"EVALUATION OF THE EFFECT OF ELECTIVE TRACHEOSTOMY ON MORBIDITY AND MORTALITY FOLLOWING OESOPHAGEAL SURGERY WITH NECK ANASTOMOSIS"

DISSERTATION SUBMITTED IN PARTIAL FULFILLMENT OF THE REQUIREMENT OF THE TAMILNADU DR. M.G.R. MEDICAL UNIVERSITY FOR THE DEGREE OF M.S. BRANCH I - GENERAL SURGERY EXAMINATION TO BE HELD IN MARCH-2008

Certificate

This is to certify that **"EVALUATION OF THE EFFECT OF ELECTIVE TRACHEOSTOMY ON MORBIDITY AND MORTALITY FOLLOWING OESOPHAGEAL SURGERY WITH NECK ANASTOMOSIS"**, which is being submitted as thesis requirement for M.S. Degree Branch I – General Surgery examination of the Dr. M.G.R. Medical University of Tamil Nadu, is a bonafide work of the candidate – **Dr. Rohin Mittal**

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Certificate

This is to certify that the topic entitled **"EVALUATION OF THE EFFECT OF ELECTIVE TRACHEOSTOMY ON MORBIDITY AND MORTALITY FOLLOWING OESOPHAGEAL SURGERY WITH NECK ANASTOMOSIS"** is a bonafide work done by **Dr. Rohin Mittal**, post graduate in General Surgery of Christian Medical College, Vellore. This work has been carried under my guidance and supervision in partial fulfillment of the regulation of Dr. M.G.R. Medical University of Tamil Nadu for Master of Surgery- Branch I (General Surgery) examination to be held in March 2008.

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Acknowledgements

- Dr. George Mathew, my guide, without whom this study would not have been possible
- Dr. Sudhakar Chandran, for his inspiration, help, and support
- Dr. Inian S. and Dr. Nagmani Sen, for their ideas, support and encouragement
- Mr. Solomon, biostastician, for his help in analyzing and interpreting the data
- All my colleagues, senior and junior, who co-operated with me in the recruitment of study cases
- Staff of P3 Ward for their co-operation and support
- Staff of Surgical ICU , for their co-operation
- Staff of Medical records, for their co-operation in collecting old medical records
- Office staff at Surgery III , who helped me with all the paperwork

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INTRODUCTION AND JUSTIFICATION

Oesophageal surgery involves a major surgical and physiological insult to the body with associated significant morbidity and mortality. Oesophageal surgery remains a demanding surgical procedure for surgeons who deal with benign and malignant disease of oesophagus. Significant advances in perioperative and postoperative care have occurred in the past decade. However mortality and morbidity rates associated with oesophagectomy worldwide remain high. Major contributors to the mortality and morbidity are post operative pulmonary complications.

Pulmonary complications remain the most common complications that develop after oesophageal surgery[1]. The incidence of pulmonary complications has been reported to vary from 17% [2]to 45%[3] in published literature. These account for up to 50% of the hospital deaths in patients undergoing oesophagectomy[4].

20% of patients who undergo oesophageal surgery require prolonged ventilatory support and undergo tracheostomy in the intensive care setting[5].

The role of early tracheostomy in critically ill patients has been extensively studied[6]. Recent literature has shown that an early tracheostomy in the intensive care setting, for patients requiring prolonged ventilation, reduces the duration of ventilation, duration of ICU stay and mortality. The timing of tracheostomy is still a matter of debate, but clearly there is a definite trend that the earlier tracheostomy is associated with better outcome in terms of morbidity and mortality.

Elective tracheostomy for patients undergoing major oesophageal surgery has not been studied so far, though some centers have been using the same in a few patients. This study aims at evaluating the effect of tracheostomy performed at the time of primary operation, in reducing pulmonary complications and improving outcomes after major oesophageal surgery.

AIMS AND OBJECTIVES OF THE STUDY

To evaluate the effect of elective tracheostomy on morbidity and mortality following oesophageal surgery with neck anastomosis

REVIEW LITERATURE

Anatomy of the Oesophagus

The oesophagus is a muscular tube that begins at the lower border of the cricoid cartilage (at the level of C6 vertebrae) and ends in the abdomen at the cardiac orifice of the stomach (at the level of T11 vertebrae). It is 25 cm long and is divided into cervical, thoracic and abdominal parts. The cervical oesophagus inclines slightly to the left of the midline and returns to the midline at the T5 vertebral level. It continues down and pierces the diaphragm about 2.5 cm to the left of midline at the level of T10 vertebra.[7]

The oesophagus lacks serosa and is surrounded by a layer of loose fibro alveolar adventitia. Beneath the adventitia is a layer of longitudinal muscle, overlying an inner layer of circular muscle. Between the two muscular layers lie the blood vessels and ganglion cells (Auerbach plexus).

Both the longitudinal and circular muscle layer of the upper third of the oesophagus are striated whereas the layers of the lower third are smooth.

The oesophageal mucosa is of squamous epithelium except for the distal 1 to 2 cm, which is junctional columnar epithelium. [8]

The cervical oesophagus receives blood from the superior thyroid artery as well as the inferior thyroid artery. The major blood supply of the

thoracic oesophagus is from four to six aortic oesophageal arteries, supplemented by collateral vessels from the inferior thyroid, intercostals, bronchial, inferior phrenic and left gastric arteries.[8] They are slender, tenuous vessels and this makes it possible to mobilize the intrathoracic oesophagus by blind digital dissection from the suprasternal notch above and from the oesophageal hiatus below during transhiatal oesophagectomy.

The veins of the cervical oesophagus drain into the inferior thyroid vein. The veins on the left side of the thoracic oesophagus drain into the brachiocephalic vein via the left hemiazygous system. On the right side, the drainage is through the azygous system into the superior vena cava. At the cardio oesophageal junction, venous drainage of the oesophagus may be into the coronary, splenic, retroperitoneal and inferior phrenic veins which connect with the portal and caval systems[9].

Many of the complications of oesophageal surgery are directly related to specific features of oesophageal anatomy and physiology. One distinct feature of oesophageal anatomy is its unusually fatty submucosa, which allows greater mobility of the overlying squamous mucosa. When performing an oesophageal anastomosis manually, meticulous technique is essential to ensure that every suture traverses the mucosal edge, which sometimes can retract up to 1 cm.[10]

OESOPHAGEAL OPERATIONS

Oesophageal operations are some of the most demanding procedures of the gastrointestinal tract. The postoperative morbidity and mortality rates remain high in spite of the advances in surgical technique and perioperative care. Two of the most common conditions requiring surgery upon the oesophagus are carcinoma oesophagus and corrosive injury to the oesophagus.

CARCINOMA OESOPHAGUS

Oesophageal carcinoma continues to be a challenge to the surgeon and the oncologist. The classical presentation is one of progressively worsening dysphagia, and the disease is usually at an advanced stage at presentation[11]. Both surgery and chemoradiation are being used as modalities of treatment[11]. However, despite numerous clinical trials, none has been proven superior to the other.

Only about 50% of patients are eligible for a curative resection at presentation[12]. In the absence of metastatic disease, an oesophagectomy can be performed with a gastric pull-up for reconstruction. In cases where the stomach is involved by tumor, colon can be used as an alternative conduit.

Since 1970, the reported 5-year survival rates for patients undergoing oesophagectomy has risen from 10%-15% to a high of 35%[13]. This is

secondary to refinements in surgical technique, improved anesthesia and critical care management and an emphasis on nutrition by enteral or parenteral routes[13]. Despite these improvements in surgical outcome, the overall survival rate for carcinoma oesophagus has changed little.

Oesophagectomy can be performed by any of the following approaches - transhiatal, transthoracic or video-assisted. None of them has been shown to have any survival advantage over the other[10,14].

TRANSTHORACIC OESOPHAGECTOMY

Transthoracic oesophagectomy may be performed via a left or right thoracoabdominal incision, separate posterolateral thoracic incision and abdominal incision (Ivor-Lewis oesophagectomy) and cervical, posterolateral thoracic and abdominal incision (Mckeown's oesophagectomy).

A transthoracic surgery allows complete resection of the tumor and also enables one to do a lymph node dissection under direct vision.

Disadvantages of transthoracic oesophagectomy include increased post operative morbidity and mortality due to combined chest and abdominal incisions. Although disruption of an intrathoracic oesophageal anastomosis is reported less frequently than a cervical anastomotic leak from a transhiatal oesophagectomy, the consequences, including mediastinitis and sepsis, are

fatal in up to 40% of patients[15]. The operative mortality varies significantly depending on the centre, ranging from 14% to 2.2%[15].

TRANSHIATAL OESOPHAGECTOMY

Here the entire thoracic oesophagus is dissected through a widened hiatus, without performing a thoracotomy. Reconstruction is achieved by tubing the stomach and pulling it to the neck, with a cervical oesophago-gastric anastomosis.

Transhiatal oesophagectomy is associated with a low operative mortality of 2 to 8% and an anastomotic leak rate of 5 to 19% [16,17]. Orringer et. al. reviewed their 22 year experience with transhiatal oesophagectomy (1085 patients). They reported hospital mortality of 4% with an anastomotic leak rate of 13%[18].

Transhiatal oesophagectomy minimizes the operative insult to the patient by avoiding a thoracotomy. The incidence of post operative pulmonary complications is thereby reduced, and the possibility of mediastinitis secondary to an intrathoracic leak is virtually eliminated.

Critics of transhiatal oesophagectomy object to the limited exposure to the intrathoracic oesophagus. The limited exposure potentially increases the risk of uncontrolled haemorrhage by injury to the azygous vein, the

pulmonary veins or the aortic arch and precludes a complete mediastinal lymph node dissection for purposes of staging and potential cure.

A review of the literature with a meta-analysis, however, has shown that operative blood loss is significantly less during transhiatal than transthoracic oesophagectomy[14]. The overall in-hospital mortality for transhiatal oesophagectomy is 5.7% versus 9.2% for transthoracic oesophagectomy with no significant difference in 3 and 5-year survival[15]. Contraindications include evidence of tumour invasion of the pericardium, aorta or tracheo-bronchial tree[15]. Leak rates are higher with transhiatal oesophagectomy (13.6% for transhiatal versus 7.2% for transthoracic) [18]. However, the leak is in the neck and it heals spontaneously[15].

THORASCOPIC ASSISTED OESOPHAGECTOMY

Thoracoscopic assisted oesophagectomy involves three steps: the first is thoracoscopic dissection of the intrathoracic oesophagus. The second is the laparoscopic mobilization of the gastric conduit and the third is the cervical anastomosis. There is an operative mortality of up to 13.5%[19]. The morbidity has been reported to be 27 to 55%[20,21]. Although, technically feasible, the success of thoracoscopic oesophagectomy is highly dependant on the experience of the surgeon. No currently available technique is considered standard. Thoracoscopic oesophagectomy has not been shown to

reduce the length of hospitalization or complications when compared to open surgical procedures[19]. Randomized trials with longer follow up are required to fully evaluate the procedure[10].

CORROSIVE STRICTURE OESOPHAGUS

One of the oesophageal pathology that requires major surgical intervention is caustic injury to the oesophagus. Initial management is usually conservative but many of these patients present at a later date with stricture of the esophagus and in most cases, also the stomach. The treatment of choice is oesophageal dilatations in patients with single strictures. In cases of multiple strictures, long segment strictures, very tight strictures and failed dilatations, an operative procedure is indicated. Gastric pull up is the preferred treatment if the stomach is adequate in length and not injured by the corrosive. However in majority of the patients with caustic injury, the stomach is also involved and a colon bypass is required. This can be achieved via a substernal tunnel or via the posterior mediastinum, using side-to-side anastomosis between the cervical oesophagus and left or right colon[10]. These patients are nutritionally depleted and are hence prone for post operative respiratory complications and anastomotic leak[11].

COMPLICATIONS OF OESOPHAGEAL SURGERY

Oesophageal surgery is a major undertaking involving opening of multiple body cavities, prolonged operating time and major blood loss. The patients are malnourished secondary to decreased oral intake due to dysphagia. Most patients give history of chronic smoking and co-existing lung disease. Therefore it is not unusual to find that these operations are associated with a high complication rate.

Pulmonary complications are the most common complications following oesophagectomy and are the leading cause of mortality related to the procedure[1]. These have been discussed in detail later.

Some of the other complications of oesophagectomy include cardiovascular complications, anastomotic leaks and strictures, chylothorax, gastric outlet obstruction, and recurrent laryngeal nerve injuries.

CARDIOVASCULAR COMPLICATIONS

Arrhythmias are common after oesophagectomy and commonly occur on day 2-4. These are often an early sign of pulmonary complications, anastomotic leak or sepsis[22].

Postoperative supraventricular tachyarrhythmias are associated with an increased mortality [23]. Early recognition and treatment is therefore necessary.

Treatment of the underlying cause, correction of electrolyte abnormality or pharmacological therapy with a cardiac glycoside is usually effective [22].

ANASTOMATIC LEAKS

The overall incidence of anastomotic leaks after oesophagectomy ranges from 12% to 30% as per several studies. This wide range shows the involvement of multiple perioperative factors that play a role in its development.

Pre operative factors include

- presence of other co morbid illnesses[22]
- poor nutritional status[24]
- low hematocrit and[24]
- neoadjuvant chemotherapy[24]

Intraoperative factors include

- experience of the surgeon[25]
- conduit ischaemia[24]
- cervical anastomosis[26]
- estimated blood loss[26]
- anastomosis being performed via a retrosternal or subcutaneous route as opposed to an intrathoracic route[27]

- use of colonic interposition as opposed to gastric pedicle[27]
- performing a manual anastomosis as opposed to a mechanical anastomosis[27]
- employing an end to end anastomosis as opposed to an end to side anastomosis using a mechanical technique[27]

Although management of cervical anastomotic leak is usually conservative, the long term sequelae of a cervical leak are significant. Upto 50% of cervicoesophagogastric anastomotic leaks result in anastomotic stricture, as healing occurs. This represents an unsatisfactory outcome of an operation that is intended to provide comfortable swallowing. These can be managed with endoscopic pneumatic dilatations and may require multiple sessions of the same.

CHYLOTHORAX

The thoracic duct travels alongside the oesophagus and crosses over to the left at the fifth thoracic vertebrae level. It can be injured at any point in its entire course, leading to a chylothorax.

This is identified by leakage of chyle from the intercostal tube. If there is no intercostal tube in situ, chylothorax presents with massive pleural effusion leading on to respiratory embarrassment[22].

Initial conservative management is applied. However in patients with high output, and those not responding to conservative management, surgical ligation is indicated[22].

GASTRIC OUTLET OBSTRUCTION

Recurrent vomiting and aspiration after oesophagectomy, most commonly is due to gastric outlet obstruction. Absence of a pyloroplasty or an inadequate pyloroplasty is the usual cause.

Contrast radiology establishes the diagnosis. Initially balloon dilatation may be tried, however most patients require a re-operation[22].

RECURRENT LARYNGEAL NERVE INJURY

Recurrent laryngeal nerve injury during oesophagectomy may result in one of the most devastating complications, cricopharyngeal muscle dysfunction, with resultant incapacitating cervical dysphagia[10].

TRACHEO OESOPHAGEAL FISTULA

One of the most disastrous complications after oesophageal resection and reconstruction is the development of a fistulous communication between the tracheobronchial tree and either the oesophagus or the oesophageal substitute, generally at the site of anastomosis. Once a fistula develops there is little option other than to prevent repeated contamination of the

tracheobronchial tree by identifying and dividing the fistula and repairing the airway[10,22]. This is a major undertaking in a desperately ill patient.

Other complications include stridor and hoarseness of voice. Speech retraining with the help of a speech therapist helps in such conditions [22].

POST OPERATIVE PULMONARY PHYSIOLOGY

A host of factors contribute to the abnormal pulmonary physiology after an operative procedure.

A loss of functional residual capacity is present in virtually all patients[11]. This loss may be due to

- abdominal distention
- painful upper abdominal incision
- obesity
- strong smoking history with associated chronic obstructive pulmonary disease
- prolonged supine positioning
- fluid overload leading to pulmonary edema

Virtually all patients who undergo an abdominal incision or a thoracic incision have a significant alteration of their breathing pattern. Vital capacity may be reduced up to 50% of normal for the first 2 days after surgery for reasons that are not completely clear[11].

Use of narcotics substantially inhibits the respiratory drive, and the effect of anesthetics may take some time to wear off[11].

After a thoracotomy, the reduced lung volumes and spirometry may take up to 6 months to come back to normal[28].

A host of iatrogenic maneuvers place the patient at increased risk for aspiration pneumonitis. During anesthesia induction, patients are sedated and lose control of the ability to clear the airway. The aforementioned setting is probably the most common cause of aspiration[11]. The patient with a nasogastric tube is also at a high risk for aspiration pneumonia.

The sensitivity and force of the cough reflex is decreased during the post operative period. This can be attributed to the paresis or damage of the vagus nerve during dissection or due to diaphragmatic injury during dissection. This leads to increased risk of aspiration pneumonia[2].

Major surgery is associated with an elevation of inflammatory mediators within the lungs, with a concomitant increase in vascular permeability and fluid sequestration[29]. Thoracotomy exacerbates these effects, and single lung ventilation adds further to the insult[22]. These can lead to acute lung injury and ARDS.

Meticulous attention to fluid replacement and maintenance during surgery and during the post operative period is required with particular

attention to prevent fluid overload. Fluid overload both intraoperatively and post operatively, is the major cause of post operative pulmonary oedema[11].

SINGLE LUNG VENTILATION

Single lung ventilation is frequently used in oesophageal surgery to improve surgical access to the oesophagus. This is most commonly achieved with a Robertshaw double lumen endotracheal tube. Right and left sided tubes are available in different sizes.

Single lung ventilation causes major physiological changes and can cause injury to both the dependent and non dependent lung. The principal physiologic change of OLV is the redistribution of lung perfusion between the ventilated (dependent) and blocked (nondependent) lung[30]. Many factors contribute to the lung perfusion; the major determinants of them are hypoxic pulmonary vasoconstriction (HPV) and gravity[30].

HPV, a local response of pulmonary artery smooth muscle, decreases blood flow to the area of lung where a low alveolar oxygen pressure is sensed. It aids in keeping a normal V/Q relationship by diversion of blood from under ventilated areas, responsible for the most lung perfusion redistribution in OLV. The mechanism of HPV is not completely understood.

PULMONARY COMPLICATIONS

In every series of patients undergoing oesophageal resection and substitution with stomach or colon, the leading causes of death is respiratory insufficiency[1].

The incidence of pulmonary complications after oesophagectomy has been reported as varying from 17% to 45%.[2,3,5]

These account for up to 50% of the hospital deaths in these patients[4]. 20% of these patients require prolonged ventilatory support[31].

The common pulmonary complications include aspiration pneumonia, acute lung injury and ARDS, pleural effusion, pneumothorax and chylothorax.

Aspiration Pneumonia is the most common pulmonary complication and is seen in up to 32% of the patients[1]. It is defined as the presence of new pulmonary infiltrates on chest radiograph associated with fever, raised white cell count or necessitating antibiotic use [1].

Acute Lung Injury (ALI) is a distinct form of acute respiratory failure characterized by diffuse pulmonary infiltrates, progressive hypoxemia, reduced lung compliance and normal hydrostatic pressures[3]. ARDS or Adult Respiratory Distress Syndrome is a more severe form of ALI. These are

diagnosed when all the following are present (American European Consensus Conference definition) [32]

- Bilateral pulmonary infiltrates on chest x-ray
- Pulmonary Capillary Wedge Pressure <18mmHg
- PaO2/FiO2 <300 = ALI
- PaO2/FiO2 <200 = ARDS

Pleural effusion is common after oesophagectomy and may necessitate intercostal tube drainage.

Pneumothorax occurring after oesophagectomy may also lead to intercostal tube insertion, thus contributing to operative morbidity.

PREDICTORS OF PULMONARY COMPLICATIONS

A large number of studies have been done on pre operative prediction of pulmonary complications in patients undergoing oesophagectomy. In spite of the large volume of literature being available on the subject, no specific criteria exist to classify patients into specific risk groups. Most centers continue to use their own criteria to choose patients suitable for oesophagectomy, based on experiences at their own centre.

Some of the risk factors associated with the development of pulmonary complications include age, history of smoking, poor pre operative spirometry, duration of surgery, blood loss during surgery, duration of one lung ventilation, and concurrent liver disease.

Advanced age has been identified as a risk factor for both pulmonary complications and death after oesophagectomy[1,5,33,34,35]. The chance of developing pulmonary complications was twice in patients older than seventy years and the mortality was four fold[33]. The adverse factors responsible for adverse outcome in elderly patients seem to be the presence of preexisting cardiopulmonary illness.

Smoking has also been identified as a major risk factor for development of post operative pulmonary complications[3]. These patients have an underlying chronic obstructive lung disease and are hence more prone to

complications. Total abstinence from smoking for as short a period as 3 weeks can lead to an improvement in outcome in such patients.

Poor pre operative spirometry is also a predictor of poor post operative outcome[1,5,34,36,37]. The FEV1 (forced expiratory volume in one second) when compared to the expected (as a percentage) is a good indicator of risk. Patients with FEV1 less than 65% of the predicted have a higher complication rate and higher mortality[1,5,34,36,37].

The forced vital capacity is also a good indicator to predict post operative pulmonary complications and mortality. A FVC of less than 90% of expected leads to more complications and morbidity[5,36].

Longer operation duration[3,33] and more intraoperative blood loss[4,35] were associated with more pulmonary complications and more hospital deaths. Both factors may be associated with more advanced tumors, where tumor resection was more difficult. Decreased blood loss and blood transfusion have been shown in other studies to correlate with decreased hospital death rate as well as with long term survival after major cancer surgery.

Duration of single lung ventilation is also a factor in post operative pulmonary outcome[3]. To optimize surgical access the lung on the thoracotomy side is collapsed and all ventilation delivered to the contra lateral lung. This results in injury to both the collapsed and the ventilated

lung. Relatively high tidal volumes are used during one lung ventilation, and this can induce microbarotrauma, leading to an ARDS like picture[3].

Injury to the collapsed lung may be followed by reperfusion injury, which may add to the damage.

Single lung ventilation should thus be kept for the minimal amount of time to prevent pulmonary complications.

Patients with oesophageal squamous cell cancer, particularly those treated with preoperative chemo radiation have greater risk for post operative pulmonary morbidity, including pleural effusion, pneumonia and respiratory insufficiency[38].

Intraoperative hypoxia and hypotension[3], the need for ionotropic supports[3] and presence of concurrent liver disease[36,37] has also been associated with higher pulmonary complications.

SCORING SYSTEMS TO ASSESS RISK OF COMPLICATIONS

A Large number of studies have been done to predict operative risk in patients undergoing oesophagectomy. Few scoring systems have been developed for the same. However these have not gained wide acceptance and most centers continue to use self made criteria for choosing appropriate patients.

In a study at the Royal Adelaide Hospital, Australia by Liu JF, Watson DI and Mathew G et al., hypertension, a history of previous cigarette smoking and FEV1/FVC were identified as independent predictors of the post-operative outcome. Based on these a scoring system was developed which stratified patients into low, moderate and high risk for surgery[39].

A study done in Germany identified a compromised general status ($P < 0.001$) and poor cardiac ($P < 0.001$), hepatic ($P < 0.05$) and respiratory ($P < 0.05$) function as independent predictors of a fatal postoperative course. Based on the relative risk associated with the individual impaired organ functions, a composite risk score was established. A prospective study in 121 patients confirmed that this composite scoring system provides a better identification of high-risk patients than any of the individual parameters[40].

STRATIGIES TO REDUCE PULMONARY COMPLICATIONS

A thorough knowledge of the post operative pulmonary complications and their predictors is essential to develop a strategy for their prevention. A large number of techniques, both pre, intra and post operative have been used to decrease pulmonary complications.

Stringent patient selection remains the cornerstone to prevent adverse outcome. Patients at high risk for developing complications should be optimized before surgery or offered other modalities of treatment.

A vital part of minimizing post operative pulmonary complications is vigorous preoperative pulmonary physiotherapy[10]. Home use of incentive Spiro meter and deep breathing exercises are begun at least 3 weeks preoperatively[10]. This investment of time and energy in improving the patient's preoperative respiratory status is repeatedly rewarded by a lower incidence of pulmonary complications

Total abstinence from cigarette smoking for at least 3 weeks prior to surgery has been shown to improve outcome[11].

A transhiatal oesophagectomy without thoracotomy and a cervical oesophageal anastomosis is applicable in most patients requiring oesophageal reconstruction for both benign and malignant disease. This procedure minimizes the operative insult to the patient by avoiding a

thoracotomy. The incidence of post operative pulmonary complications is thereby reduced[14,15].

Adequate post operative analgesia has been associated with a lower cardiopulmonary complication rate and a lower mortality[41]. Pain aggravates pulmonary complications because it discourages the patient from taking deep inspirations, coughing effectively and cooperating with the chest physiotherapist.

Routine use of a thoracic epidural catheter for analgesia has contributed to significant decrease in morbidity and mortality due to respiratory complications after oesophagectomy. In a study done at Queen Mary Hospital, Hong Kong, the incidence of post operative major pulmonary complications decreased from 14% to 6 % after the routine use of a thoracic epidural catheter for pain relief[42]. This difference is even more significant in patients requiring thoracotomy.

Routine use of fibreoptic bronchoscopy and suctioning for removal of mucous plugs is being used is some intensive care units in an effort to reduce pulmonary complications[22].

Various other methods such as nebulisations, use of steam inhalation and mucolytics have also been used in an effort to reduce pulmonary complications.

TRACHEOSTOMY IN THE INTENSIVE CARE UNIT

Tracheostomy is a surgically created opening in the neck which allows direct access to the trachea, and through which a tracheostomy tube is placed for respiration. Since its first description by Chevalier Jackson in 1909, it has been widely used in modern medicine. It is one of the most commonly performed procedures in the critically ill patients

Open surgical tracheostomy has been practiced for a long time in modern medicine. Sheldon and colleagues first described the method of percutaneous tracheostomy in 1969. However the classic method of percutaneous dilatational tracheostomy was described by Ciaglia and colleagues in 1985[43].

There has been considerable debate in recent literature about the role of a tracheostomy in patients admitted to an intensive care unit. A few salient points are highlighted below.

ADVANTAGES

A tracheostomy gives practical and theoretical advantages compared with conventional orotracheal intubation in ventilated patients.

- It provides a more secure airway
- It avoids laryngeal and vocal cord trauma

- It reduces airway resistance and dead space, thereby reducing the work of breathing
- It allows for easier nursing care
- Oral feeding is possible with a tracheostomy in place.
- It improves patient comfort and is better tolerated than an orotracheal tube.
- Better pulmonary hygiene is possible.

COMPLICATIONS OF TRACHEOSTOMY

Although there are clear advantages of a tracheostomy over orotracheal intubation, a tracheostomy is not without its complications.

The complications associated with a tracheostomy can be classified as immediate, early and late.

IMMEDIATE COMPLICATIONS

These usually occur at the time of the procedure

- Apnea – this usually occurs in people with chronic airway obstruction
- Bleeding – this usually is from the skin and subcutaneous tissue and stops on its own.
- Pneumothorax

- Pneumomediastinum
- Injury to adjacent structures

EARLY COMPLICATIONS

These occur during the first week of tracheostomy

- Bleeding
- Mucus obstruction
- Inflammation of the trachea
- Tube displacement
- Subcutaneous emphysema
- Pulmonary infection

LATE COMPLICATIONS

These occur after 1 week of the tracheostomy

- Bleeding
- Tracheomalacia - usually due to degeneration of the elastic and connective tissue of the trachea
- Tracheoesophageal fistula
- Tracheocutaneous fistula
- Granulation and scarring

- Subglottic stenosis

PERCUTANEOUS VERSUS OPEN TRACHEOSTOMY

Percutaneous dilatational tracheostomy (PDT) is increasingly being used in intensive care units as the procedure of choice for tracheostomy. However, proof of PCT's superiority to standard tracheostomy is contestable. Investigators who endorse PCT as the preferred technique of airway access maintain that PCT is cost-effective, safe, fast, and easy to perform[44]. However, certain PCT steps, such as endotracheal (ET) tube replacement and blind formation of tracheal stoma, can cause serious perioperative complications[45]. In addition, numerous investigators have proposed a learning curve for PCT[46], and increased complications result for patients who are treated by a surgeon who is inexperienced with the procedure or at an institution where the procedure is preformed infrequently.

Open tracheostomy, on the other hand is a well established procedure and can be performed bedside or in the operating room.

Currently both open and percutaneous tracheostomy are being used in most centers. The superiority of one over the other has not been proved, and

further prospective studies with long term follow up are required to establish the same.

TIMING OF TRACHEOSTOMY

The ideal timing of a tracheostomy in critically ill patients has always been a debate, and evidence to guide practice has been limited. In 1989 the National Association of Medical Directors of Respiratory Care recommended that translaryngeal (endotracheal) intubation be used only for patients requiring less than 10 days of artificial ventilation and that a tracheostomy should be placed in patients who still require artificial ventilation 21 days after admission.

However In 2001 they revised their guidelines and recommended that a tracheostomy be considered after an initial period of stabilization on the ventilator, when it becomes apparent that a patient will require prolonged ventilation.

Although these recommendations were based only on expert opinion, modern practice broadly seems to follow them.

Recent evidence indicates that a tracheostomy performed early (ie, within 3 days of intubation) may decrease the risk for pneumonia, the length of mechanical ventilation, and the length of stay in the ICU[47,48,49].

In a study by Lesnik et.al it was shown that tracheostomy during the first 4 days in polytrauma patients resulted in shorter duration of ventilation. The mean duration of ventilation in the tracheostomy group was 6 days when compared to 20.6 days in the no tracheostomy group. There was also reduction ion duration of ICU stay in these patients[50].

In a prospective randomized trial by Rodriguez et.al, polytrauma patients were randomized to early vs. late tracheostomy. Patients who fell in the early tracheostomy group (within 7 days of admission to ICU) had lesser days on a ventilator than the controls (12 days vs. 37 days). Also the duration of ICU stay was significantly shorter in these patients when compared to the controls[51].

A meta-analysis of studies on the timing of tracheostomy in adult patients undergoing artificial ventilation concluded that performing a tracheostomy at an earlier stage than is currently practiced may shorten the duration of artificial ventilation and length of stay in intensive care[52].

They found that an early tracheostomy

- did not significantly alter mortality (relative risk 0.79, 95% confidence interval 0.45 to 1.39).
- The risk of pneumonia was also unaltered by the timing of tracheostomy (0.90, 0.66 to 1.21).

- Early tracheostomy significantly reduced duration of artificial ventilation (weighted mean difference − 8.5 days, 95% confidence interval − 15.3 to 1.7), and
- length of stay in intensive care (− 15.3 days, − 24.6 to − 6.1)
-

From this Meta analysis published in BMJ in 2005 it was also concluded that the timing of tracheostomy did not alter mortality (Relative risk 0.70, 95 % confidence interval 0.45-1.39, and P value 0.42)[52].

However in a study by Rumbac et al. mortality was 50 % lower in the early tracheostomy group when compared to the late tracheostomy group. In this study the tracheostomy was done within 48 hours of ICU admission[53].

Early tracheostomy has not been shown to affect the risk of developing hospital associated pneumonias[53].

From the above it is evident that an early tracheostomy is beneficial in critically ill patients. How early this should be done is a matter of debate. However, the trend is that the earlier the tracheostomy is done, the more are its benefits. Most studies have defined an early tracheostomy as one done within 7 days of translaryngeal intubation. However no test or scoring system is available that predicts the need for prolonged ventilation and hence the decision of tracheostomy is always subjective and clinical

EARLY TRACHEOSTOMY IN OESOPHAGEAL SURGERY

Currently there is no literature available on the role of an early tracheostomy in patients undergoing oesophageal surgery.

METHODOLOGY

This study aimed at assessing the role of an elective tracheostomy in reduction of mortality and morbidity due to pulmonary complications in patients undergoing oesophageal surgery with neck anastomosis.

DESIGN OF STUDY

Case control study with a prospective cohort of cases and a retrospective cohort of controls.

SELECTION CRITERIA

Patients for the study were selected according to a set of inclusion and exclusion criteria. They were as follows:

Inclusion criteria:

All patients undergoing oesophageal resection or bypass with a cervical oesophageal anastomosis.i.e.

- Substernal Colon Bypass for corrosive stricture oesophagus
- Mc Keowns oesophagectomy for benign or malignant oesophageal lesions

- Transhiatal oesophagectomy for oesophageal malignancies or benign oesophageal disease.

Exclusion criteria:

- Patients undergoing laryngectomy.
- Non consenting patients.
- Patients found inoperable at surgery

DURATION OF THE STUDY

The study extended from May 2005 to April 2007 (2 years)

A retrospective cohort of controls was used. Controls were chosen using the same inclusion criteria over a period of May 2002 to April 2005 (3 years)

METHODOLOGY

A review of all patients who confirmed to the inclusion criteria was done for the year 2004. The incidence of pulmonary complications among these patients was found to be 65%. 30% of these patients required prolonged ventilation and hence a tracheostomy. Aspiration pneumonia was the most common pulmonary complication (73 %) and was responsible for 50 % of the hospital deaths.

Based on this data, the sample size was calculated to be 22.

Sample size = 4pq/d^2

Where

p = incidence of pulmonary complications (65%)

q = 1-p (35%)

d = expected difference in outcome (=20%)

After the detailed research plan was laid down, approval was obtained from the Department of Upper Gastrointestinal Surgery unit and the fluid research committee.

All patients fitting into the inclusion criteria were included in the study. Informed consent was taken prior to inclusion in the study. (Appendix 2)

All the include patients underwent an elective open surgical tracheostomy at the end of surgery. They were then transferred to the surgical intensive care unit for further monitoring and ventilation if required. No changes were made in the surgical intensive care protocols for monitoring these patients.

METHOD OF TRACHEOSTOMY

All the patients included in the study underwent an open surgical tracheostomy. This was towards the end of surgery.

The tracheostomy was performed more lateral rather than midline in order to keep normal muscle interposition between the anastomotic site and the tracheostomy.

A portex tube (size 7 or 8) was used, which was anchored in place with 2-0 ethilon sutures.

After the patients were transferred to the ward from the intensive care unit, the portex tracheostomy tube was changed to a metal tracheostomy tube.

A routine nasopharyngolaryngoscopy and lateral X Ray neck were performed prior to decanulation. The tracheostomy was corked for 24 hours prior to decanulation.

DATA COLLECTION

Data from these patients were recorded in the pre designed proforma. (Appendix 1) These patients were followed up till discharge from the hospital. The time taken for decanulation of the tracheostomy was noted. In cases where the patient was discharged before decanulation, they were followed up on an outpatient basis till decanulation.

Data from the controls were collected in the same proforma using both inpatient and outpatient hospital records.

DATA ANALYSIS

Data obtained from the study was tabulated and analyzed with the help of the Department of Community Medicine and Biostatistics and the results are presented in the next section.

DESCRIPTIVE STASTATICS

Number of cases enrolled

There were a total of 56 patients enrolled for the study. These included 14 cases and 42 controls. This included patients undergoing transhiatal or transthoracic oesphagectomy and substernal colon pullthrough. Patients who had undergone similar operations during the last 3 years were included in the control group.

Age distribution of patients

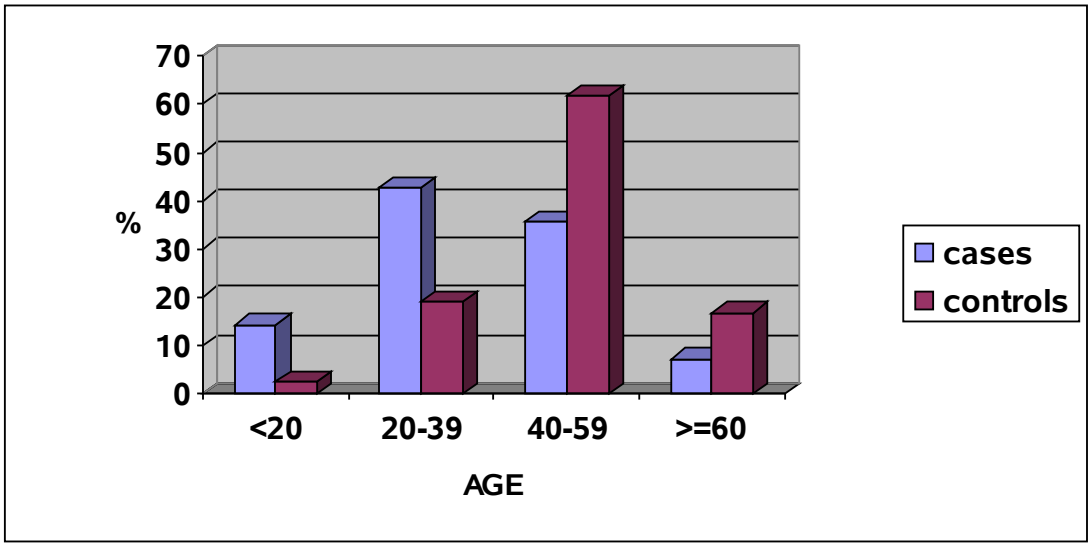

Fig. 1 Age distribution of patients

The distribution of study cases and controls within the different age groups is shown in the chart above.

The cases ranged from 17 to 61 years with a mean of 35.9 years. The controls varied from 19 to 75 years of age with a mean of 47.5 years.

Sex distribution of patients

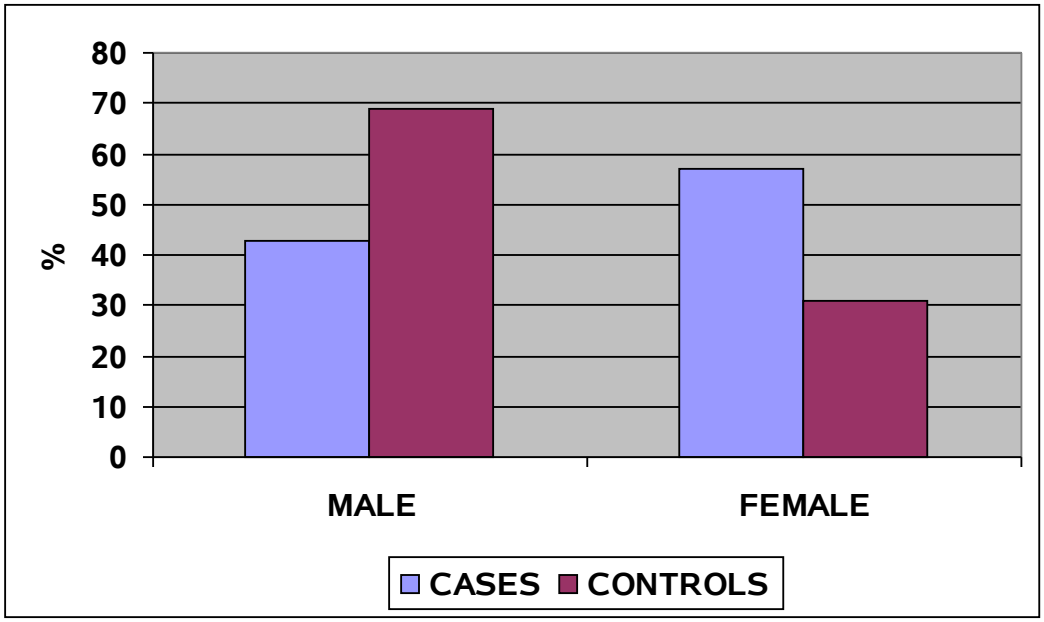

Fig. 2 Sex distribution of patients

The sex distribution among study cases and controls is depicted in the diagram above. There were 6 males and 8 females in the case group and 29 males and 13 females in the control group.

Diagnosis

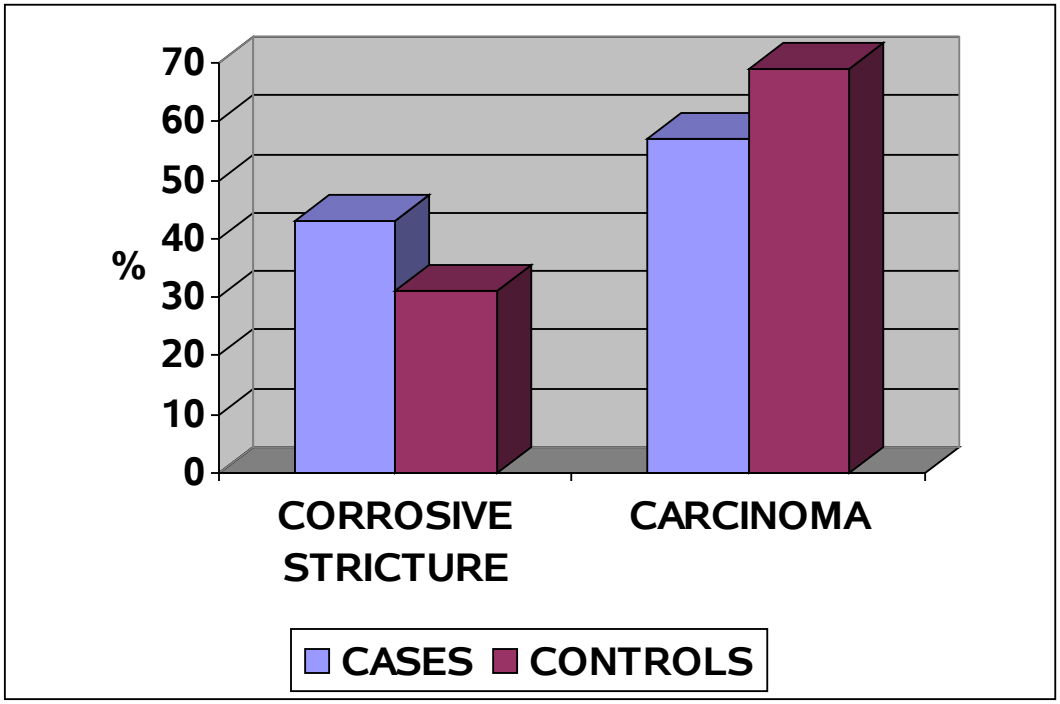

Fig. 3 Diagnosis

Among the cases there were 6 cases of stricture oesophagus secondary to corrosive ingestion and 8 cases of carcinoma oesophagus. Among the controls there were 10 cases of Corrosive stricture oesophagus and 32 cases of carcinoma oesophagus. This is depicted in the diagram above.

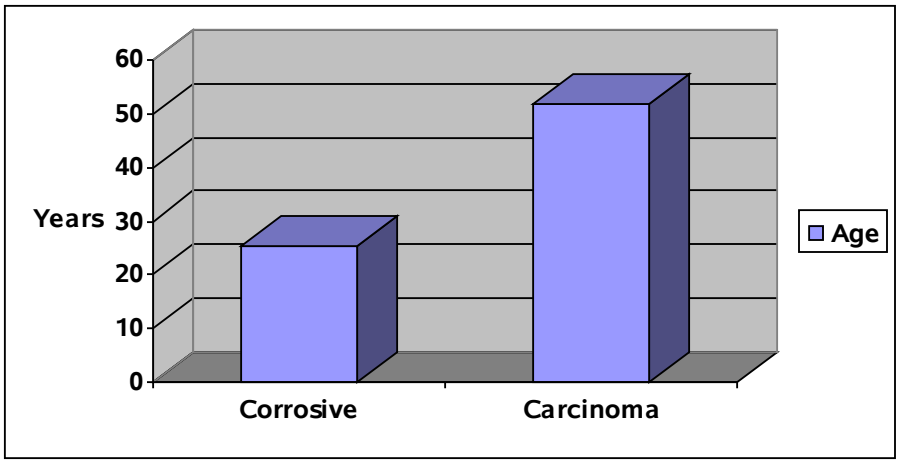

Fig. 4 Age distribution by diagnosis

From the above chart we can see that patients with corrosive induced stricture of the oesophagus were much younger than those with malignant disease.

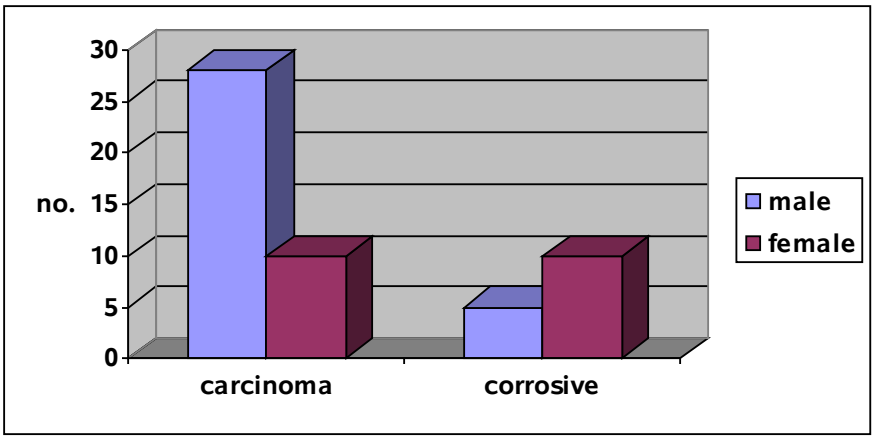

Fig 5 Sex distribution by diagnosis

From the above graph we can see that there were more males with oesophageal carcinoma and more females with corrosive induced stricture of the oesophagus.

Weight

The mean weight among the cases was 44.21 kg (range 33-64 kg), and that among the controls was 50.26 kgs. (Range 30-74 kg).

Laboratory parameters

The haemoglobin, albumin, FEV1 (forced expiratory volume in 1 second) and FVC (forced vital capacity) among the cases and controls were studied.

Haemoglobin

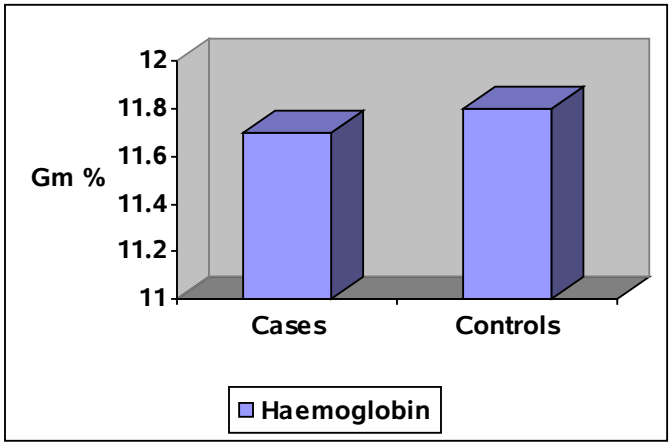

Fig. 6 Mean Haemoglobin.

Mean haemoglobin among the cases was 11.7gm %(range 8.8 to 13.6 gm %) and among controls was 11.8 gm %.(range 7.6 to 16.1 gm %)

Albumin

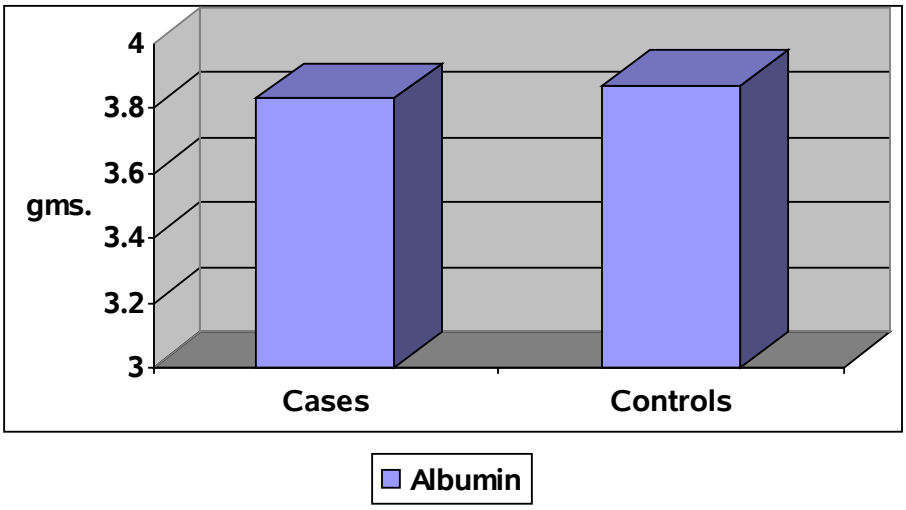

Fig. 7 Mean albumin

Mean albumin among cases was 3.83 gms. (Range 3.1 to 4.6 gms) and among controls was 3.87 (range 2.7 to 4.7 gms.)

FEV1 and FVC

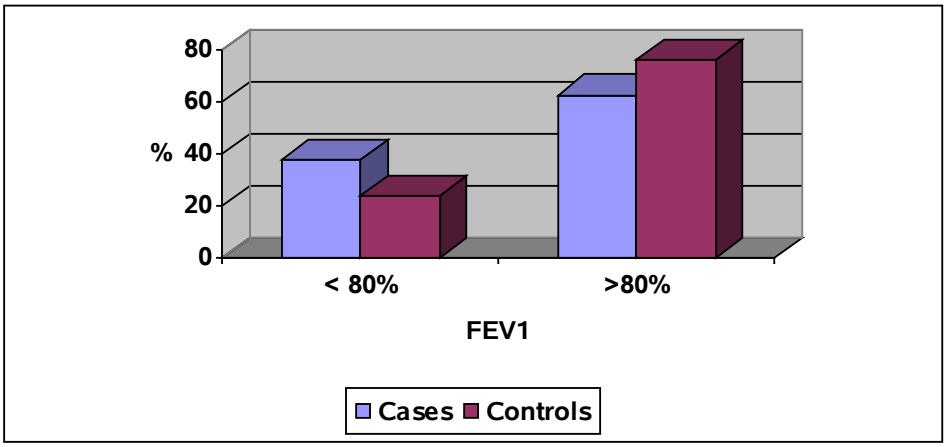

Fig. 8 FEV1 among cases and controls

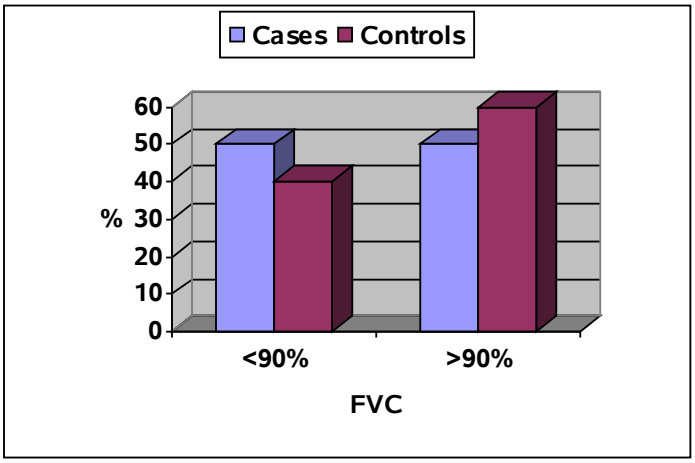

Fig. 9 FVC among cases and controls

Among the cases the FEV1 ranged from 71 % of expected to 110 % of expected. 3 were less than 80% of expected out of the 14 patients. The FVC ranged from 71.7 to 112.8 % of expected. 4 were less than 90 % of expected.

Among the controls the FEV1 ranged from 45.3 to 124 % of expected. 6 were less than 80% of expected. The FVC ranged from 53.6 to 122.2 % of expected and 10 were less than 90% of expected.

OPERATIVE DETAILS

Type of surgery

Patients underwent the following surgeries

Transhiatal oesophagectomy

Transthoracic oesophagectomy

Thorascopic assisted oesophagectomy

Substernal colon bypass.

The no. of patients in each group is depicted below.

	Cases	Controls
Transhiatal	4	21
Transthoracic	4	10
Thorascopic Assisted	2	1
Substernal Bypass	4	10

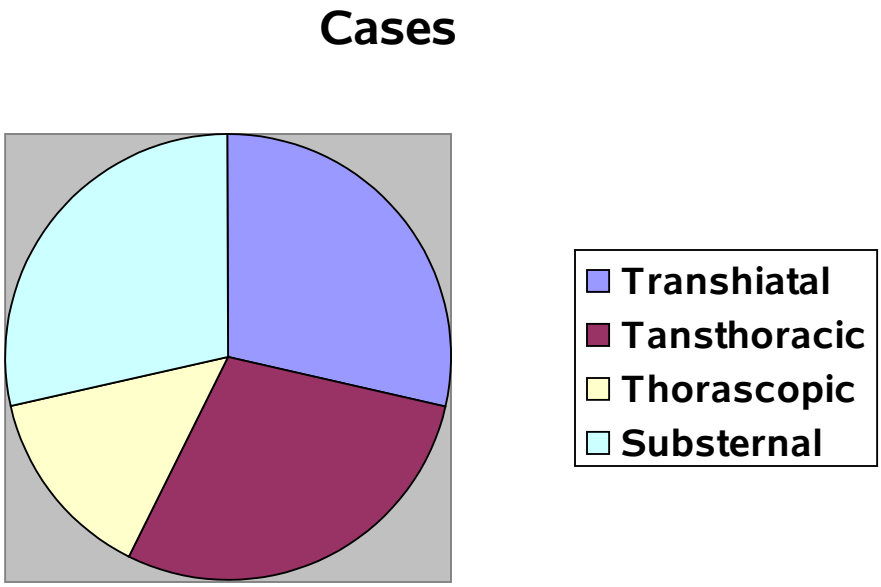

Fig. 10 Distribution of surgery among cases

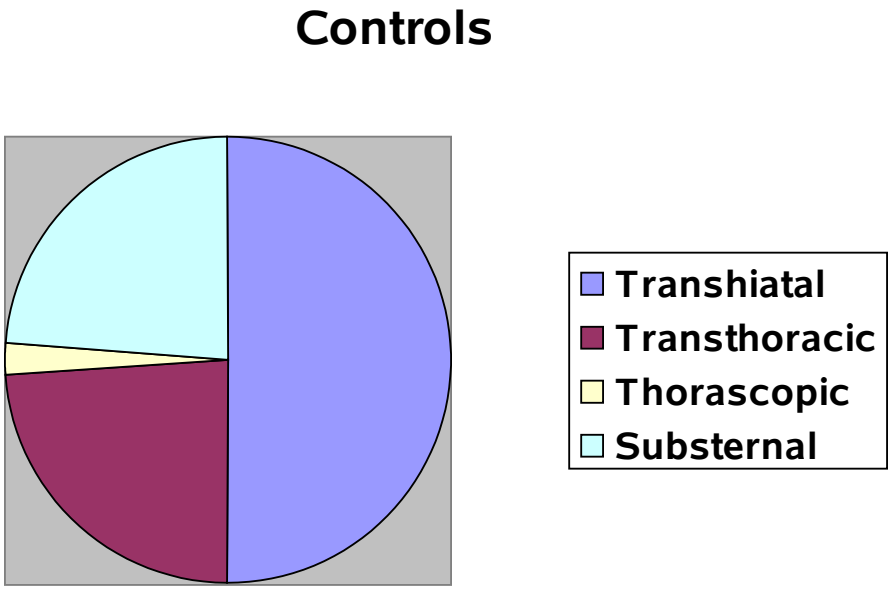

Fig. 11 Distribution of surgery among controls

Duration of surgery and blood loss

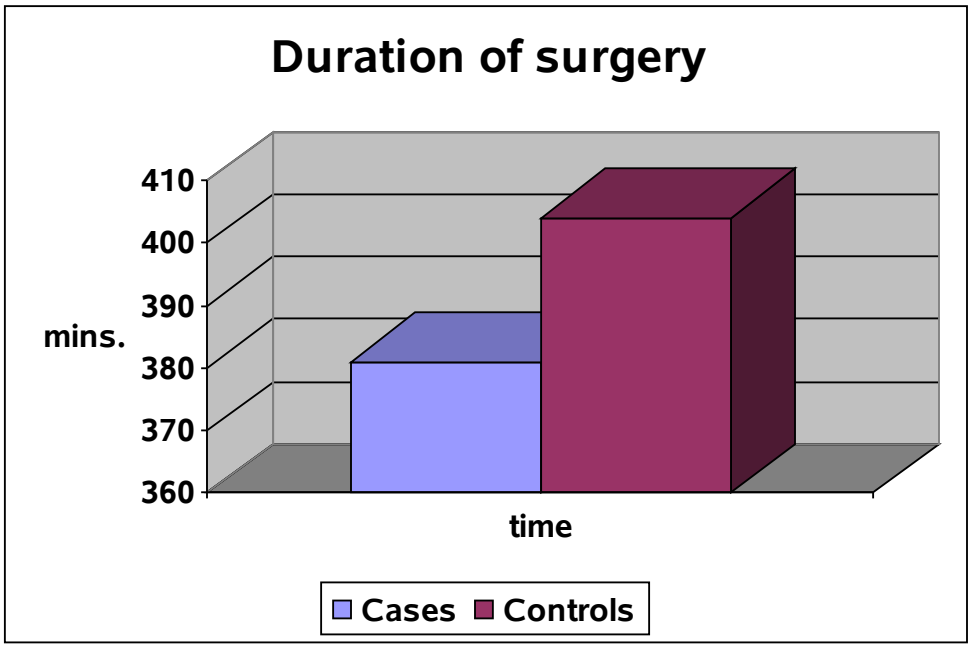

Fig. 12 Duration of surgery

The average duration of surgery among cases was 381 minutes with a range of 300 mins to 480 mins. The average blood loss was 677 ml with a range of 300 to 2000 ml.

Among controls the average duration of surgery was 404 minutes with a range of 330 to 435 minutes. The average blood loss was 978 ml with a range of 300 to 4000 ml.

POST OPERATIVE DETAILS

DURATION OF VENTILATION

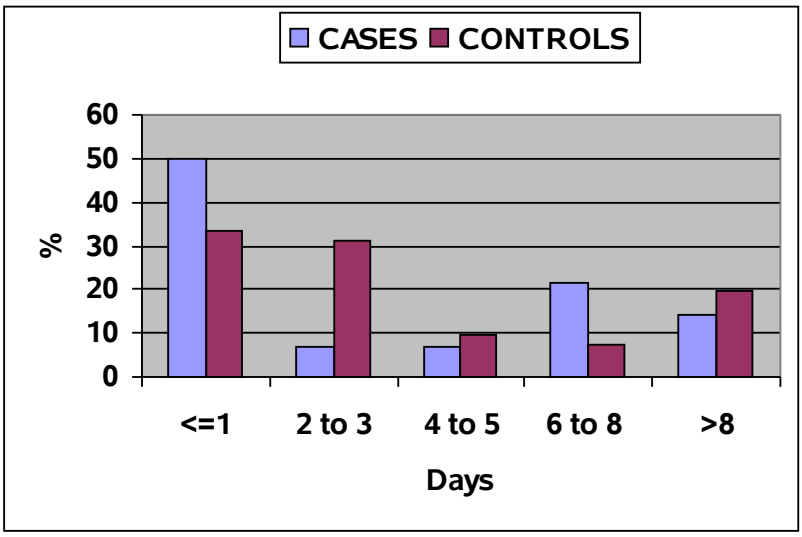

Fig. 13 Duration of ventilation

The duration of ventilation among the study cases and controls is depicted above. From this graph we can observe that among the cases there were a higher proportion of patients who needed ventilation for less than 24 hours, where as among the controls there were a higher proportion of patients who needed ventilation for 2-3 days.

The average duration of ventilation among cases was 4.28 days and among controls was 5.05 days. The median was 2 days for cases and controls.

Thus there was an observed difference of about 0.8 days of ventilation among the cases and controls. However on stastical analysis using the Mann Whitney test this was not found to be stastically significant. (p=0.354)

DURATION OF ICU STAY

The duration of ICU stay among cases and controls is shown in the graph below.

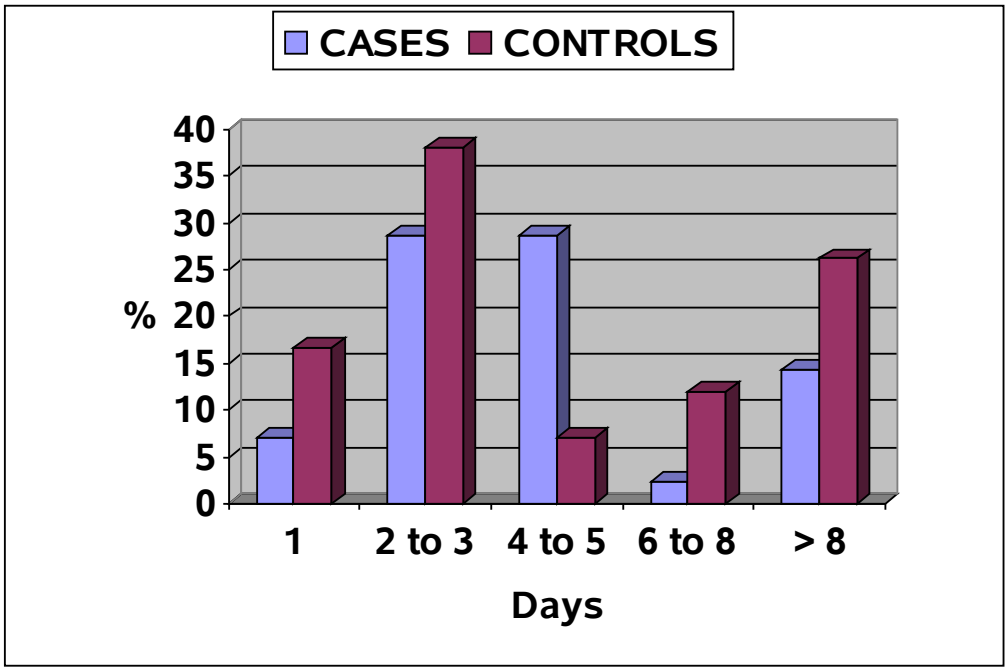

Fig. 14 Duration of ICU stay

From this chart we can make out that among the cases there was a lesser number of patients requiring ICU stay for more than 6 days.

The average duration of ICU stay among cases was 6.14 days and among controls was 6.69 days.

Thus there was a difference of 0.5 days of ICU stay among the cases and controls. This difference was not found to be significant on stastical testing using the Mann Whitney test. (p=0.474)

POST OPERATIVE HOSPITAL STAY

The post operative hospital stay of the patients is depicted in the graph below.

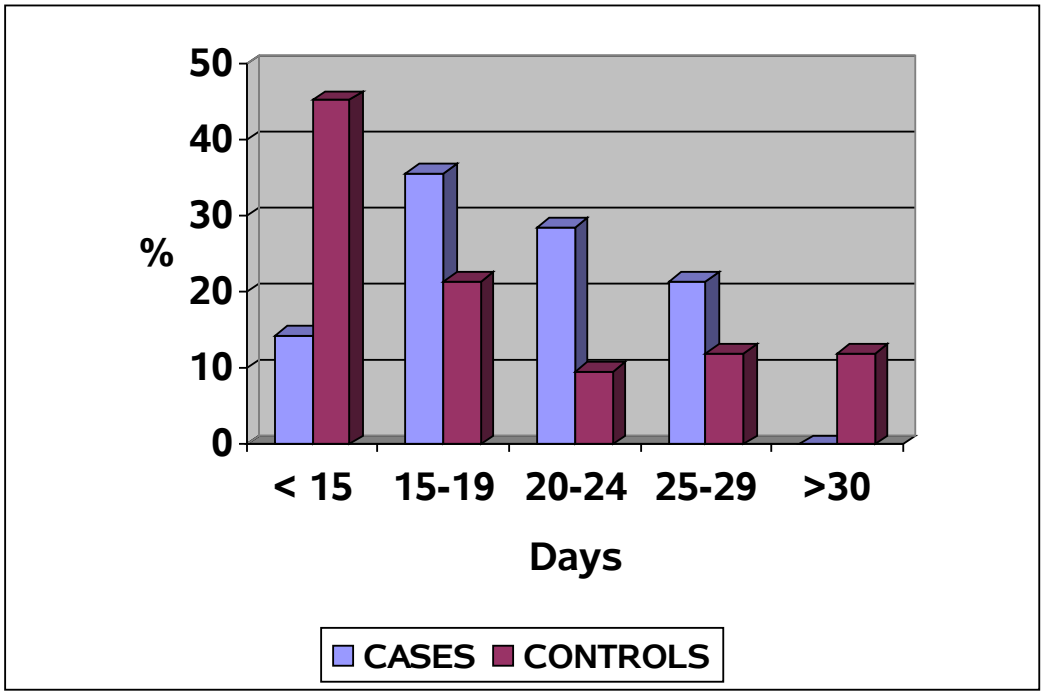

Fig. 15 Duration of Hospital stay

The mean hospital stay for cases was 19.86 (range 13 to 29 days) days and for controls was 19.23 days. (Range 3 to 75 days).

However by looking at the chart above we can see that there were no cases that stayed in the hospital for more than 30 days where as about 10 % of the controls had a hospital stay of more than 30 days.

PULMONARY COMPLICATIONS

The following graph depicts the incidence of pulmonary complications in the case and control arms.

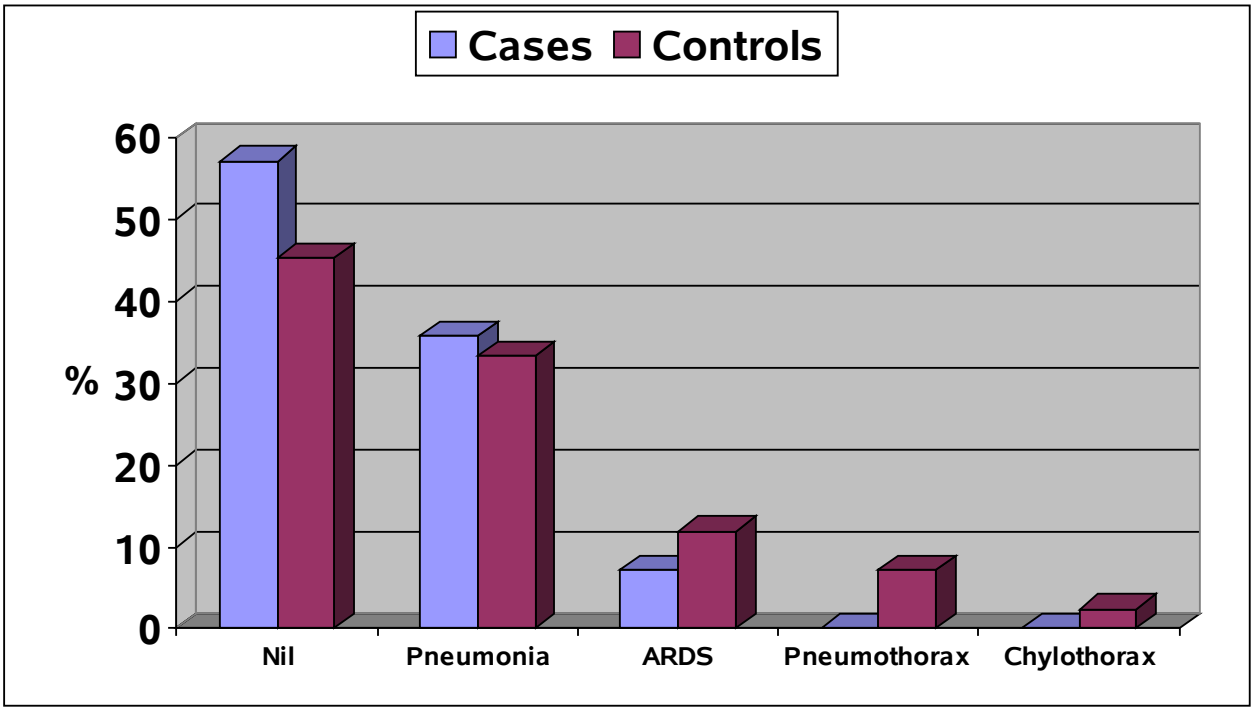

Fig. 16 Pulmonary complications

43 % of the cases had pulmonary complications when compared to 55 % of the controls.

From this we can see that there were a greater proportion of controls cases who had pulmonary complications. Also we see that there was a decrease in ARDS in the case group when compared to the control arm.

This difference also was however, not stastically significant on analysis.

ARDS

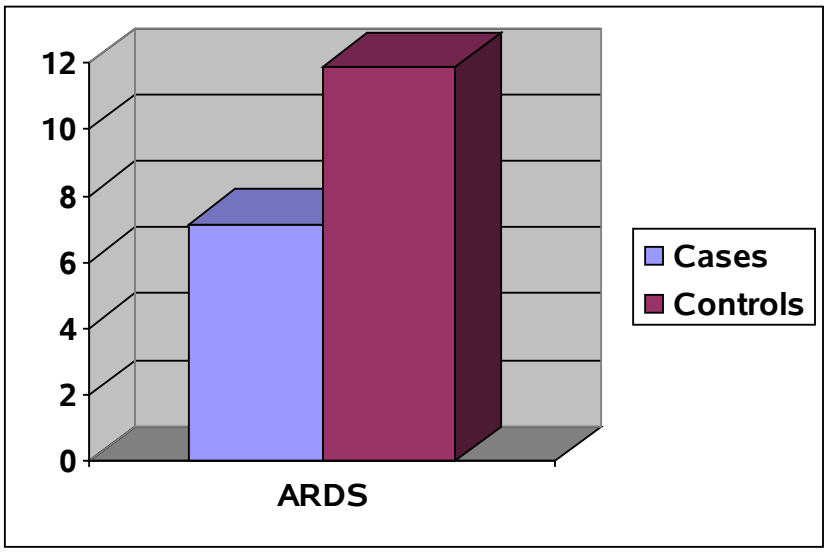

Fig. 17 ARDS in cases and controls

From the graph above we can see that the incidence of ARDS among the cases was considerably less than the controls. This observed difference, however was not stastically significant (p=0.26), though there is a strong trend towards decrease incidence of ARDS.

DEATH

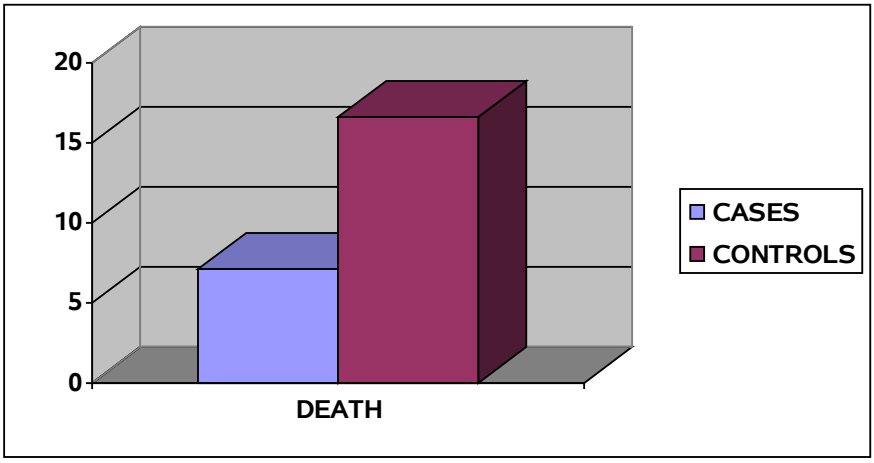

Fig. 18 Death among cases and controls

Among the cases there was 1 death (7.14%) and among the controls there were 7 deaths (16.66 %)

The cause of death among the cases and controls is depicted in the table below.

	Cases	Controls
ARDS	1	5
Aspiration Pneumonia	0	2

This observed difference of about 9 % seen in the death rate was analyzed using the Chi Square test. This difference was not found to be significant. (p=0.382)

TRACHEOSTOMY

All cases underwent an elective tracheostomy.

Among the controls 8 patients (19%) required an emergency tracheostomy. The indication of this was prolonged ventilatory support due to ARDS or aspiration pneumonia.

Among these 8 patients, there were 4 deaths (50%).

During the course of the study there were no complications noted due to the tracheostomy.

Decanulation

All patients were changed to a metal tracheostomy tube in the ward and then subsequently decanulated.

The average time for change to a metal tube was 7 days (range 6-14 days).

Mean time to decanulation was 14 days (range 10 – 21 days). All patients were successfully decanulated.

DISCUSSION

Pulmonary complications are the most common complications that develop after oesophageal surgery, and are the major cause of morbidity and mortality.

Various methods have been tried to reduce pulmonary complications. A rigid patient selection criterion with inclusion of patients with good performance status only, has long been used. Various scoring systems have also been used extensively to identify patients at a higher risk of complications.

In this study we used an elective tracheostomy as a tool to reduce pulmonary complications and mortality. These patients were compared to a retrospective cohort of patients who underwent a similar procedure without tracheostomy, over the last 3 years.

The end points used to compare outcomes were

- Duration of ventilation
- Duration of ICU stay
- Duration of post operative hospital stay
- Development of pulmonary complications
- Death

- Complications due to tracheostomy per se

It was found that the duration of ventilation was 0.8 days less in patients on a tracheostomy than those without. Though this difference was not stastically significant, on close observation of the data we notice that there is a trend that patients who had tracheostomy spent less time on a ventilator than those without.

Duration of ICU stay was also found to be about 0.5 days shorter in those with tracheostomy than those without. Although this was also not statistically significant, again there was a strong trend that patients with a tracheostomy spent less time in the ICU than those without.

Duration of post operative stay was found to be equal in both the groups. However on close analysis, we notice that in the tracheostomy group no patient spent more than 30 days in hospital, where as in the non tracheostomy group, a significant number of patients had a hospital stay of more than 30 days.

The significance of these findings cannot be commented on this study due to the small sample size; however a larger study may answer this question.

The development of pulmonary complications was less in the tracheostomy group when compared to the control. This translates into lesser morbidity and mortality.

Death rate in the tracheostomy group was 50 % of that of the non tracheostomy group. Although this was also statistically not significant, this trend needs to be kept in mind. A larger study is needed to conclusively assess the effect of tracheostomy on morbidity and mortality in patients undergoing oesophageal surgery.

No complications were noted in this study secondary to the tracheostomy.

All patients were successfully decanulated after change to a metal tube.

LIMITATIONS

The major limitation of this study was its sample size.

As this study was limited to 2 years, the sample size attained was very small.

A larger sample size would have given a better picture of the true impact of tracheostomy on pulmonary complications.

Also, the controls that were used were retrospective, and hence could not be matched to the cases for many confounding factors.

As the factors which affect outcome in oesophageal surgery are numerous, randomization would have been ideal for this study.

CONCLUSION

Prevention of pulmonary complications is the cornerstone to reduction of morbidity and mortality in oesophageal surgery.

This study reveals that if tracheostomy is done at the time of primary operation, there is a trend that the patients are weaned off the ventilator earlier and a shorter ICU stay. Also there is a trend that these patients are discharged earlier from hospital.

Although these differences did not reach stastical significance, there was a definite trend in the reduction of morbidity and mortality. This has clinical implications, especially with regard to ARDS and aspiration pneumonia. The small sample size and the absence of randomization in this study need to be kept in mind.

It has also been shown that a tracheostomy by itself is associated with minimal morbidity and is tolerated well by the patient.

With the above findings in mind, there is a strong case for a prospective randomized case control trial for evaluating elective tracheostomy as a strategy to reduce morbidity and mortality in patients undergoing oesophageal surgery.

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APPENDIX 1

CARCINOMA OESOPHAGUS STUDY PROFORMA

Name : Hospital number :

Age : Sex: Male / Female

Address:

Date of admission :
Date of discharge :
No. of hospital days:

HISTORY

Dysphagia yes / no duration _____ solids / liquids / both

Weight loss yes / no _____ kg.
Loss of Appetite yes / no
Cough while eating yes / no
Voice change yes / no
Back pain yes / no

Smoking yes / no _____ pack years
Alcoholism yes / no _____ years
Tobacco yes / no _____ years

Diabetes yes / no
Hypertension yes / no
IHD yes / no
COPD / asthma yes / no

Any other significant history :

EXAMINATON

Height _____ cm
Weight _____ kg.

Lymph node enlargement : none / left or right supraclavicular / cervical
Abdominal findings : _____
Digital Rectal Examination : _____
Other Significant findings :

INVESTIGATIONS

Hb / PCV :
TC :
DC :
Creatnine :
LFT :
PT :
APTT :

CXR : normal / abnormal _____
PFT : FVC
FEV1
PEFR
DLCO
Final Impression

ABG :

ECG Normal / Abnormal _____
ECHO Normal / Abnormal _____
EF :
TMT :

Upper GI Endoscopy : UES :
Tumour Location :
Lumen occluded : third / two third / circumferential
Ulcerative / proliferative / infiltrative / Polypoidal
Negotiable / Non negotiable
GE Junction at :
Associated lesions :

Endoscopic biopsy : well / moderately / poorly differentiated
adeno / squamous cell carcinoma

Bronchoscopy : Not Done / Normal / Abnormal _____
Bronchial washings : Positive / negative

Barium Swallow :
USG abdomen : Normal / Abnormal _____
CT scan Thorax / Abdomen :

PRE OPERATIVE CHEMO / RADIOTHERAPY

Pre Operative Chemotherapy : Yes / No
No. Of Cycles _____
Drugs Used :

Pre Operative Radiotherapy : Yes / No
_____ Gray
From _____ to _____

OPERATIVE DETAILS

Date of Surgery :
Type of Surgery : Ivor Lewis / Mc Keowns / Transhiatal / others

Duration Of Surgery :
Blood Loss :
Total Fluid transfused :Colloid :
Crystalloid :
Blood :

Use Of Double lumen tube : Yes / No
Duration of one lung ventilation :

Use Of Epidural : Yes / No
:Level Of Epidural :

Intraoperative Hypotension : Yes / No Duration : _____
Intraoperative Hypoxia : Yes /No Duration : _____
Need for Ionotropic support : Yes / No _____

Surgical Findings :

Replacement Organ : stomach / colon / small bowel
Route : Posterior Mediastinum / Substernal / Subcutaneous
Anastomosis Level : Neck / Chest
Anastomosis Done with _____ using _____ Layers.

Elective Tacheostomy : Yes / No.

ICU STAY

Duration Of Ventilation :
Duration of ICU stay :

Reintubation : Yes / No
: Cause _____
Readmission to ICU : Yes / NO
: Cause _____
Post Operative Tracheostomy : Yes / No
: Cause _____
Done On Day _____

POST OPERATIVE COMPLICATIONS

Pneumonia : aspiration / VAP / _____
Pleural Effussion :
ARDS :
Other Pulmonary Complications :

Arrythmias :_____

Wound Infection / Dehiscence.

Anastomotic Leak :

Vocal Cord palsy :

Reoperation :
Details :

Other Complications :

Final Biopsy Report : pT ___ N _____ M _____
Well / moderately / poorly differentiated
Adeno / sauamous cell carcinoma
Margins : Proximal free/ involved
Distal Free / involved
Visceral Free /Involved
Nodes Thoracic Positive / Negative _____
Abdominal Positive / Negative _____

Post Operative Contrast study : Done On _____
: Leak Present / Absent

FOLLOW UP

Details of Chemo / RT and Follow UP

TRACHEOSTOMY

Changed to metal tube on _____ post op day
Decanulated on _____ post op day
Complications related to the tracheostomy

APPENDIX 2

INFORMED CONSENT FORM

PATIENT INFORMATION

Mr. /Mrs. :

S/D/W/H of:

Has been diagnosed to have :

And has been planned for an oesophageal resection/bypass.

In addition to the routine surgery a tracheostomy will be done at the end of surgery for the patient.
All other aspects of treatment will not differ from what is routinely followed.
A Tracheostomy helps in better airway management in the post operative period.
However its exact role is not known.
Complications of the tracheostomy are rare and include hemorrhage and accidental decanullation.
If you are willing for this, you will be enrolled in this study, provided you meet the inclusion criteria.

CONSENT FORM

I understand that my participation in the study is completely voluntary.
I understand that a tracheostomy will be done at the time of surgery.
I understand that if I need any further information regarding the rights as a participant in the study, I may contact the doctor concerned, at the hospital, at any time.
I have been given an opportunity to ask questions and I have had them answered to my satisfaction.
I have read and understood the consent form.
I agree to participate in the study.

_____ _____

PATIENTS NAME AND SIGNATURE DATE

_____

WITNESS
(NAME AND SIGNATURE)

MASTER DATA VARIABLE DESCRIPTION

Sex	1-male 2-female
Diagnosis	1-carcinoma 2-corrosive stricture 3-others
Smoking	0-nil 1-yes
Alcohol	0-nil 1-yes
Diabetes	0-nil 1-yes
Hypertension	0-nil 1-yes
Chemo/RT	0-nil 1-yes
Type of Surgery	1-Transhiatal 2-Transthoracic 3-Thorascopic assisted 4-Substernal colon pullthrough
Epidural	0-nil 1-yes

One lung ventilation	0-nil 1-yes
Tracheostomy	0-nil 1-yes 2-delayed
Pulmonary complications	0-Nil 1-Pneumonia 2-ARDS 3-Pneumothorax 4-Pleural Effusion 5-Chylothorax
Leak	0-nil 1-yes
Death	0-nil 1-yes
Conduit used	1-Stomach 2-colon