

## THREE-DIMENSIONAL THORACO-LAPAROSCOPIC SURGERY IN TREATMENT OF ESOPHAGEAL CANCER: INITIAL EXPERIENCE AT VIETNAM NATIONAL CANCER HOSPITAL

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### SUMMARY

*Objectives: To evaluate the early results of three dimensional thoraco-laparoscopic surgery in esophageal cancer. Subjects and methods: This is a retrospective, descriptive study. Patients with esophageal cancer and undergoing three-dimensional thoraco-laparoscopic esophagectomy and lymphadenectomy were recruited. Surgery and postoperative information including postoperative complications were reported. Results: 17 patients underwent completely three-dimensional endoscopic surgery. The mean age was 51 years old. The average duration of surgery was 260 minutes. The mean blood loss was 105 mL. The mean number of harvested lymph nodes was 12. Surgical margins were negative in all patients. The average hospital stay was 12 days. 1 patient had pneumonia. There was 1 patient with subcutaneous emphysema. Wound infection was reported in 1 patient. There was no case of anastomotic leakage as well as postoperative death within 30 days. Conclusion: Initially, three-dimensional thoraco-laparoscopic surgery in esophageal cancer shows safety, feasibility and promise.*

*\* Keywords: Esophageal cancer; Three-dimensional thoraco-laparoscopic surgery; Initial experience.*

### INTRODUCTION

The global prevalence of esophageal cancer has increased 50% during the past two decades. Each year, there is approximately 482,300 new cases of esophageal cancer and 83.4% deaths due to this disease. The American Cancer Society estimates that in 2018, there are about 17,290 new cases and 15,850 deaths from esophageal cancer. Although esophageal cancer is still one of the poorest prognosis cancers, the efforts of oncological surgeons have improved significantly 5-year survival from 5% in

1960s to around 20% in the present [1, 2, 3].

Until now, esophageal cancer management has been a multidiscipline approach including chemoradiation, esophagectomy and regional lymph node dissection, in which surgery plays the most important role in treatment strategy.

However, conventional open surgery is associated with more postoperative complications. Large studies reported the mortality rate after surgery was from 5% to 20% [2].

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Thoraco-laparoscopic surgery (TLS) in esophageal cancer treatment is a potential technological advance because of reducing complications, especially pulmonary problems, thus leading to decrease mortality rate considerably. Nevertheless, after more than three decades of two-dimensional (2D) TLS (i.e. traditional TLS), the disadvantages of lacking of intra-operative depth perception and three-dimensional (3D) space orientation remain a challenge for surgeons, even with experienced ones. 3D endoscopic surgery was firstly applied in the early of 1990s to overcome the limitations of 2D TLS, for instance depth and 3D perception of surgeons, thus provide better hand-eye coordination in operation. 3D TLS is an excellent tool to perform dissection, sutures, knots in thoracic surgery. However, 3D TLS has not yet become a standard choice for surgeons because of negative effects of 3D imaging, for instance eyestrain, headache, dizziness, fatigue and stress [1, 2, 3, 4, 5, 6]. Moreover, there are still considerably inadequate numbers of studies focusing on 3D TLS in esophageal cancer treatment.

The objective of this study is: *To evaluate the early outcomes of 3D TLS for esophageal cancer.*

**SUBJECTS AND METHODS**

**1. Subjects.**

17 patients with lower two-third esophageal cancer, stage T1-3, N0-1, M0 (including 2 patients with preoperative chemoradiation) undergoing 3D TLS esophagectomy + lymphadenectomy were recruited in this study.

**2. Methods.**

\* *Study design:* A retrospective, descriptive study.

\* *Parameters:* Age, sex, pathology, tumor position, tumor size, smoking history, operation duration, rate of conversion to open surgery, blood loss, postoperative complications including pneumonia, anastomosis leakage, lymphatic leakage, nerve injury, wound infection, subcutaneous emphysema, days in Intensive care unit, duration of hospital stay, mean number of harvested lymph nodes, and surgical margin status.

**RESULTS**

*Table 1: Characteristics of subjects.*

Characteristics	Value	Percentage (%)
Age		
Mean (range)	51 (48 - 56)	
Sex		
Male	17	100
Female	0	0
Smoking history		
Yes	17	100
No	0	0
Tumor position		
Middle third	7	41.1
Lower third	10	58.9
Tumor size		
≤ 2 cm	15	88.2
> 2 cm	2	11.8
Histology		
Adenocarcinoma	1	5.8
Squamous cell carcinoma	16	94.2
TNM stage		
IB	59	48.4
IIA	14	11.5
IIB	45	36.9

There were 17 patients undergoing 3D TLS, in which all patients were male. The mean age was 51 years (range from 48 to 56 years). All patients had history of smoking.

More than half of patients had tumor in the lower third of esophagus (58.9%). The majority of patients had tumor size below 2 cm (88.2%). Most cases presented with results of histology being squamous cell carcinoma. After surgery, TNM stage was evaluated. Among 17 patients, there were 5 patients (29.4%) in stage IB, 10 patients (58.8%) in stage IIA and 2 patients (11.8%) in stage IIB.

*Table 2: Surgery and postoperative features.*

Features	
Surgery duration (minute)	260 (230 - 360)*
Switch to open surgery (%)	0
Blood loss (mL)	105 (50 - 200)*
Negative surgical margin	17 (100)**
Postoperative complications	
Pneumonia	1 (5.8)**
Anastomosis leakage	0 (0)**
Lymphatic leakage	0 (0)**
Nerve injury	0 (0)**
Wound infection	1 (5.8)**
Subcutaneous emphysema	1 (5.8)**
Death within 30 days	0 (0)**
Days in intensive care unit (day)	2 (1 - 3)*
Days of hospitalization (day)	12 (8 - 15)*
Number of harvested lymph node	12 (8 - 20)*

(\*: Mean [range]; \*\*: number [%])

The lymph nodes were 12. Surgical margins were negative in all patients. The average hospital stay were 12 days.

In postoperative complication analysis, there was 1 patient with pneumonia, 1 patient with subcutaneous emphysema. Wound infection was reported in 1 patient. There was no case of anastomotic leakage and also no case of postoperative death within 30 days.

## DISCUSSION

### 1. 3D TLS indications in esophageal cancer.

Esophagectomy + lymphadenectomy is the most radical treatment for early esophageal cancer. In 1992, Cuschieri was the first person to report the application of endoscopic surgery in esophageal cancer treatment. This success was known as "Minimally invasive esophagectomy" [2, 3]. The development of endoscopic surgery for more than 3 decades had proved that this was a new and effective approach in esophageal cancer treatment, accompanied with many advantages, for instance reducing postoperative complications, especially pneumonia, less postoperative pain, faster recovery, less hospitalization duration, and still achieving oncological targets, in comparison with conventional open surgery. However, when a new method is applied, there is likely to reveal its disadvantages and lead to the proposal of better solution. 2D TLS also has to deal with this problem since it lacks depth perception and makes it difficult for surgeons to perform precise manipulations such as sutures, knots, blood dissection, particularly thoracic vessels. Due to these limitations of 2D endoscopic surgery, 3D endoscopic

surgery was firstly applied in 1992 in cholecystectomy and demonstrated many advantages such as faster gallbladder resection, and easier cystic duct ligation, in comparison with 2D endoscopic surgery. In gynecology, Wenzel utilized 3D endoscopic surgery in hysterectomy and oophorectomy. He concluded that 3D endoscopic surgery was associated with less operation time and more precise manipulations than 2D endoscopic surgery. Up to now, 3D endoscopic system has been improved by many advances in imaging technology with dual lenses and high-definition (HD) camera, delivering high quality 3D images and being optimal for surgical performance. Recommendations from large studies in the world suggested that endoscopic surgery should only indicate for tumor with average size and without evidence of invasion to regional organs (below T4B) [2, 7, 8]. We indicated 3D TLS mainly for stage IB (29.4%), IIA (58.8%), tumor below 2 cm (88,2%). 2 cases with tumor over 2 cm and stage T3 underwent preoperative chemoradiation, thus also had shrinking tumor size before surgery.

## **2. Safety and feasibility of 3D TLS in esophageal cancer treatment.**

Some studies on safety and feasibility of 3D TLS in large gastrointestinal cancer centers indicated optimistic outcomes in several aspects: postoperative complications, recovery and hospitalization, when comparing to conventional open surgery [2, 9, 10]. However, there are still inadequate studies of 3D TLS to guarantee its advantages over 2D TLS.

In this study, 3D TLS duration was 260 minutes. Duration of operation is also an important factor of the reduction in postoperative complications. During thoracic esophageal dissection step, it is necessary to collapse the right lung. Consequently, reducing the time of atelectasis will facilitate postoperative lung expansion. Rosa T.van der Kaaij reported the mean duration of 3D TLS of 280 minutes [1]. Zhao Li et al presented thoracoscopic duration of 3D TLS, being  $138 \pm 14$  minutes [3].

Mean blood loss in 3D TLS is a considerable factor because it reflects dissection ability of surgical method and surgeon. Rosa T.van der Kaaij presented the average blood loss of 170 mL (50 - 300) [1]. Zhao Li reported the blood loss among 45 patients undergoing 3D TLS of  $68.2 \pm 10.7$  mL [3]. In this study, our result was 105 mL.

Postoperative complications are always obsessed issues of esophageal surgeons and sometimes even prevent us from performing surgery. Esophageal cancer itself has poor prognosis, and when complications occur, patient's chance of survival after operation will be much lower as well as treatment cost will also increase. Some meta-analysis showed that the rate of postoperative complications varies from 20% to 40%. They included pneumonia, cardiologic complications, embolism and surgical complications such as anastomosis leakage, recurrent laryngeal nerve injury, and lymphatic leakage [2, 11, 12].

Pulmonary complications are the most common problem with the rate of 16 - 47%. Anastomosis leakage rate is 0 - 40%. Multivariable analyses suggested that risk factors of postoperative complications are age, chronic respiratory diseases, cardiovascular diseases, malnutrition, hepatic and renal function disorders. A prospective study in 450 patients with esophageal cancer revealed that comorbidity group had higher rate of postoperative complications than non-comorbidity group (28% vs. 18%, respectively) [3, 4]. A study comparing endoscopic surgery and open surgery in 5,991 patients indicated that complications were 38.2% in endoscopic group and 52% in open surgery group [11].

In this study, all participants were good surgical candidates (average age of 51 years old, and in good performance status), underwent comprehensively preoperative work-ups (including respiratory function and cardiovascular tests), nourished with intravenous supplement for 1 week, guided respiratory training and smoking cessation at least 3 weeks before surgery, and treated carefully comorbidity problems such as diabetes and hypertension. In this study, rate of postoperative complications was 17.4%. There was 1 patient (5.8%) with pneumonia in the second day after surgery. This patient was treated with antibiotics and airway clearance techniques. Eventually, patient recovered after 10 days. Rosa T.van der Kaaij reported 2 cases (15.3%) of pneumonia among 13 patients undergoing 3D TLS [1]. Zhao Li also showed rate of pneumonia and pulmonary embolism as 13.3% [3].

The reasons of our lower rate of pulmonary complications rate might be due to small number of patients and comprehensive respiratory check-up before surgery.

Anastomosis leakage usually leads to death if anastomosis is placed in the thorax. In all patients, we performed 3D TLS and cervical esophagogastric anastomosis, thus it reduced mortality risk if anastomosis leakage appeared. In this study, there was no case with anastomosis leakage. Rate of anastomosis in other studies was 2.2 - 23%. Besides, lymphatic leakage and recurrent pharyngeal injury were also reported in other studies, being 8 - 10% [1, 2, 3, 11, 12]. There was no case of lymphatic leakage, nerve injury, or death within 30 days. Nevertheless, there was 1 patient with subcutaneous emphysema. Zhao Li and Rosa T.van der Kaaij also presented no case of postoperative death [1, 3].

Number of harvested lymph nodes and surgical margin status are also important predictive factors of oncology aspect. In this study, the mean number of lymph nodes was 12 and surgical margins were negative in all patients. Other authors reported that the average number of harvested lymph nodes in 3D TLS were 14.2 and 20.6. The higher number of harvested lymph nodes in other studies could be due to the fact that their studies included stage IIIA and IIIB patients [1, 3]. Finally, it is still necessary to mention that the limitations of our study are small size and not providing long-term outcomes.

## **CONCLUSSION**

3D TLS is a safe, feasible, and potential method with mean operation duration of 260 minutes, blood loss of 105 mL, no case converted to open surgery, low risk of postoperative complications (17.4% in general, in which 1 case with pneumonia, 1 case with wound infection, and 1 case with subcutaneous emphysema), no case with postoperative death, mean number of harvested lymph nodes of 12, and negative surgical margins in all cases.

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