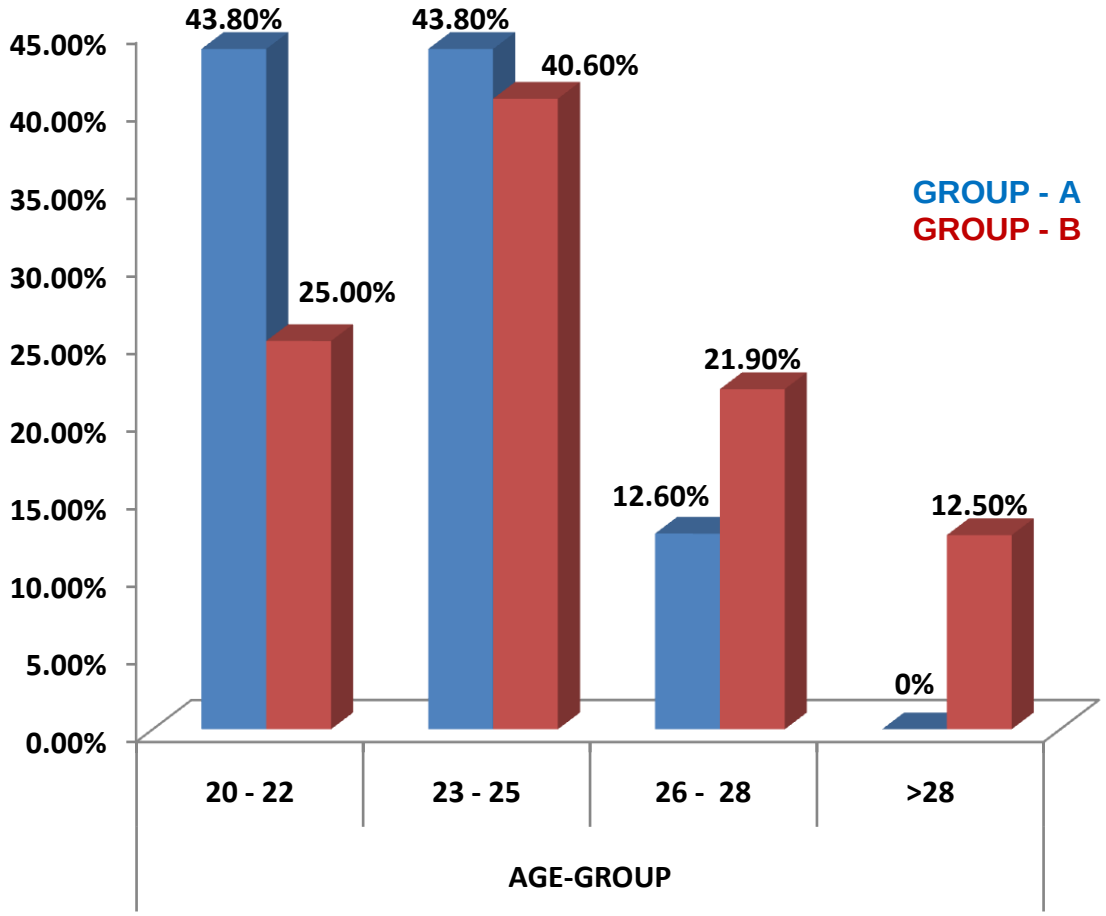
The mean age in both the groups was around 25 years. Both the groups were comparable with regard to age and there was no statistically difference between the two groups.

Table: 2 DISTRIBUTION OF AGE-GROUP AMONG GROUPS

Age – Groups (in years)	Group – A No. of patients (%)	Group – B No. of patients (%)
20 – 22	11 (43.80)	7 (25.00)
23 – 25	11 (43.80)	10 (40.60)
26 - 28	3(12.60)	5 (21.90)
>28	0 (0)	3 (12.50)
TOTAL	**25 (100.00)**	**25(100.00)**

The age group distribution shows more patients in 23-25 age in both the study (group A) and control (group B) groups.

Figure: 1 DISTRIBUTION OF AGE-GROUP AMONG GROUPS



This graphical representation shows the age group distribution of patients in both the groups.

Table: 3 BODY WEIGHT IN STUDY AND CONTROL GROUPS

GROUP	NUMBER OF PATIENTS	MEAN WEIGHT IN KG	STD. DEVIATION	P VALUE
STUDY (GROUP A)	25	59.53	11.45	0.950*
CONTROL (GROUP B)	25	58.75	10.52	

***Not Significant (p<0.05) values are express in mean ± SD**

The mean weight in both the groups was around 59 kgs. Both the groups were comparable with regard to weight. There was no statistical difference in between the groups in terms of weight.

Table: 4 BODY MASS INDEX IN STUDY AND CONTROL GROUPS

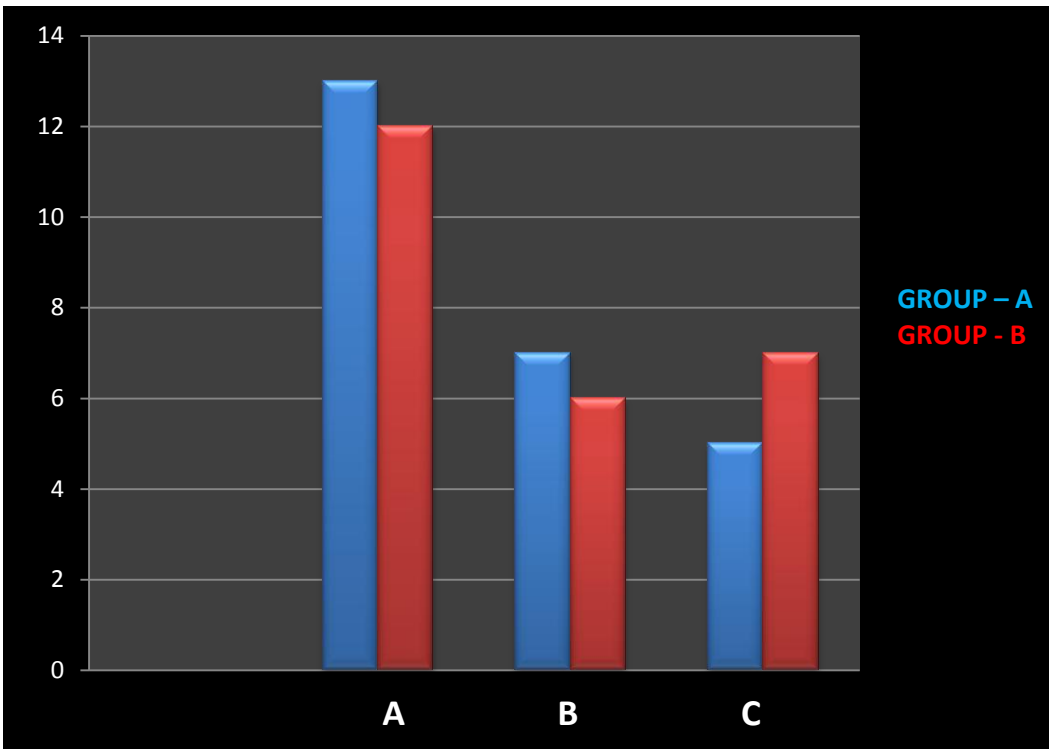
GROUP	NUMBER OF PATIENTS	MEAN WEIGHT IN KG	STD. DEVIATION	P VALUE
STUDY (GROUP A)	25	24.34	2.38	0.572
CONTROL (GROUP B)	25	27.18	2.98	

***Not Significant (p<0.05)**

The values are expressed in mean ± SD

The mean Body Mass Index was around 25. There was no statistical difference in between the groups in terms of BMI.

FIGURE :2 DISTRIBUTION OF INDICATIONS FOR LSCS IN TWO GROUPS



A – Previous LSCS

B – Primi with CPD

C – Other causes

In this column diagram, the indications for which the patients underwent ceaserean section are shown. The other causes- post dated pregnancy, precious pregnancy etc.

Table: 5 FASTING DURATION IN STUDY AND CONTROL GROUPS

GROUP	NUMBER OF PATIENTS	MEAN FASTING TIME(HRS)	STD. DEVIATION	P VALUE
STUDY (GROUP A)	25	9.41	0.76	0.589
CONTROL (GROUP B)	25	9.06	0.84	

This table compares the fasting duration (in hours) in the pre operative period, which is almost the same – 9 hours in both the groups.

Table: 6 MEAN pH VALUES AT VARIOUS INTERVALS IN THE STUDY AND CONTROL GROUPS

VARIABLES	STUDY (GROUP A)	CONTROL (GROUP B)
Baseline pH	2.94 ± 0.76	2.84 ± 0.73
pH after 5 mins.	4.46 ± 1.05	2.97 ± 0.73
pH after 30 mins.	4.53 ± 1.11	2.86 ± 0.72
pH before Extubation	4.64 ± 1.20	2.77 ± 0.67

The values are expressed in mean ± SD.

The mean baseline pH in study and control groups are 2.94 and 2.84 respectively and there is no statistical difference in baseline pH values in both. After administration of the test solution, the pH values in the study group at 5min, 30min and extubation are all at a higher range than that of control group, signifying the acid neutralizing effect of 0.3M sodium citrate in the study group.

Table: 7 COMPARISON OF BASELINE pH BETWEEN TWO GROUPS

Groups	Mean baseline pH	Mean Rank	Sum of Ranks	Mann-Whitney U test value & p - value
STUDY (GROUP A)	2.94	33.88	1084.00	468.00 0.554 NS
CONTROL (GROUP B)	2.84	31.12	996.00	

NS - statistically not significant

The base line pH taken in both the groups before giving the test drug, before induction, was comparable in both the groups. The mean rank was around 32. There was no statistical significance in between the two mean pH, since 'p' value is more than 0.05.

Table: 8 COMPARISON OF pH AT 5MIN OF INDUCTION BETWEEN TWO GROUPS

Groups	Mean pH at 5min	Mean Rank	Sum of Ranks	Mann-Whitney U test value & p - value
STUDY (GROUP A)	4.46	44.75	1432.00	120.00 0.000 HS
CONTROL (GROUP B)	2.97	20.25	648.00	

HS: Highly Statistically Significant

The table 8 shown compares the pH values at 5 min after induction, after the test drug is given in the study and control groups. A highly statistical difference was observed in between the groups. This implies that sodium citrate increases the pH of the gastric contents well above than the pH in control group.

Table: 9 COMPARISON OF pH AT 30 MIN OF INDUCTION BETWEEN TWO GROUPS

Groups	Mean pH at 30min	Mean Rank	Sum of Ranks	Mann-Whitney U test value & p - value
STUDY (GROUP A)	4.53	45.44	1454.00	98.00 0.000 HS
CONTROL (GROUP B)	2.86	19.56	626.00	

HS : Highly Statistically Significant

In table 9, the pH in the study group is higher than in the control group, as seen by the difference in mean ranks in both the groups. A 'p' value of <0.001 is observed in this table, implying high statistical difference in pH between the groups.

TABLE: 10 COMPARISON OF pH AT EXTUBATION BETWEEN TWO GROUPS

Groups	Mean pH at extubation	Mean Rank	Sum of Ranks	Mann-Whitney U test value & p - value
STUDY (GROUP A)	4.64	45.78	1465.00	87.00 0.000 HS
CONTROL (GROUP B)	2.77	19.22	624.00	

HS : Highly Statistically Significant

Table 10 shows the pH measured at extubation, which also states a high statistically significant difference in the pH between the groups, as seen in the mean rank and ‘p’ value.

Table: 11 PATIENTS AT HIGH RISK (pH < 2.5) AT VARIOUS INTERVALS:

SAMPLING INTERVALS	STUDY GROUP – A (N = 25)	CONTROL GROUP – B (N = 25)
Baseline	11 (44 %)	11 (44%)
5 minutes after induction	0 (0)	10 (40%)
30 minutes after induction	0 (0)	9 (36%)
Extubation	0 (0)	11 (44%)

Table 11 shows the number patients who are having a pH of less than 2.5 in both the groups at various time intervals after induction and at extubation. They in turn fall under the high risk category for pulmonary damage if aspiration occurs, as per criteria. From this table, it is evident that, no patient in the study group came under high risk, after the drug is given.

Figure: 3 DISTRIBUTION OF PATIENTS AT HIGH RISK (pH < 2.5)

AT VARIOUS TIMING

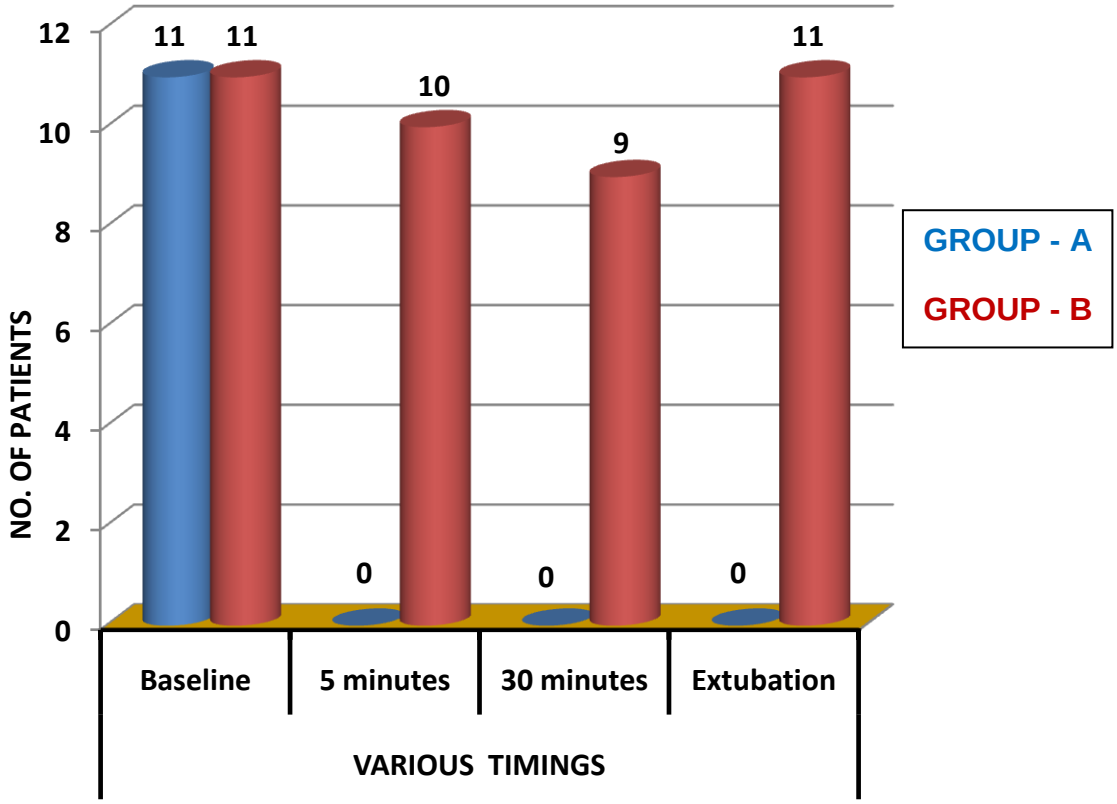


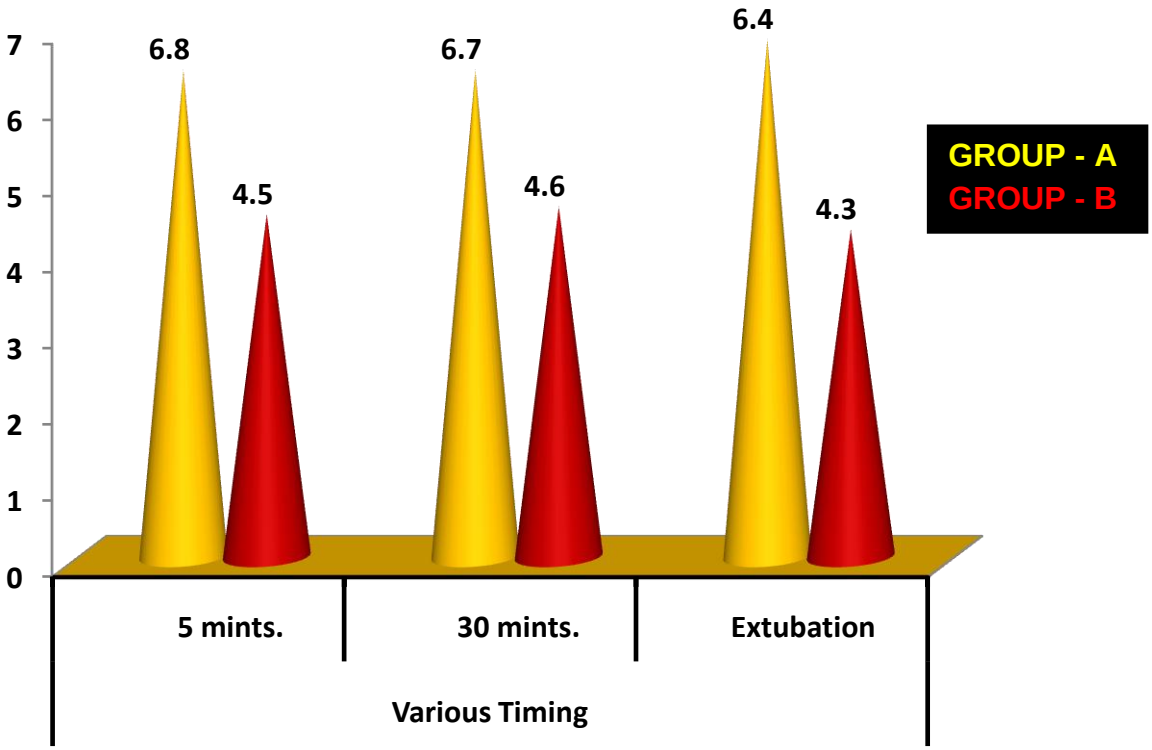
FIGURE 3 is the pictorial representation of table 11. This also shows no patient is in high risk in the study group.

Table : 12 DISTRIBUTION OF TIME AT WHICH pH WAS MAXIMUM IN STUDY AND CONTROL GROUPS

Various Timing	Group – A	Group - B
5 min after induction	6.8	4.5
30 min after induction	6.7	4.6
Extubation	6.4	4.3

Table 12 helps to find out the maximum highest pH attained in the two groups at various time intervals. It is obvious that the highest pH of study group, A is higher than the pH in the control group at all times. In the study group A itself, the5min pH value is the highest. This signifies the protective effect of sodium citrate is maximal in about 30min after administration, offering lower risk of pulmonary damage, should aspiration occur during intubation. The figure 4 also mentions the same.

FIGURE: 4 DISTRIBUTION OF TIME AT WHICH pH WAS MAXIMUM IN STUDY AND CONTROL GROUPS



This graphical representation shows that the maximum mean pH in the study group A is 6.8 at the time of 5 min after intubation, than in the control group B.

Table 13: DISTRIBUTION OF RANGE OF pH AT VARIOUS TIME PERIOD AMONG STUDY (GROUP A)

RANGE OF pH	STUDY GROUP A (N=25)		
	5 MIN AFTER INDUCTION	**30 MIN AFTER INDUCTION**	**EXTUBATION**
< 2.5	**0(0.00)**	**0(0.00)**	**0(0.00)**
2.6 – 3.0	2(8%)	1(4%)	3(12%)
3.1 – 4.0	9(36%)	7(28%)	8(32%)
4.1 – 5.0	7(28%)	7(28%)	6(24%)
5.1 – 6.0	4(16%)	6(24%)	4(16%)
6.1 – 7.0	3(12%)	4(16%)	4(16%)

In table 10, maximum number of patients have a pH range between 3.1- 5.0 at all times, well above the high risk (pH of less than 2.5). The pie-chart in figure 5 denotes the same**.**

FIGURE 5 : DISTRIBUTION OF pH IN STUDY GROUP A

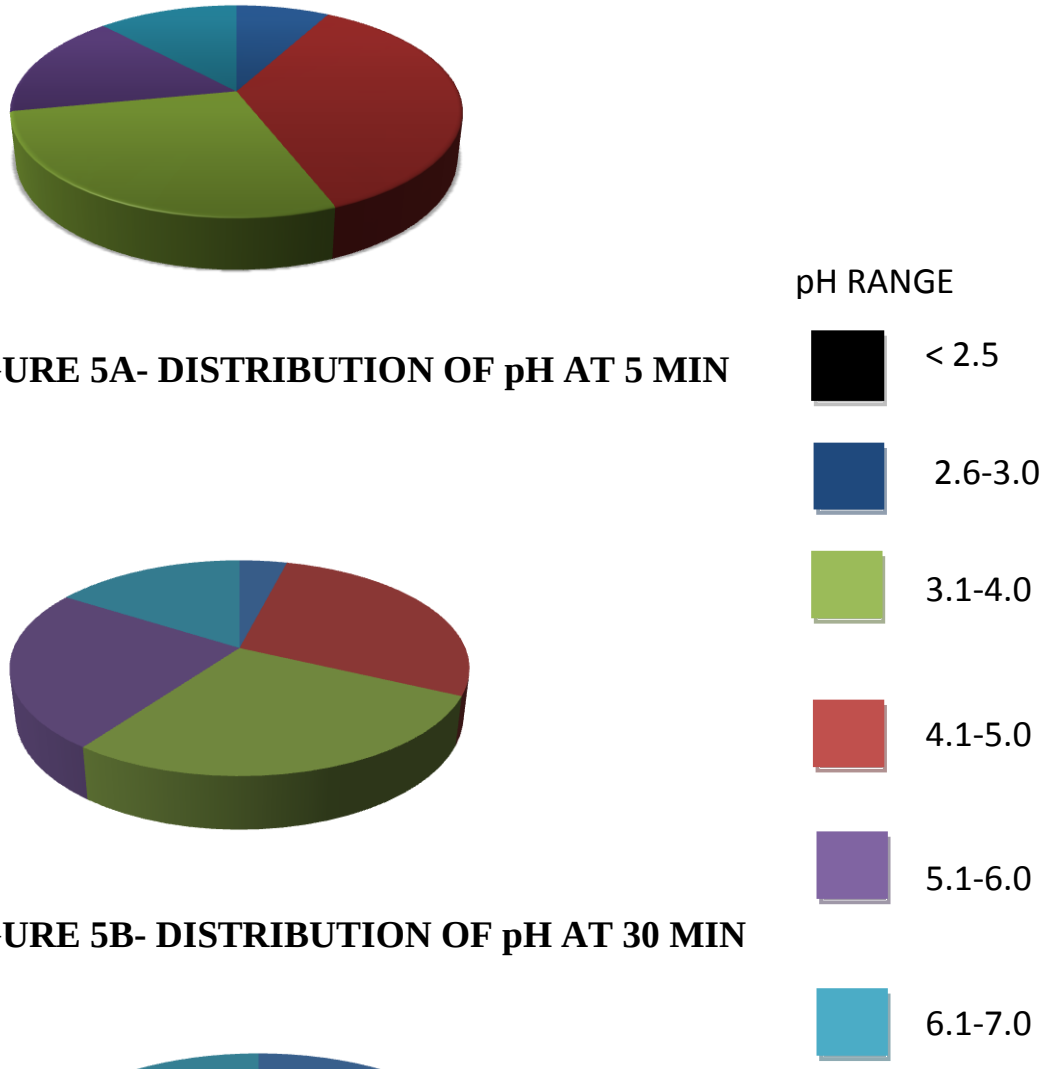


FIGURE 5A- DISTRIBUTION OF pH AT 5 MIN

FIGURE 5B- DISTRIBUTION OF pH AT 30 MIN

FIGURE 5C - DISTRIBUTION OF pH AT EXTUBATION

Table: 14 DISTRIBUTION OF RANGE OF pH AT VARIOUS TIME PERIOD AMONG CONTROL (GROUP B)

RANGE OF pH	GROUP - B (N=25)		
	5 MIN	30 MIN	EXTUBATION
< 2.5	10(40%)	9(36%)	11(44%)
2.6 – 3.0	5(48%)	8(62%)	6(52%)
3.1 – 4.0	8(32%)	6(24%)	7(28%)
4.1 – 5.0	2(8%)	2(8%)	1(4%)
5.1-6.0	0(0)	0(0)	0(0)
6.1- 7.0	0(0)	0(0)	0(0)

In table 14, pH in the control group shows more number of patients having pH in the range of 2.1-3.0, which in turn comes under the high risk category. No patient in control group had a gastric pH of more than 5.1. The pie chart in figure 6 also shows the distribution of pH in control group, depicting the same.

FIGURE 6 : DISTRIBUTION OF pH IN THE CONTROL GROUP B

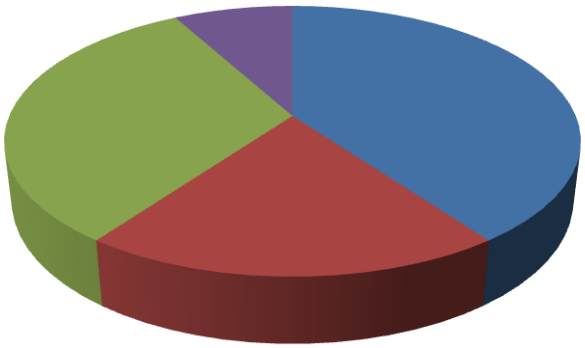


FIGURE 6A: DISTRIBUTION OF pH AT 5 MIN OF INDUCTION

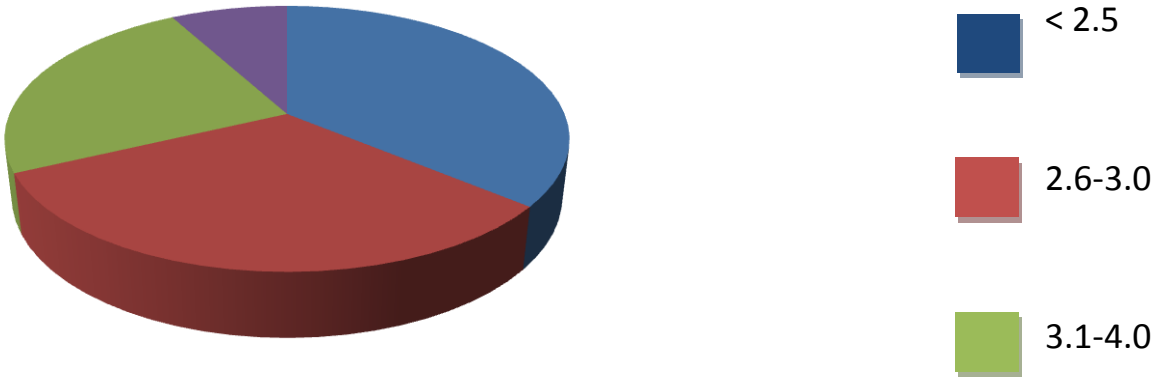


FIGURE 6B: DISTRIBUTION OF pH AT 30 MIN OF INDUCTION

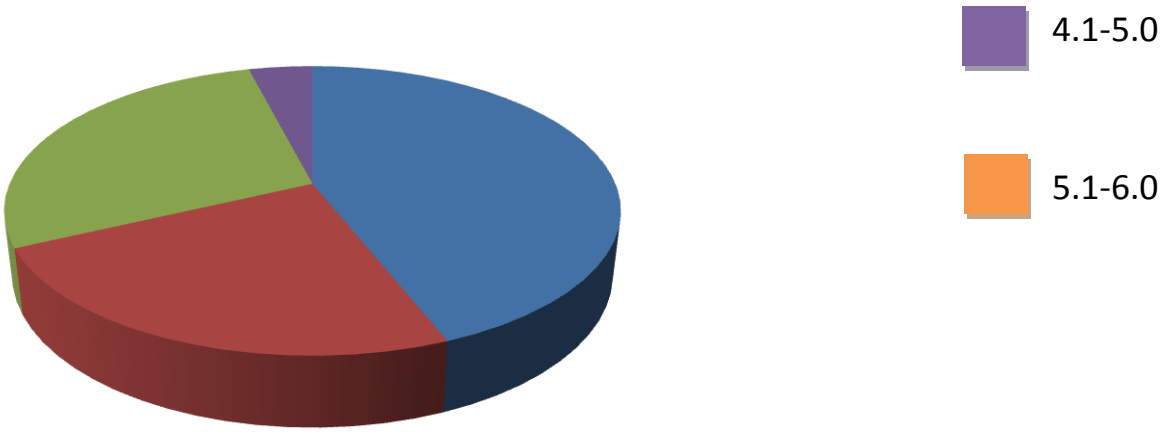


FIGURE 6C: DISTRIBUTION OF pH AT EXTUBATION

13. DISCUSSION

Based on the observation and results obtained in our study involving 25 patients in each group are discussed in detail by comparing with the available evidence in the literature**.**

In our study comparing the efficacy of 0.3 molar sodium citrate, a non particulate antacid with control group, the mean age, weight, Body Mass Index were comparable among the two groups(Tables 1,2,3,4). Our results show that 0.3M sodium citrate is effective as a form of anti-aspiration prophylaxis by increasing the pH of gastric contents than that of the control group. It in turn lessens the degree of damage to pulmonary mucosa, if aspiration of this less acidic gastric content occurs.

0.3 molar sodium citrate, 30ml when given in 20min before induction, raises the pH of gastric contents to above 2.5, in the protective range. The study group chosen was pregnant women undergoing elective LSCS. This type of patients are considered to be ‘full stomach’ even after they are allowed adequate proper fasting time in the preoperative period. Hence, they are always at a greater risk of aspiration during the peripartum period. Procedures under general anesthesia in this group carries even more higher risk, especially during times of intubation and extubation.

The dosage of sodium citrate was 30ml. In his study, Lahiri et al. found that 5 ml of 0.3 molar sodium citrate increased th gastric pH above 3.0 in 21 of 22 parturients. Later, Heath and Hester, analyzed the same volume and dosage of sodium citrate and they found no difference was there in between treated and untreated groups. In the subsequent related studies, they increased the volume of sodium citrate given to twice, and the buffering capacity of antacid administered, and successfully brought the gastric content ph to above 2.5. In our study also, 30ml was used to increase the pH.

The timing of drug before is also accountable, since in their study, DEWAN ET AL showed that the elevated mean ph in the short interval group (sodium citrate given in less than 60min before induction) and the increased incidence of low pH in the long interval group (sodium citrate given in more than 60min before induction), when compared to the short interval group, is due to the shorter duration of action of sodium citrate. In our study, the mean timing of drug administration was 20 minutes (less than half an hour) before induction.

Recently, O'Sullivan and Bullingham observed that gastric emptying represents an important factor in determining the duration of action of antacids (14). When gastric emptying occurs faster, the antacid rapidly

leaves the stomach and this results in a short duration of action. Factors that slow gastric emptying cause extended duration of action of antacids. Our patients received narcotics in the intraop period that might slow gastric emptying.

The sampling interval was standardized in both the groups to find out the time at which the drug action in elevating the gastric pH was maximal. In our study, it was noted that ph elevation was maximal 6.8 in drug group (table 10) during the time of intubation. Thus, it offers higher protection at that time.

As per Roberts and Shirley risk criteria, no patients given sodium citrate had a pH of less than 2.5 at any point of time during subsequent samplings (table 9). This correlates well with the study done by Oscar and Ravindran et al, where it was noted that nearly all patients given sodium citrate had a gastric pH of more than 3.5, whereas in the control group only two patients (13 %) had the pH above 2.5.

In our study, volume of gastric contents was not measured as it was not considered as a parameter for comparison between the two groups. The influence of gastric volume by antacids have been described in the literature. An increased incidence of gastric volumes more than **20** ml after the administration of antacids has been found in study of in

Stoelting R K et al. However, other reports (Detemir M D et al, Newson A J et al **)** found that the dosing of antacid does not affect the mean volume of gastric contents.

Most commercial preparations has aluminum hydroxide which may slow down the gastric emptying and therefore produce larger gastric volumes ((Detemir M D et al). The estimation of gastric fluid volume by aspiration of the stomach is less than ideal and may reflect an erroneously low measurement, as full aspiration of all the gastric contents is not possible even after repositioning and aspirating. Hence, the measurement of gastric fluid volume is imprecise. So, in our study we elected not to measure gastric volume in both the group of patients.

Moreover, as stated before, the critical volume and pH of gastric contents needs to be revised as per the pioneering studies by Rocke DA et al. this will make clinicians towards a more liberal use of antacids, which are mainly avoided because of their inherent propery of increasing the gastric content volume to above the critical limit.

The pH meter used for analyzing pH in our study, is a pen type pH meter. Hence, the pH can be measured at the patient's bedside, which is more time conserving and economical. The amount of aspirate required for

each sample is also less than 20ml when compared with the conventional laboratory techniques requiring 50-60ml of aspirate for analysis.

The side effects and drug interaction of sodium citrate as discussed in the literature was seldom seen in our study. This may be due to the reason that all patients were well scrutinized in the preoperative for co-existing medical illness and drug intake that interact with sodium citrate.

14. SUMMARY

A prospective randomized double blind study was designed to establish the efficacy of 0.3molar sodium citrate in pregnant patients undergoing elective lower segment caesarean section under general anesthesia. Based on the analysis of the results and discussion in our study, the conclusions arrived at are summarized as below.

In our study,

- The demographic variables such as age, height, weight & body mass are comparable between the groups
- The preoperative fasting time was around 9 hours, which is also comparable in both the groups.
- We observed that the baseline pH was > 2.5 and were comparable with no significant difference between the study and control groups.
- The mean pH measured at 5 minutes, 30 minutes and extubation in study group was statistically significantly higher in the study group than in the control group. (p value < 0.001- highly significant).
- The mean pH in the study group was maximally highest at 5min after intubation, signifying the protective effect of 0.3M sodium citrate during the time of induction, laryngoscopy and intubation.
- No patient were at high risk zone (i.e pH <2.5) in the study and control groups, at any time during the anesthesia.

- No patients were observed to have complications like aspiration, nausea or vomiting in the intra operative or postoperative period.
- The side effects of general anesthesia like nausea, vomiting, epigastric pain was found in few of our patients in both the groups with not much statistical significance in our study.

15. CONCLUSION

We conclude that the non particulate antacid 0.3 molar sodium citrate given orally about 20min before induction of anesthesia, is an effective and safe antacid for anti-aspiration prophylaxis in all elective obstetric surgeries without producing any side effects.

16. BIBLIOGRAPHY

1. Textbook of anesthesiology-AITKENHEAD 4th ed
2. Gastric Fluid pH in Patients Receiving Sodium Citrate,Viegas et al 1981 ;60:521-3.
3. Clinical significance of pulmonary aspiration during the perioperative period Warner MA et al,Anesthesiology. 1993 Jan; 78(1):56-62.
4. BENUMOFS AIRWAY MANAGEMENT- 2nd ed
5. Roberts RB, Shirley MA: Reducing the risk of acid aspiration during cesarean section. Anesth Analg 1974; 53:859-868.
6. Ng A, Smith G: Gastroesophageal reflux and aspiration of gastric contents in anesthetic practice. Anesth Analg 2001; 93:494-513.
7. Baum GL, et al, Textbook of pulmonary diseases. 6th ed. Vol. 1. Philadelphia: Lippincott–Raven, 1998:645-55.
8. Aspiration pneumonitis and aspiration pneumonia -Paule Marik, N Engl J Med, Vol. 344,2001
9. Gibbs CP, Banner TC: Effectiveness of Bicitra as a preoperative antacid. Anesthesiology 1984; 61.
10. Kennedy TP, et al.Acute acid aspiration lung injury in the rat: biphasic pathogenesis. Anesth Analg 1989; 69.
11. Nader et al. Reactive oxygen species contribute to oxygen-related lung injury after acid aspiration. Anesth Analg 1998;87:127-33.

12. Gibbs CP, Modell JH. Pulmonary aspiration of gastric contents: pathophysiology, prevention, and management. 1994:1437-64.
13. Pulmonary Aspiration Of Gastric Contents In Anesthesia , Eingelhardt & Webster, B J A, 1999, 83,453-60
14. Goodmann LR, postoperative radiograph .I. alterations after abdominal surgeries ,Am J of Roentgenol 1980 134, 533-41
15. Campinos L, Duval G- value of early fibreoptic bronchoscopy after aspiration of gastric contents, B J A 1983, 55,1103-5.
16. Marrie TJ, Durant H, Yates L. Community-acquired pneumonia requiring hospitalization: 5 year prospective study. Rev Infect Dis. 1989;11:586.
17. Bartlett JG, et al. Community-acquired pneumonia in adults: Guidelines for management. Clin Infect Dis. 1998;26:811.
18. Bone RC et al. Early methylprednisolone treatment for septic syndrome and ARDS. Chest 1987;92:1032-6. [Erratum, Chest 1988;94:448.]
19. Lobato, Emilio B.; Gravenstein, Nikolaus; Kirby, Robert R. Title: Complications in Anesthesiology, 1st Edition.
20. Report by the ASA Task Force on Preoperative Fasting. Anesthesiology 1999.

21. Stone SB: Efficacy of cimetidine in decreasing the acidity and volume of gastric contents: Inadequacy of nasogastric suction and endotracheal intubation [letter]. J Trauma 1981; 21:996.
22. Barash, Paul G.; Cullen, Bruce F.; Stoelting, Robert K.; Cahalan, Michael K.; Stock, M. Christine Title: Clinical Anesthesia, 6th Edition.
23. Sellick BA: Cricoid pressure to control regurgitation of stomach contents during induction of anaesthesia. Lancet 1961; 2: 404.
24. Peden NR, saunders et al, Inhibition of pentagastrin stimulated and nocturnal gastric secretion by Ranitidine, LANCET 1979, 1, 690-2.
25. Taylor G, acid pulmonary aspiration syndrome after antacids, B J A 1975, 65-7.
26. Gibbs CP, Spohr et al: the effectiveness of sodium citrate as an antacid. ANESTHESIOLOGY 57: 44-46, 1982
27. Sodium citrate pretreatment in elective cesarean section patients- dewan dm, floyd h m, thistle wood j m, bogard td , spielman fj.
28. Brock-Utne JG et al: Effect of domperidone on lower esophageal sphincter tone in late pregnancy. Anesthesiology 1980.
29. Chestnut: Obstetric Anesthesia: Principles and Practice, 3rd ed.
30. Methods for Testing pH of Liquids | eHow.com.

31. Prevention of gastric aspiration in pregnant women, King Edward Memorial Hospital Perth Western Australia , July 2009.
32. Effect of single dose oral ranitidine and sodium citrate on gastric pH during & after general anesthesia, C J A 1995/42:5/ 382-6.

17. ANNEXURES

PROFORMA

Name of patient :

Group assigned :

Age / Sex :

IP number :

Weight/ height :

Preop assessment

History-

Examination-

Airway assessment-

Diagnosis and indication for LSCS-

ASA status –

Last oral intake :

Premedication :

Test solution number :

Time of drug administration before induction :

Duration of surgery :

Baseline pH :

pH at 5min : pH at 30min : pH at extubation:

ETHICAL COMMITTEE CERTIFICATE

INSTITUTIONAL ETHICAL COMMITTEE
GOVT.KILPAUK MEDICAL COLLEGE,
CHENNAI-10
Ref.N.1463/MEI(Ethics)/2012 Dt:08.05.2012

CERTIFICATE OF APPROVAL

The Institutional Ethical Committee of Govt. Kilpauk Medical College , Chennai reviewed and discussed the application for approval entitled "To determine the efficacy of 0.3M Sodium Citrate as an antacid prophylaxis against aspiration pneumontis in obstretic surgical patients undergoing surgery" submitted by Dr.Sujaritha.T, MD (Anaesthesiology), PG Student, Govt. Kilpauk Medical College, Chennai-10

The Proposal is APPROVED.

The Institutional Ethical Committee expects to be informed about the progress of the study any Adverse Drug Reaction Occurring in the Course of the study any change in the protocol and patient information /informed consent and asks to be provided a copy of the final report.

GOVT. KILPAUK MEDICAL COLLEGE
15 JUN 2012
Kilpauk, Chennai-10.

15/6/12
CHAIRMAN,
Ethical Committee
Govt.Kilpauk Medical College,Chennai

PATIENT CONSENT FORM

"A Study To Determine The Efficacy Of 0.3 M Sodium Citrate As An Antacid Prophylaxis Against Aspiration Pneumonitis In Obstetrical Patients Undergoing Elective Ceasarean Section Under General Anesthesia"

Study centre: Department of Anaesthesiology & Critical Care, Kilpauk.

Medical college:

Participant name: Age: Sex:

I.P. no:

I, confirm that I have understood the purpose of procedure for the above study. I had the opportunity to ask the question and all my questions and doubts have been answered to my satisfaction.

I have been explained about the pitfall in the procedure and the management of it. I have been explained about the safety, advantages and disadvantages of the techniques.

I understand that my participation in the study is voluntary and that I am free to withdraw at anytime without giving any reason.

I understand that investigator, regulatory authorities and the ethics committee will not need my permission to look at my health records both in respect to current study and any further research that may be conducted in relation to it, even if I withdraw from the study.

I understand that my identity will not be revealed in any information released to third parties or published, unless as required under the law. I agree not to restrict the use of any data or results that arise from the study.

I hereby consent to participate in this study of "A Study To Determine The Efficacy Of 0.3M Sodium Citrate As An Antacid Prophylaxis Against Aspiration Pneumonitis In Obstetrical Patients Undergoing Elective Caesarian Section Under General Anesthesia".

Name of the patient:	Signature/thumb impression of patient:
Name of the witness:	Signature:
Address:	Contact Number:
Name of the investigator:	Signature:
Time:	Date:
Place:	

MASTER CHART – STUDY GROUP - A

S.NO	NAME	AGE/SEX	WT. (KG)	IP NO	DRUG	DIAGNOSIS	FASTING (HRS)	BASELINE PH	PH 5MIN	PH 30 MIN	PH EXTUB
1	INBASELVI	25/F	80	13140	NA CITRATE	PREV LSCS &CPD	10	4.3	3.1	5.2	5.8
2	NIRMALA	24/F	90	10517	NA CIT	PRIMI WITH CPD	9	2.2	3.8	5.2	5.1
3	SHOBANA	26/F	74	11863	NA CIT	PREV LSCS &CPD	10	2.2	5.8	6.1	6
4	JAMUNA	24/F	82	17062	NA CIT	PRIMI -POSTDATED PREG	10	4.3	6.2	6.7	6.1
5	UMA	25/F	75	13415	NA CIT	PRIMI WITH CPD	8	2	5.8	4.2	6.4
6	KANIMOZHI	22/F	55	10338	NA CIT	PREV LSCS &CPD	10	1.9	4.8	5.2	5.3
7	SIVASAKTHI	25/F	56	14087	NA CIT	PREV LSCS &CPD	10	2.1	6.8	5.8	3.1
8	REVATHY	26/F	47	14090	NA CIT	PRIMI- PRECIOUS PREG	10	3.8	5.2	6.4	6.2
9	KUMUDHA	20/F	50	18140	NA CIT	PRIMI WITH CPD	8	3.2	4.1	4.3	3.8
10	PAULIN	21/F	45	18121	NA CIT	PREV LSCS	10	4.2	4.5	4.6	4.2
11	SAMUNDEESWARI	20/F	55	17853	NA CIT	PRIMI-POSTDATED PREG	9	3	3.6	4.5	4.6
12	LATHA	21/F	50	16812	NA CIT	PREV LSCS &CPD	10	4.3	6.2	6.3	2.8
13	KAMALA DEVI	25/F	62	17179	NA CIT	PREV LSCS &CPD	8	3.1	4.8	5.1	5.2
14	JHANSI RANI	21/F	65	17233	NA CIT	PRIMI WITH CPD	10	2.3	3	3.2	3.3
15	JAYANTHI	22/F	45	17423	NA CIT	PREV LSCS	10	3.2	5	5.1	4.9
16	KOMALA	23/F	60	17942	NA CIT	PREV 2 LSCS	9	1.8	2.6	2.7	3
17	AROKIA MARY	22/F	54	17899	NA CIT	PRIMI WITH CPD	8	2.3	3.8	3.8	3.7
18	SHAGIRA BEGUM	20/F	65	20045	NA CIT	PREV LSCS	10	2.4	3.2	3.3	3.6
19	REKHA	26/F	66	20076	NA CIT	PRIMI WITH CPD	9	2.4	3.2	3.3	3.4
20	PUSHPA	21/F	45	20013	NA CIT	PREV LSCS	10	2.8	3.9	4.1	4.3
21	DURGA DEVI	24/F	68	18426	NA CIT	PRIMI WITH CPD	10	4.1	5.2	3.8	2.8
22	PACHAIAMMAL	22/F	50	20043	NA CIT	PREV LSCS	9	2.3	3.8	3.2	3.6
23	MARY	24/F	48	19986	NA CIT	PREV 2 LSCS	10	2.8	3.8	3.6	3.6
24	ALLIRANI	24/F	56	18453	NA CIT	PREV LSCS	10	3.5	4.6	4.7	4.8
25	SATHYA	23/F	58	20527	NACIT	PREV LSCS	8	3.1	4.6	4.3	4.2

MASTER CHART – CONTROL GROUP - B

S. NO	NAME	AGE SEX	WT (KG)	IP NO	DRUG	DIAGNOSIS	FASTING	BASELINE PH	PH 5MIN	PH 30 min	PH EXTUB
1	NANDHINI	22/F	62	10517	PLACEBO	PREV LSCS	9 HR S	2.6	2.8	2.6	3.1
2	MALLIGA	26/F	65	11223	PLACEBO	PRIMI WITH CPD	9 HRS	2.1	2.1	2.4	2.5
3	KANNAKI	28/F	56	10113	PLACEBO	PREV LSCS	10 HRS	2.5	2.8	2.5	2.6
4	KALAISELVI	21/F	55	18103	PLACEBO	PRIMI WITH CPD	8 HRS	3.2	3.3	2.8	2.8
5	SUBHA	24/F	60	16800	PLACEBO	PREV LSCS	10 HRS	2.9	3.1	2.6	2.6
6	DHANALAKSHMI	21/F	45	16870	PLACEBO	PRIMI- POSTDATED PREG	9 HRS	3.2	3.4	3.1	2.7
7	SARALA	24/F	55	17176	PLACEBO	PRIMI WITH CPD	8 HRS	1.7	2	1.6	1.7
8	KAVITHA	25/F	70	17236	PLACEBO	PREV LSCS	10 HRS	2.1	2.2	2.4	1.9
9	NASEEMA	24/F	68	18423	PLACEBO	PREV LSCS	7 HRS	3.4	2.9	3	3.1
10	DEVIKA DEVI	27/F	60	18446	PLACEBO	PRIMI WITH CPD	10 HRS	2.7	2.8	2.3	2.3
11	AMUL	21/F	48	18502	PLACEBO	PREV LSCS	8 HRS	4.2	4.5	4.5	3.9
12	KANCHANA	23/F	80	18842	PLACEBO	PREV LSCS	9 HRS	2.6	2.7	3	2.5
13	SHAKILA BANU	23/F	75	18823	PLACEBO	PRIMI -POSTDATED PREG	10 HRS	2.3	1.8	1.8	2
14	MUTHU SELVI	30/F	70	18876	PLACEBO	PRECIOUS PREGNANCY	9 HRS	2.8	3.1	2.8	2.6
15	LALITHA	28/F	68	19277	PLACEBO	PREV LSCS	8HRS	2.2	2.4	2.3	2.3
16	NATHIYA	22/F	53	19677	PLACEBO	PRIMI WITH CPD	10 HRS	3.1	3.5	3.4	3
17	MARIAMMAL	29/F	55	19740	PLACEBO	PREV LSCS	9 HRS	4.2	4.5	4.6	4.3
18	BAGHYALAKSHMI	24/F	65	19233	PLACEBO	PREV LSCS WITH CPD	8 HRS	2.4	3.1	3.2	3.3
19	ANNAL	32/F	67	19824	PLACEBO	PREV LSCS	10 HRS	2.7	2.9	2.7	2.3
20	DEVI	24/F	55	19199	PLACEBO	PRIMI- POSTDATED PREG	9 HRS	2.1	2.4	2.3	2.3
21	INBASEELI	28/F	45	12537	PLACEBO	PRIMI-SHORT STATURE	10 HRS	2.8	2.7	2.8	2.6
22	SUDHA	26/F	59	19124	PLACEBO	PREV LSCS	9 HRS	2.2	2.4	2.6	2.1
23	RAJESWARI	29/F	65	19599	PLACEBO	PREV LSCS	10 HRS	3.9	3.8	3.5	3.6
24	DEVAKI	24/F	56	19604	PLACEBO	PRIMI WITH CPD	9 HRS	3.4	3.2	2.8	2.5
25	INDIRA	22/F	55	20807	PLACEBO	PRIMI WITH MOBILE HEAD	8 HRS	2.8	3.9	4.2	4.3

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1 A STUDY TO DETERMINE THE EFFICACY OF 0.3M SODIUM CITRATE AS AN ANTACID PROPHYLAXIS AGAINST ASPIRATION PNEUMONITIS IN OBSTRETIC PATIENTS UNDERGOING ELECTIVE CEASEREAN SECTION UNDER GENERAL ANESTHESIA Dissertation submitted In partial fulfillment for the award of M.D DEGREE EXAMINATION M.D ANESTHESIOLOGY & CRITICAL CARE-BRANCH X KILPAUK MEDICAL COLLEGE & HOSPITAL, CHENNAI-10 SUBMITTED TO THE TAMILNADU DR.MGR MEDICAL UNIVERSITY CHENNAI APRIL-2013 2 CERTIFICATE This is to certify that this dissertation titled “A STUDY TO DETERMINE THE EFFICACY OF 0.3M SODIUM CITRATE AS AN ANTACID PROPHYLAXIS AGAINST ASPIRATION PNEUMONITIS IN OBSTRETIC PATIENTS UNDERGOING ELECTIVE CEASEREAN SECTION UNDER...