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Gastrointestinal Cancer

Minimally Invasive Esophagectomy in Semi-Prone Position (Pawar Technique): Technical Aspects and Outcome in 224 Patients

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Abstract

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Background and Objectives There are two patient positions described for minimally invasive esophagectomy (MIE) for esophageal cancer, viz., left lateral and prone positions. To retain the benefits and overcome the disadvantages of these positions, a semi-prone position was developed by us. Our objective was to analyze the feasibility of performing MIE in this position.

Materials and Methods A retrospective review of patients who underwent MIE at our center from January 2007 to December 2017 was done. A semi-prone position is a left lateral position with an anterior inclination of 45 degrees. Intraoperative parameters including conversion rate, immediate postoperative outcomes, and long-term oncological outcomes were analyzed.

Statistical Analysis Statistical Package for the Social Sciences version 19 (IBM SPSS, IBM Corp., Armonk, New York, United States) was utilized for analysis. Survival analysis was done using Kaplan-Meier graph. Quantitative data were described as mean or median with standard deviation, and qualitative data were described as frequency distribution tables.

Results Consecutive 224 patients with good performance status were included. After excluding those who required conversion (14 [6.6%]), 210 patients were further analyzed. Median age was 60 years (range: 27–80 years). Neoadjuvant treatment recipients were 160 (76%) patients. Most common presentation was squamous cell carcinoma (146 [70%]) of lower third esophagus (140 [67%]) of stage III (126 [60%]). Median blood loss for thoracoscopic dissection and for total operation was 101.5 mL

Keywords
- thoracoscopic surgery
- minimally invasive surgery
- esophagectomy
- patient positioning

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(range: 30–180 mL) and 286 mL (range: 93–480 mL), respectively. Median operative time for thoracoscopic dissection alone was 67 minutes (range: 34–98 minutes) and for entire procedure was 215 minutes (range: 162–268 minutes). There was no intraoperative mortality. Median 16 lymph nodes were dissected (range: 5–32). Postoperative complication rate and mortality was 50% and 3.3%, respectively. Disease-free interval was 18 months (range: 3–108 months) and overall survival was 22 months (range: 6–108 months).

Conclusion MIE with mediastinal lymphadenectomy in a semi-prone position is feasible, convenient, oncologically safe, which can combine the benefits of the two conventional approaches. Further prospective and comparative studies are required to support our findings.

Introduction

Surgical procedure for esophageal cancer can be challenging as it involves radical resection of the esophagus, local and regional lymphadenectomy, and restoration of gastrointestinal continuity.

Though conventional open procedures like thoracotomy and laparotomy are effective in achieving oncological clearance, they are associated with major complications and poor postoperative quality of life.[1-3]

With the advancement of videoscopic technology, minimally invasive surgery using thoracoscopic and laparoscopic approaches for esophageal cancers became an attractive option both for the surgeons and for the patients[4-7] with an equally good oncological clearance as compared with open procedures.[8]

Traditionally, minimally invasive esophageal dissection has been performed in either left lateral position[8] or prone position.[9,10] Left lateral position has the advantage of familiar surgical field as open surgery, and easy and quick conversion to thoracotomy. But it has some disadvantages like the need for an extra port for lung retraction, pooling of blood in the operative field, and limited exposure to the posterior mediastinum, especially left recurrent laryngeal nerve group of lymph nodes. The prone position has the advantage of a good access to the posterior mediastinal structures without any need for lung retraction. However, patient positioning is difficult and in case of need for emergency thoracotomy, changing to lateral position can be time consuming.

At our cancer center we have been doing minimally invasive esophagectomy (MIE) using a modified technique of a semi-prone position since the year 2007. This technique aims to combine the advantages and overcome the disadvantages of the two conventional positions. In this report we describe our technique and analyze our data for feasibility of performing MIE in semi-prone position in terms of intraoperative and postoperative performances and final oncological outcome.

Methods

Sample Population

This is an audit of all patients with resectable esophageal cancer (either primary or post neoadjuvant treatment) who underwent MIE using semi-prone position between January 2007 and December 2017. We excluded patients who underwent resection using thoracotomy, and those with tumors extending into the gastric side of the esophago-gastric junction for more than 2 cm since they were treated as stomach cancers.

Pretreatment Assessment

Preoperative staging of all patients was done with upper gastrointestinal endoscopy and computed tomography of neck, chest, and abdomen. Operative fitness was done by clinical assessment, hematological investigations, pulmonary function testing, and two-dimensional echocardiography. While patients with early lesions (cT1, N0, M0) underwent esophagectomy alone, those patients with locally advanced resectable (cT2, T3, T4a N+, M0) lesions underwent neoadjuvant treatment before surgery.

Technique of Surgery

Patient Position

We developed an innovative "semi-prone position," which is a left lateral position with an anterior inclination of 45 degrees with the horizontal (►Fig. 1). A double-lumen endotracheal tube for single-lung ventilation is preferable, although the procedure can also be done with routine dual-lung ventilation. An epidural analgesia is used in all cases.

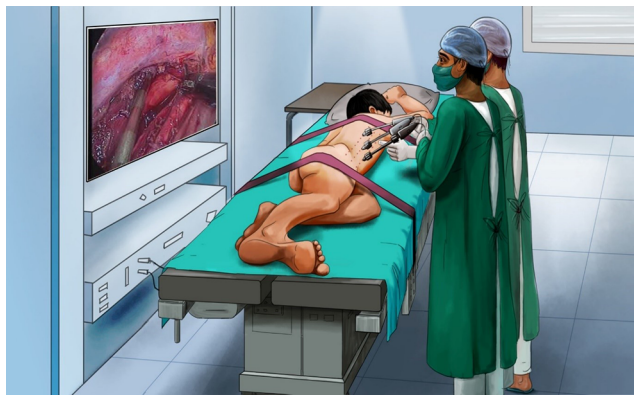

Fig. 1 A sketch showing patient position: semi-prone with 45 degrees angle to the horizontal.

Port Positions

In a three-port approach, ports are placed in fifth, seventh, and ninth intercostal spaces in the posterior, mid, and anterior axillary lines, respectively, in the right chest (►Fig. 2). Camera port (10 mm) is passed through the seventh intercostal space whereas two 5 mm operating ports are passed through the fifth and ninth intercostal spaces. Pneumothorax is created with CO_2 pressure of 8 to 10 mm Hg. This helps to keep the lungs away without requiring an extra port. The thoracoscopic surgery is performed in three steps, viz., infra-azygous dissection, retro-azygous dissection, and supra-azygous dissection.

Infra-Azygous Dissection

Dissection is started in infra-azygous region after opening the mediastinal pleura overlying the esophagus. The dissection begins in the posterior plane between the esophagus and the aorta, starting from the azygous vein up to the diaphragmatic crura (►Fig. 3A, B). All the paraesophageal lymph nodes and fibro-fatty tissues are dissected circumferentially in a centripetal fashion toward the esophagus.

Then the dissection continues anteriorly clearing the lower paraesophageal and pericardial nodes and proceeds superiorly to clear the right and left bronchial, subcarinal, and aorto-pulmonary group of lymph nodes. The vagus nerves are divided well below the carina after saving the tracheobronchial branches. Thus, circumferential mobilization of the esophagus along with all the surrounding lymph nodes, periesophageal tissue, and fat is performed from the diaphragmatic reflection up to the azygous vein.

Retro-Azygous Dissection

Azygous vein is lifted and dissection is done to release the esophagus from surrounding structures. The aorto-pulmonary lymph node dissection is performed at this stage (►Fig. 4). The azygous vein and right bronchial artery running underneath it are preserved to maintain vascularity of right bronchus. This is expected to reduce the pulmonary morbidity by maintaining a good blood supply to the right bronchus. The azygous vein acts as a support to the thin and delicate right bronchial artery. Also, the vein helps in subsequently keeping the gastric conduit in the same anatomical position as the esophagus. However, in case of T4 lesions at the level of the azygous vein, both these structures can be sacrificed for radical clearance.

Supra-Azygous Dissection

This includes the dissection of paraesophageal, lower paratracheal, and right and left recurrent laryngeal group of lymph nodes along with esophageal mobilization right up to the thoracic inlet. The semi-prone position facilitates clear visualization of both the recurrent laryngeal nerves and surrounding lymph nodes (►Fig. 5A, B). Dissection under vision also minimizes traction injury to the recurrent nerves as they are carefully dissected away from the esophagus.

An intercostal underwater drain tube is placed through the ninth intercostal port site. This step completes the esophageal mobilization and thoracic part of the extended two-field lymphadenectomy (►Fig. 6).

Laparotomy

Following this, the patient is turned supine and the anesthesia team changes the double-lumen endotracheal tube to a single-lumen tube. A single-lumen tube is less bulky and facilitates working in the neck. In addition, in case the patient is not ready for extubation at the end of surgery, a single-lumen tube is easier to manage. It also allows toilet bronchoscopy at the end of the procedure if required before extubation.

After upper midline laparotomy, stomach is mobilized based on right gastroepiploic arcade. Lymphadenectomy is performed along the left gastric, hepatic, celiac, and splenic vessels and along lesser curvature of the stomach.

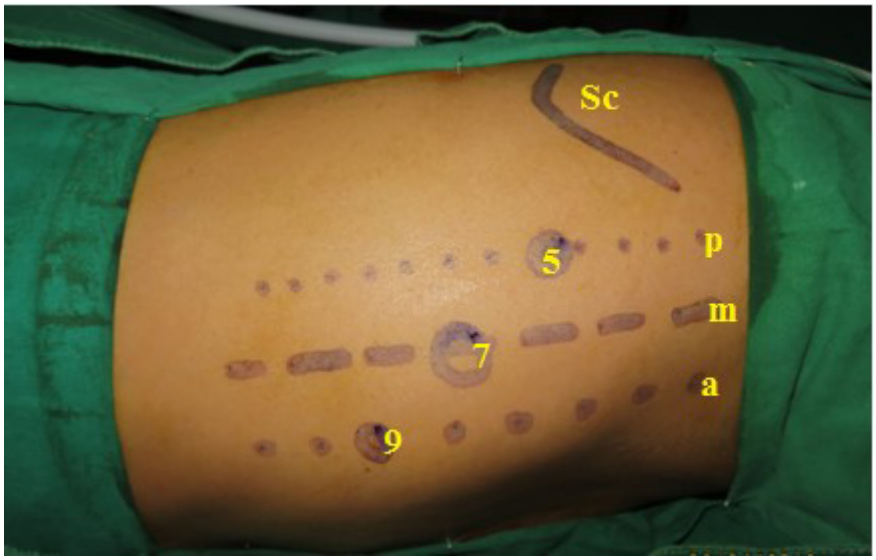

Fig. 2 Port positions: at fifth, seventh, and ninth intercostal spaces in the posterior(p), mid(m), and anterior(a) axillary lines, respectively. Sc: angle of scapula.

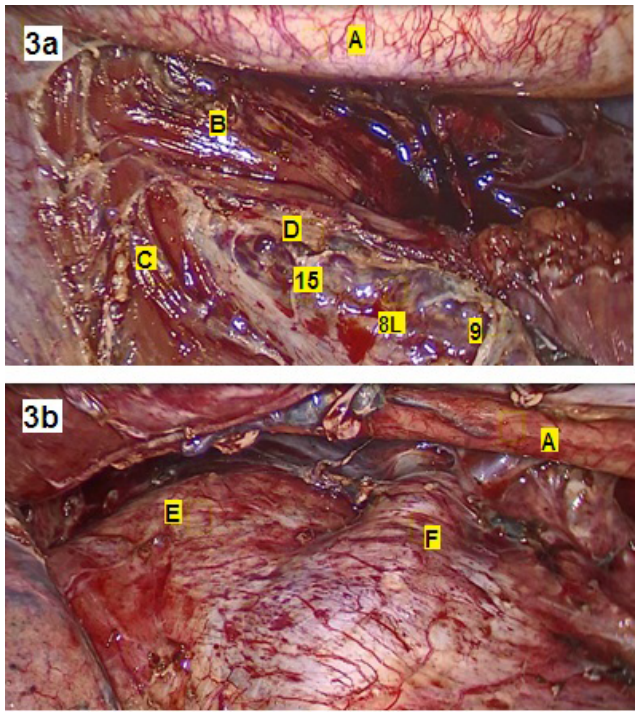

Fig. 3 Thoracoscopic view of infra-azygous dissection. **(A)** View showing lower paraesophageal lymph nodes: aorta A; left crura of diaphragm B; right diaphragmatic crura C; esophagus D; lower paraesophageal lymph nodes 8L; pulmonary ligament nodes 9; and diaphragmatic nodes 15. **(B)** View after lymph node clearance: aorta A; pericardium E; inferior pulmonary vein F; and esophagus retracted upward (not shown).

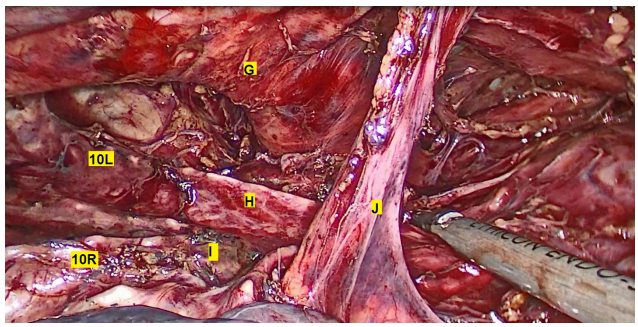

Fig. 4 Thoracoscopic view of retro-azygous dissection: arch of aorta G; left main bronchus H; right main bronchus I; azygous vein J; subcarinal nodes 7; left bronchial nodes 10L; and right bronchial nodes 10R.

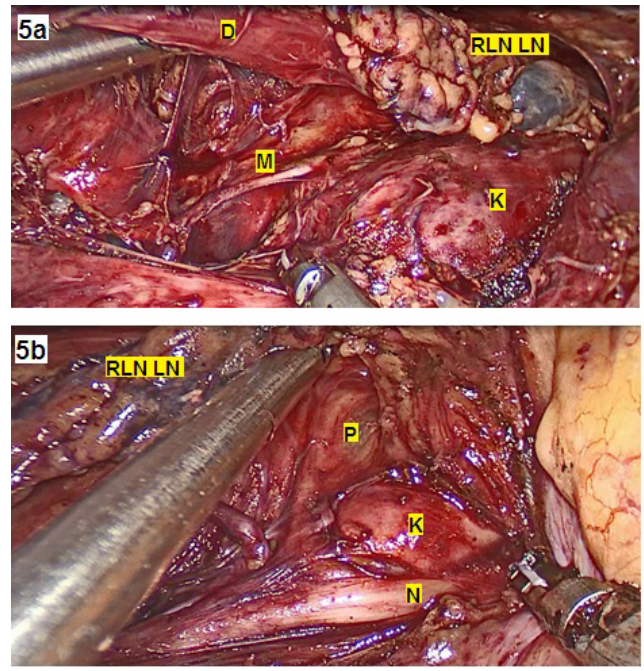

Fig. 5 Thoracoscopic view of supra-azygous dissection. **(5a)** Esophagus D; left recurrent laryngeal nerve M; trachea K; and right recurrent laryngeal group of lymph nodes (RLN LN). **(5b)** Right vagus nerve N; right recurrent laryngeal nerve P; trachea K; and RLN LN.

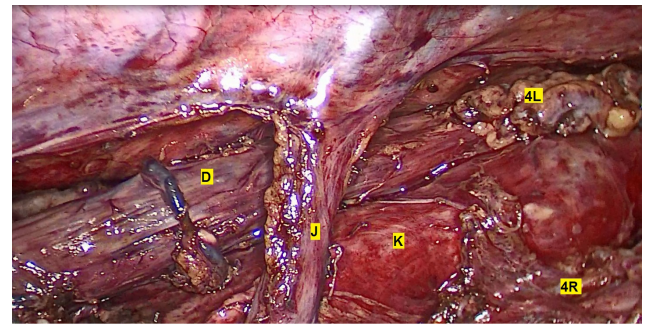

Fig. 6 Thoracoscopic view of completely mobilized esophagus and the lymph nodal dissection: esophagus D; trachea K; azygous vein J; and lower paratracheal nodes—right 4R and left 4L.

Neck Incision

A left neck 4 to 5 cm transverse skin crease incision is taken at supraclavicular fossa. The left recurrent laryngeal nerve is identified. The esophagus is dissected and divided in the neck and the specimen is pulled in the abdomen. Gastric tube is prepared and brought in the neck orthotopically for an end-to-side hand sewn anastomosis in the neck. Care is taken to avoid rotation of the gastric tube.

A feeding jejunostomy is done prior to abdominal closure.

Postoperatively, patient is extubated and kept in intensive care unit for a day. Jejunostomy tube feeding is started from the second postoperative day. On postoperative day-10, oral feeds are started after water soluble contrast swallow examination shows no evidence of leak and patent anastomosis.

Data Collection and Data Analysis

From the hospital records, we obtained demographic information of the patients like age, gender, and preoperative details like tumor node metastasis (TNM) staging, tumor site, histology, and neoadjuvant treatment received. Preoperative staging was performed according to sixth and seventh International Union Against Cancer TNM classification. From the prospectively maintained records, we further obtained intraoperative findings like operative time and blood loss each for thoracoscopic and for the entire procedure. Intraoperative and postoperative complications were recorded. Anastomotic leaks were categorized into three grades according to Esophagectomy Complications Consensus Group (ECCG) criteria.[11] Type

1 anastomotic leaks were defined as a localized defect that was treated using medical therapy or by observation alone; type 2 leaks were defined as a localized defect requiring intervention but not surgical therapy; and type 3 leaks were defined as a localized defect requiring surgical intervention.

Standard follow-up was performed with physical examination every 3 months for the first year and thereafter 6-monthly in second through fifth years and annually thereafter. Endoscopic evaluation and imaging studies were done when indicated for suspicion of recurrence.

Statistical Package for the Social Sciences version 19 (IBM SPSS Statistics for Windows, version 19, IBM Corp. Armonk, New York, United States) was utilized to analyze the results. Analysis of those patients was done in whom proposed surgical procedure could be completed. During MIE, necessity for conversion to an open procedure can be considered as a consequence of that particular technique. Hence, we included those patients who required conversion as an outcome parameter but not for further analysis. Disease-free interval was calculated from the date of end of definitive treatment, that is, surgery, till the date of first recurrence (for those who had recurrence) or till the date of last follow-up (for those without recurrence). Overall survival (OS) was calculated from the date of diagnosis till the date of death or last follow-up. Survival analysis was done using Kaplan-Meier graph. Quantitative data was described as mean or median with standard deviation, and qualitative data described as frequency distribution tables. Patient consent was not required as it was a retrospective study. Institutional ethical committee approval was obtained for the study.

Results

We obtained data of 224 patients from our hospital database. Fourteen patients required conversion to an open procedure, hence they were excluded from further analysis. Rest 210 patients were considered for analysis with the available follow-up. Median age was 60 years (range: 27–80 years). Patient variables are given in ►Table 1. Majority of the patients belonged to stage II (80 [38%]) and stage III (126 [60%]).

As can be seen in ►Table 1 location wise, the incidence of gastroesophageal junction tumors is still low in our patients: 7 (3.3%). Also, squamous cell carcinoma of lower third esophagus and gastroesophageal junction is still the predominant presentation: 146 (70%). Majority of the patients had received neoadjuvant treatment in view of locally advanced but resectable disease.

►Table 2 shows intraoperative performance of the surgery. The mean blood loss and operative duration for thoracoscopy part of the surgery were less compared with most other studies of MIE. Median number of lymph nodes dissected were 16 (range: 5–32) with 36% having 20 or more lymph nodes dissected.

Total 18 (8.5%) patients had intraoperative complications (►Table 2). Fourteen (6.6%) patients required conversion to thoracotomy for bleeding (3), tracheal injury (1), and difficult dissection mainly due to dense pleural adhesions (10). There was no intraoperative mortality.

Table 1 Baseline preoperative patient-related variables

Patient variables		*n* (%)
Total number of patients		210
Gender	Female	136 (65)
	Male	74 (35)
ECOG PS	0	10 (4.76)
	1	130 (62)
	2	70 (33.33)
Clinical stage	I	2 (1)
	II	80 (38)
	III	126 (60)
	IV	2 (1)
Tumor Location	Upper 1/3rd	0
	Middle 1/3rd	63 (30)
	Lower 1/3rd	140 (67)
	Gastroesophageal junction	7 (3.3)
Histological types	Squamous cell carcinoma	146 (70)
	Adenocarcinoma	62 (29)
	Neuroendocrine tumor	2 (1)
Neoadjuvant treatment	Neoadjuvant chemotherapy	48 (23)
	Neoadjuvant concurrent chemoradiotherapy	112 (53)
Primary Surgery	–	50 (24)

Abbreviation: ECOG PS, Eastern Cooperative Oncology Group Performance Status.

Table 2 Intraoperative performance of the surgery

Intraoperative variables		Mean (standard deviation)
Blood loss (in mL)	Thoracoscopy	101.5 (30–180)
	Total	286 (93–480)
Operative time (in minutes)	Thoracoscopy	67 (34–98)
	Total	215 (162–268)
		***n* (%)**
Intraoperative complications	Cardiac arrhythmia	10 (4.76)
	Bleeding	3 (1.4)
	Hypotension	2 (0.9)
	Bleeding from splenic hilum	1 (0.4)
	Superior vena cava tear	1 (0.4)
	Tracheal tear	1 (0.4)
Patient required conversion	Yes	14 (6.6)

►Table 3 shows postoperative outcomes. The most common were the pulmonary complications: 63 (30%). All patients with ECCG grade I and II anastomotic leaks recovered with proper wound drainage. Those with vocal cord paresis recovered to normal within 6 to 8 weeks. The median duration of hospital stay was 14 days (range: 8–33 days).

Complete resection (R0) rate was 98%. Final histopathological evaluation showed squamous cell carcinoma in 146 (70%) patients, adenocarcinoma in 62 (29%) patients, and 1 patient having neuroendocrine tumor of esophagus. As per grading of the tumor, well-differentiated carcinoma was seen in 58 (28.5%) patients, moderately differentiated in 85 (39%), and poorly differentiated in 34 (18.5%) patients. The pathological complete response was seen in 23 (11%) cases. Appropriate adjuvant therapy was given wherever required.

The median follow-up period was 36 months (range: 8–108 months). Total 59 (28%) patients had recurrence locally or in distant organs. The median disease-free survival (DFS) was 18 months (range: 3–108 months; 95% confidence interval [CI] =12.26–23.74 months). OS was 22 months (range: 6–108 months; 95% CI = 28.01–43.58). The 1-, 3-, and 5-year OS rate was 82.5, 46, and 15%, respectively.

Discussion

Of the 224 patients of cancer of esophagus and esophagogastric junction who were treated at our center and operated in semi-prone position using minimally invasive approach, surgery could be successfully completed by this approach in 94% with a median operative time of just over an hour for the thoracic part of the surgery.

MIE was assessed by various authors in terms of feasibility, short-term results, and oncological results.[4,6,7,9] Early reports of MIE demonstrated reduced trauma of surgery and decreased morbidity and mortality as compared with an open approach.[10] Smithers et al demonstrated comparable DFS and OS between open and MIE.[5] Nguyen et al concluded MIE to be an oncologically acceptable surgical approach.[4]

There have been variations among surgeons with respect to the approach of MIE. MIE in the left lateral position was initially described in 1992 by Cuschieri et al[12] and popularized by Luketich et al.[8] Easy conversion to thoracotomy, which can be done quickly without repositioning the patient, was the main advantage of this position. Also, for the operating surgeon, the anatomical orientation is the same as that of open thoracotomy. However, in this position, exposure to upper mediastinal structures is limited, especially the left recurrent laryngeal group of lymph nodes. Lung as well as diaphragm need to be retracted for exposure, which requires an extra assistance port. Also, there is pooling of blood in the surgical field. Since surgeon's arms remain abducted during surgery, there is more shoulder and arms fatigue.[13]

In 1994, Cuschieri first described thoracoscopic mobilization of the esophagus in prone position in six patients.[9] Subsequently, prone position was suggested by some authors to improve the exposure of the posterior mediastinum.[10,12] A recently published systematic review demonstrated reduced pulmonary complications and blood loss in MIE done in prone position as compared with MIE done in left lateral position.[14] Due to gravity effect, lung remains retracted to dependent position obviating the need for lung retraction. Similarly, blood does not interfere in the operative field. Since operating surgeon's hands remain at a low level, there is less fatigue.[13,15] Ergonomically, prone position is better than lateral position as seen by Shen et al.[16] However, conversion to a classic thoracotomy is more difficult and time consuming in the prone position. This may prove critical, especially in emergency situations.

Table 3 Postoperative outcome

Postoperative variables		*n* (%)
Hospital stay (median)	14 days (range: 8–33 days)	–
Immediate postoperative complications	Pulmonary complications	63 (30)
	ECCG type I anastomotic leak	10 (4.7)
	ECCG type II anastomotic leak	5 (2.3)
	Vocal cord paresis/palsy	19 (9)
	Cardiac arrhythmia	3 (1.4)
	Bleeding	2 (1)
	ECCG type III anastomotic leak	2 (1)
	Myocardial infarction	2 (1)
	Tube necrosis	2 (1)
	Cerebrovascular accident	1 (0.4)
	Chylothorax	2 (1)
Delayed complications	Anastomotic stricture	8 (3.8)
	Incisional hernia	3 (1.4)
	Aspiration pneumonia	3 (1.4)
Postoperative mortality		7 (3.3)

Abbreviation: ECCG, Esophagectomy Complications Consensus Group criteria.

To retain the benefits and overcome the disadvantages of the left lateral decubitus and prone positions, a modified semi-prone position has been used by our team. To the best of our knowledge, this patient position for MIE has been first described by us.[17] With the patient in semi-prone position, one gets maximum exposure of the esophagus and the entire posterior mediastinum. The thoracic duct can be well visualized along its entire length. Bilateral recurrent laryngeal group of lymph nodes can be easily and safely cleared. There is minimum pooling of blood at the surgical field. This position avoids crowding of instruments and offers better ergonomics. Also, since the surgeon's elbow remains at the level of the patient, there is less elbow fatigue. The theoretical ease of performing surgery in various patient positions is shown in ►Table 4.

To our knowledge, there was no published study on performing MIE in semi-prone position before 2007 when we first started performing it at our center. Subsequently, very few reports have described the experience of performing MIE using semi-prone position.[18-20] Lin et al compared the feasibility and safety of performing MIE in semi-prone and left lateral positions and found statistically insignificant differences in intraoperative and postoperative complications favoring semi-prone position.[19] Seesing et al compared the feasibility and safety of performing MIE in semi-prone versus prone position and found semi-prone positioning being safe, feasible, and at least comparable to MIE in prone position in terms of oncological clearance and postoperative complications.[20]

Consistent with the observations reproduced by Ma et al in their similar trial,[18] in our experience, posterior mediastinal and aorto-pulmonary dissection was technically easier to perform in the semi-prone approach as compared with the lateral approach. The diaphragm did not hinder the lower esophageal dissection as in lateral position. Also, bilateral recurrent laryngeal lymph node dissections were performed with technically the same ease as in prone approach. Moreover, semi-prone position kept the lung and blood away from the posterior mediastinum. Also, in cases where single-lung ventilation failed or was contraindicated, the procedure could still be completed with an additional port for lung retraction.

In our study 14 (6.6%) patients needed conversion into an open procedure, most of them due to pleural adhesions leading to difficult dissection. On two occasions we required emergency conversions, one for superior vena cava rent leading to bleeding and another for tracheal tear. On both occasions we could do immediate thoracotomy. When conversion to thoracotomy is needed during MIE in prone position, the patient needs to be repositioned and re-draped, resulting in the loss of valuable time. However, in semi-prone position, we noticed that without losing any time, an emergency thoracotomy could be performed by simply tilting the operation table to convert the patient position into left lateral position.

In our study the postoperative overall complication rate was 50% (►Table 3). Most common complication was pulmonary: 63 (30%). The 30-day mortality in our study was 7 (3.3%). The reasons for the deaths were pneumonia with sepsis in two patients, tube necrosis followed by sepsis in two, myocardial infarction in two, and one patient having cerebrovascular accident leading to death.

Perioperative parameters of our study as compared with the other studies in various patient positions are shown in ►Table 5. The results of our study are comparable to the other studies. As a result of the modified position, convenient port positions, and intraoperative ease of handling of tissues, we suppose our duration of surgery is shorter as compared with other studies.

Fifty-nine (28%) patients had either loco-regional and/or distant metastases. Consistent with the literature, the median DFS in our study was 18 months (range: 3–108 months). The median OS was 22 months (range: 6–108 months) as shown in ►Fig. 7.

Conclusion

Thoracoscopic esophagectomy with mediastinal lymphadenectomy in semi-prone position (Pawar technique) is a feasible, convenient, and a safe option that can combine the benefits of the two conventional, that is, left lateral and prone, approaches. With this technique, the intraoperative

Table 4 Theoretical ease of minimally invasive esophagectomy surgery in various patient positions

Sr no.	Parameters	Lateral position	Prone position	Semi-prone position
1	Exposure to thorax and surroundings	Limited	Adequate	Adequate
2	Ease of dissection at subcarinal, left recurrent laryngeal group, and posterior mediastinum	Difficult	Good	Best
3	Need for lung retraction—an extra port	Yes	No	No
4	Single-lung ventilation	Required	Required	Not required
5	Ergonomics:			
	1. Crowding of instruments	No	Yes	No
	2. Elbow fatigue	Maximum	Minimum	Minimum
6	Pooling of blood intraoperatively	Maximum	Minimum	Minimum
7	Conversion to thoracotomy	Easy and quick	Difficult; takes time	Easy and quick

Table 5 Comparison of studies performing minimally invasive esophagectomy in different positions

Author	Patient position	Thoracoscopy time (min)	Total time (min)	Total blood loss (mL)	Total hospital stay (days)	Lymph node yield (*n*)	Conversions (%)	Perioperative complications (%)	Postoperative mortality (%)
Smithers et al[5] (*n* = 309)	Lateral	150	225	150	13	27	4	33	1
Luketich et al[8] (*n* = 60)	Lateral	–	420	–	–	16	5	36	0
Puntambekar et al[21] (*n* = 112)	Lateral	85	185	200	–	23	1.7	13.3	2.7
Law et al[22] (*n* = 18)	Lateral	110	240	450	–	7	4	77	5.5
Palanivelu et al[10] (*n* = 128)	Prone	90	–	400	13	15	3	62	1.5
Denewer et al[23] (*n* = 30)	Prone	218	398	250	17	8.2	0	42	1
Puntambekar et al[24] (*n* = 60)	Prone	67	179	143	12.7	15	0	25	4.4
Dexter et al[25] (*n* = 22)	Prone	184	–	–	18	13	4.5	59	14
Lin et al[19] (*n* = 60)	Semi-prone	120	230	175	14	26	3	–	–
Seesing et al[20] (*n* = 39)	Semi-prone	–	368	388	18	16	5	–	3
Present study (*n* = 224)	Semi-prone	67	215	286	14	16	6.6	50	3.3

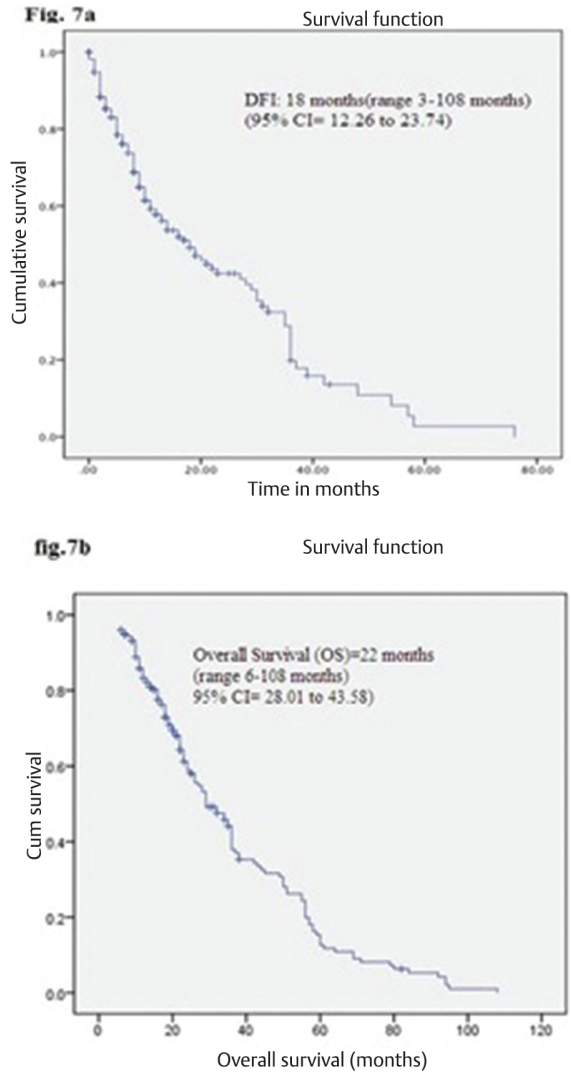

Fig. 7 Kaplan–Meier graph showing (**A**) disease-free interval (**DFI**) and (**B**) overall survival (OS). CI, confidence interval.

and postoperative outcomes and long-term oncological outcomes were comparable with the conventional approaches.

Author Contributions

Study conception and design was done by Pawar SB, Data acquisition was done by Pawar RS, Anap YS, Kulkarni SS, Pawar AS. Analysis and interpretation of data and manuscript drafting was done by Pawar SB and Bagul KG. Critical revision done by Anap YS, Tanawade PK, Mane AA. Statistical expertise was by Patil SS,Kulkarni SS and Pawar AS. The study was supervised by Pawar SB.

Note

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A. Video presentation at the SAGES—Society of American Gastroenterologists and Endoscopic Surgeons—World Conference in the invited "Best of the Videos" session at Washington D.C. on April 15, 2010.

B. Podium presentation, "Thoracoscopic Esophagectomy in Dorsolateral Position: An Innovative Approach–The

Pawar Technique, Early Surgical Results," at Vancouver, Canada, September 22–25, 2014.

C. Poster and Video of the technique at the ISDE—International Society for the Diseases of the Esophagus—World Congress 2018, Vienna, Austria, September 22–23, 2018.

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Conflict of Interest
None of the authors has any conflict of interest.

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