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Original Research Article

Minimal access esophagectomy: Review of technique

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Abstract

Minimal access esophagectomy reduces the post-operative morbidity associated with open procedure. We presented our technique which includes using double lung ventilation and a capnothorax to collapse the lung and using an adopted prone position for thoracoscopic mobilization.

Key words

Esophagectomy, Thoracoscopy, Laparoscopy.

Introduction

Esophagectomy is the surgical treatment for resectable esophageal carcinoma [1, 8]. There is a significant morbidity and mortality [1, 8]. It may be done with a thoracotomy and a laparotomy with an intra thoracic anastomosis; two stage esophagectomy. In three stage procedure the anastomosis is performed in the neck [1].

Thoracotomy contributes significantly to the morbidity. It may lead to many respiratory complications. To minimize this transhiatal blunt esophagectomy was introduced by Orringer; the esophagus being mobilized through the hiatus without vision. Even though thoracotomy is taken away there is a risk of hemorrhage and the resection may be inadequate and will not allow any lymph node clearance [1, 8]. Minimal access esophagectomy allows the procedure to be done without thoracotomy and laparotomy [1, 2, 3, 4, 5, 6, 7, 8]. The surgical and anesthetic techniques used at our institution are reviewed in this article.

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Material and methods

Patients with resectable carcinoma esophagus were treated with minimal access esophagectomy. A three stage procedure by thoracoscopy, laparoscopy and a neck incision, was done in a majority. In few with tumors close to gastro-esophageal junction, laparoscopy and transhiatal mobilization of esophagus under visual guidance of camera was performed.

All patients planned for surgery were assessed for fitness in the anesthetic clinic. They were done under general anesthesia and endotracheal intubation.

Thoracoscopy

The ipsilateral lung was collapsed to obtain space for dissection. This was done by using a double lumen tube and isolated ventilation of the opposite lung at the beginning of the series. Later all were performed while ventilating both lungs with a lung collapse by using a capnothorax at a pressure of 6-8 mmHg.

The collapsed lung was allowed to fall away from the posterior mediastinum by positioning the patient in an adopted prone position; patient was placed semi prone and a near prone position was obtained by tilting the table. Monitor was placed on the left side and surgical team positioned right side.

Three ports were used

- 10 mm camera port - 7th inter costal space, below the inferior angle of the scapula in the posterior axillary line
- 10 mm right hand working port - 5th inter costal space, mid axillary line
- 5 mm left hand working port - 9th inter costal space, mid axillary line

A 30 degree camera was used. The Azygous vein was initially identified, a useful land mark to identify the anatomy of right hemithorax. Mobilization of the esophagus was performed using ultrasound dissector with bipolar diathermy assisting dissection. Use of bipolar augments hemostais and allowed less use of ultrasonic dissector. Sucker was used occasionally for blunt dissection. The Azygous vein was ligated and divided and clips used to reinforce. Dissection enabled clear identification of the trachea and its bifurcation. The lymph nodes visualized were harvested en-block. After complete mobilization, inter costal drain was placed and the lung expansion was confirmed visually with the camera.

The patient was positioned supine and the monitor on the left side at head end. Surgeon stands in between the abducted legs. A pneumoperitoneum of 14 mmHg was created by verres needle technique using CO_2.

Five ports were used.

- Camera port – 10 mm; 1 cm above and to the left of mid line
- Epigastric port – 5 mm; entry to the left of faciform ligament
- Left hand working – 5 mm; in between camera and epigastric ports just to right of midline
- Right hand working – 10 mm; mid clavicular at the level of camera port. A 10 to 5 mm reducer was used for 5mm instruments and used at 10 mm for clip applicator.
- Retraction port – 5 mm; anterior axillary, parallel to left hand working port

The head end was elevated by about 30 degrees and tilted towards the right side. The left lobe of the liver was retracted with a fan retractor, fundus pulled back with the retraction port and

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hiatal dissection performed using bipolar diathermy and ultrasonic dissector. The chest is not entered at this stage as it will cause a loss of pneumothorax. The left gastric artery and vein were dissected in some. When the vessels don't stand out well complete dissection was done later. Bipolar diathermy was used on the left gastric vessels which facilitate standard clips to be applied. Subsequent division was done by scissor. The stomach was held up with a babcock forceps via the epigastric port and division of gastro-colic and gastro-splenic ligaments were performed. The right gastro-epiploic vessels were identified and preserved whilst the short gastric are divided. The gastro-colic was divided with ultrasonic dissector and bipolar diathermy and ultra-sonic dissector were used for the short gastric vessels. Once the stomach was fully mobilized dissection was carried out through the diaphragmatic hiatus. The left crus of the diaphragm were partially divided with ultra-sonic dissector.

Transhiatal oesophagectomy

The mobilization of the stomach was performed laparoscopically. The left diaphragmatic crus was partly divided and the mobilization of the esophagus was carried out in the chest through the hiatus. Fan retractor through the epigastric port and a probe through the retraction port were pushed in through the hiatus to obtain space. The insufflated CO_2 also helped to create space to allow the telescope and the dissecting instruments to be pushed in gradually in to the chest. Bipolar diathermy and blunt dissection with the sucker were the main way of dissection. Scissor was used to divide thick tissue following bipolar quatery.

The cervical esophagus was mobilized by open access from left side of neck. Early in the series, patients who had thoraco-laparoscopic mobilization, the stomach was pulled up to the neck incision. The esophagus was divided at the neck and at the gasto-esophageal junction for removal of the specimen. A single layer interrupted anastomosis was performed. However, some patients developed gastric dilatation with persistently high naso-gastric aspiration that necessitated a change of technique. The cervical esophagus was transected and a naso-gastric tube tied to the distal esophagus. A mini-laparotomy was performed for delivery of the mobilized stomach and esophagus. The esophagus was divided at the gastro-esophageal junction and a gastric tube constructed after excision of the lesser curve. A pyloromyotomy was performed. The gastric tube was pulled in to the neck to complete the esophago-gastric anastomosis. A feeding jejunostomy was sited early in the series. Drains were not placed in the abdomen and neck.

The following parameters were monitored during surgery.

- Pulse rate, blood pressure, central venous pressure
- Oxygen saturation
- Urine out put
- Fluid balance
- Body temperature
- Irrigation fluid used
- CO_2 volumes used

The pressure within the chest and abdomen has detrimental effects on ventilation and cardiac output which is compounded by the lung collapse during thoracoscopy. There is an increased load of CO_2.The ventilatory management were adjusted to keep safe oxygenation and to increased co_2 load. The central venous pressure was noted to rise by about 5cm H_2O with introduction of pneumothorax or pneumoperitoneum. This was taken in to consideration in the fluid management. All patients were extubated and transferred to the intensive care unit.

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Results

Total 30 patients were operated out of which 26 thoraco-laparoscopic and 4 transhiatal. Per operative data were as per **Table – 1**. The respiratory and cardio-vascular parameters were stable. There was a drop of temperature by 0.5-0.7 ˚C.

Post-operative outcome were as per **Table – 2**.There were anastomotic leaks in three patients. Two settled with conservative management by nil by mouth and naso-gastric feeding. The other patient developed a pneumonia required re-intubation and died on the 21st post-operative day. The oxygen dependency was less in the patients who underwent transhiatal esophagectomy; they had better respiratory efforts, had less X-ray changes in the chest, when compared to thoracoscopy group. Another patient in the thoracoscopy group developed a pneumonia required re-intubation and died on the 18th day.

Histopathology results

All had clear resection margins. The lymph node harvest ranged from 12 to 16 in thoracoscopic and transhiatal groups.

Discussion

Thoraco-laparoscopic oesophagectomy allows oesophagectomy through minimal incisions in the chest and abdomen. The post-operative pain and the requirement for strong analgesics is less allowing early mobilization [1, 2, 3, 4, 5, 6, 7, 8].

Other observed advantages were clear vision provided by a magnified view allowing a precise dissection. There is minimal exposure of body cavities to exterior, absence of strong retraction of incisions and less handling of other viscera. This too adds to less pain and ileus. The temperature drops were not significant in spite of prolonged operating time, use of co_2 and irrigation fluid. The temperature drop was less compared to open procedures, probably due to less exposure of body cavities.

The blood losses were minimal. Combination of ultra-sonic dissector and bipolar diathermy allowed a dissection with good hemostasis. The vessels which required suture ligation and/ or were azygous vein and left gastric pedicle. All other vessels were controlled with bipolar diathermy and ultra-sonic dissector.

Mobilization of the thoracic esophagus is less challenging than laparoscopic mobilization of stomach. This is because esophagus has no major vascular supply to control and the anatomical relationships are more or less in one plane without any major attachments to surrounding viscera. At the early phase of the learning curve, unless assisted by a surgeon who is experienced, it may be advisable to perform the thoracoscopy and mobilize the stomach by laparotomy. This hybrid procedure will help to reduce operating time and esophageal mobilization can be completed by transhiatal blunt dissection at laparotomy [9]. To embark on video assisted transhiatal oesophagectomy one has to be competent in laparoscopic mobilization of the stomach. In addition to work in close space through the hiatus is challenging.

With experience operating times can be well compared to open surgery. Lack of opening and closing times is an advantage. Transhiatal procedure has the advantage of working only in the supine position saving the time spent for position changing in the thoraco-laparoscopic procedure.

Usually thoracoscopic procedures are done with a lung collapse using a double lumen tube or a bronchial blocker. For ideal setting a flexible

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bronchoscope is required. There is a documented failure rate and complications. We have successfully performed the surgery ventilating with a single lumen tube. The lung collapse was achieved by creating a capnothorax. The lung collapse was satisfactory [3, 10, 11]. We have studied the safe and effective pressure for a wide range of thoracoscopic procedures and found to be 6-8 mmHg [12].

The favored position for posterior mediastinal procedures is prone. This allows the collapsed lung to fall away from the field of dissection [1, 4, 5, 6, 7]. Positioning prone takes time and has noted complications [13]. If conversion to thoracotomy is required, as in face of hemorrhage, changing to lateral position will take time. We evaluated the adopted prone position described in the method. This position is easy to achieve devoid of main complications of a full prone position and easy change to lateral position is possible by tilting the table. The adopted prone position allowed the collapsed lung to fall away adequately [3, 14, 15].

In the patients undergoing thoracoscopic mobilization there were more respiratory complications than the transhiatal mobilization, well explained by not having any degree of lung collapse in the latter. The hospital stay was not reduced explained by various reasons; even though incision size is small the complexity of the dissection necessitates time for recovery. Most of the patients being nutritionally depleted prior to surgery also delays recovery [3].

Pathological clearance with clear resection margins was obtained. The lymph node harvest was comparable in thoracoscopic and transhiatal approaches, which ranged from 12 to 16. This is less compared to series published on extended lymphadenectomy, which harvest about 30 nodes [1].

Conclusion

A step wise progression through thoracoscopy and laparotomy to thoraco-laparoscopy facilitates overcoming a new learning curve. Using an adopted prone position by placing the patient semi-prone and a table tilt was equally effective to full prone position. Effective lung collapse was obtained by double lung ventilation and a capnothorax of 6-8 mmHg. Laparoscopic transhiatal mobilization allowed a shorter operating time and the post-operative morbidity was less than in the thoracoscopy group. A joint anesthetic and surgical effort helped safe completion and recovery of the patients.

References

1. Joris J G Scheepers, Donald L van der Peet, Alexander A F A Veenhof, Miguel A Cuesta. Thoracoscopic resection for esophageal cancer: A review of literature. J Minim Access Surg., 2007; 3(4): 149–160.
2. Shi-ping Luh, Hui-ping Liu. Video-assisted thoracic surgery—the past, present status and the future. J Zhejiang Univ Sci B., 2006; 7(2): 118–128.
3. Galketiya KB, PintoV, SM Bandara. Thoracoscopy: Beyond the key hole. The Sri lankan Journal of Surgery, 2014; 32(1): 29-34.
4. Dapri G, Himpens J, Cadière GB. Robot-assisted thoracoscopic esophagectomy with the patient in the prone position. J Laparoendosc Adv Surg Tech A., 2006; 16(3): 278-85.
5. Nguyen NT, Roberts P, Follette DM, Rivers R, Wolfe BM. Thoracoscopic and laparoscopic esophagectomy for benign

ISSN: 2394-0026 (P)
ISSN: 2394-0034 (O)

and malignant disease: lessons learned from 46 consecutive procedures. J Am Coll Surg, 2003; 197: 902-13.
6. Collard JM. Role of video assisted surgery in the treatment of oesophageal cancer. Ann Chir Gynaecol, 1995; 84: 209-14.
7. McAnena OJ, Rogers L, William NS. Right thoracoscopically assisted oesophagectomy for cancer. Br J Surg, 1994; 81: 236-8.
8. Palanivelu C. Minimally invasive surgery in oesophageal carcinoma-current concepts. Art of laparoscopic surgery, Jaypee, 2007; p. 393.
9. Galketiya KB, Edirimuni SS, Muthumala Minimal access oesophagectomy; thoracoscopy or thoraco-laparoscopy. Annual academic sessions college of surgeons of Sri Lanka, 2007.
10. Pinto V, Perera R, Galketiya KB, Jayasooriya U, Wickramasinghe WAAP. "Tension under tension"-our experience in the use of single lung Vs both lung ventilation in thoracoscopic major surgery. Annual academic sessions of The College of Anaesthesiologists of Sri Lanka, 2013.
11. V Pinto, Perera R, Galketiya KB. Thoracoscopic sympathectomy, can it be performed safely while ventilating both lungs. Annual academic sessions college of surgeons of Sri Lanka, 2012.
12. V Pinto, K Galketiya. Insufflation pressure required for thoracoscopic surgery and its influence on respiratory and cardiovascular parameters. Sri Lankan journal of anaesthesiology, 2014; 22(2): 55-58.
13. Edgcombe H, Carter K, Yarrow S. Anaesthesia in the prone position Br. J. Anaesth., 2008; 100(2): 165-183.
14. Galketiya KB, Wickramanayake AB. Minimal access to the mediastinum; assessment of camera port placement and patient positioning. Galle medical Journal, 2009; 14: 107.
15. Galketiya KB, Pinto V, Perera R. Thoracoscopic oesophagectomy - Is semi prone position acceptable. Annual academic sessions college of surgeons of Sri Lanka, 2012.

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Table – 1: Per-operative data.

	Position	SLV	DLV	Ports	Time (min) Range	Time (mean)	Blood Loss (ml)	conversions
Thoracoscopy 26 patients	Semi-prone	5	19	3	120-180	150	100-150	Nil

	Position	Ports	Time (min) Range	Time (mean)	Blood Loss (ml)	conversions
Laparoscopy 30 patients	Supine	5	100-210	120	50-100	Nil

	Position	SLV	DLV	Ports	Time (min) Range	Time (mean)	Blood Loss (ml)	conversions
Transhiatal 4 patients	Supine	Nil	4	5	45-90	60	50-70	Nil

(SLV = Single lung ventilation, DLV = Double lung ventilation)

Table – 2: Post-operative out come.

ICU stay (days)	Narcotic Analgesic (days)	Mobilization out of bed (days)	Feeding (days)	Removal of IC tube (days)	Morbidity	Mortality	Discharge (days)
1-21	1-2	1-2	5-6	2-4	See below	2	10-16

(ICU = Intensive care unit, Days = Post operative day, IC = Inter costal)