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2014

### **document version**

Publisher's PDF, also known as Version of record

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### **citation for published version (APA)**

Maas, K. W. (2014). *Minimally invasive esophagectomy for cancer; beyond techniques*. [PhD-Thesis - Research and graduation internal, Vrije Universiteit Amsterdam].

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## Part II

### A randomized trial



# Chapter 5

Preliminary experience of minimally invasive esophagectomy for cancer.

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# ABSTRACT

## Background

The minimally invasive approach for esophageal resection is increasingly being used all over the world. Important advantage is avoidance of thoracotomy while obtaining the same quality of specimen. Thoracoscopic esophagectomy in prone position also avoids total collapse of the right lung. This may be associated with an important reduction in respiratory infections. We evaluated our own initial experience of a transthoracic esophagectomy with the thoracoscopic procedure in prone position (MIEprone) combined with laparoscopy or laparotomy in 40 patients.

## Methods

A retrospective analysis was performed of 40 patients who were operated between March 2007 and March 2009 with a resectable (T3N0-1M0) esophageal cancer by a right thoracoscopy in prone position and laparoscopy or laparotomy. Patients could undergo a MIEprone if they had a thoracic or gastro-esophageal tumor, had no prior thoracic surgery and were in a good condition (Eastern Cooperative Oncology Group  $\leq 2$ ).

## Results

Twenty-five patients had a laparoscopy and fifteen a laparotomy. Median operative time was 290 minutes with a conversion rate of 2.5% to thoracotomy and laparotomy. Median Intensive Care Unit and hospital stay were 1 day and 14 days respectively. A radical resection (R0) was achieved in 36 patients (90%). The median number of resected lymph nodes was 21 (15-33). Morbidity was observed in ten patients, three cervical anastomotic leakages and two moderate chylous leakages were treated conservatively. One patient had proximal ischemia of the gastric conduit which was resected followed by re-anastomosis and stenting. Four patients (10%) developed a respiratory infection which was treated with antibiotics. No mortality was observed in this series.

## Conclusion

The short-term results in this series of 40 patients show the safety and feasibility of a thoracoscopic esophagectomy in prone position. A multicenter randomized trial, in which this approach will be compared with the standard open thoracotomy, is needed to establish the role of this approach in daily practice.

## INTRODUCTION

The minimally invasive approach for esophageal resection is increasingly being used all over the world. Its most important advantage seems to be the reduction of complications produced by the thoracotomy and/or laparotomy. Consequences of the reduced operative trauma may be less post-operative pain, and possibly fewer respiratory complications.

Initially, surgeons have used the right lateral thoracoscopic approach with total lung block in order to visualize and dissect the esophagus.<sup>1</sup> However, initial reports show a high conversion rate to thoracotomy of 10% to 17% and a high respiratory complications of 17 to 42%.<sup>2-4</sup>

Searching for a further reduction of the conversion rate and the respiratory infection rate, Cuschieri developed the thoracoscopic approach in a prone decubitus position so that a total collapse of the lung is not necessary for dissecting the esophagus and in this way further reducing respiratory infections.<sup>5</sup>

We evaluated our own initial experience of a transthoracic esophagectomy with the thoracoscopic procedure in prone position (MIEprone) combined with laparoscopy or laparotomy in 40 patients.

## METHODS

A retrospective analysis was performed of 40 patients who were operated between March 2007 and March 2009 with a resectable (T3N0-1M0) esophageal cancer by a right thoracoscopy in prone position and laparoscopy or laparotomy (MIEprone). Patients could undergo a MIEprone if they had a thoracic or gastro-esophageal junction tumor, had no prior thoracic surgery and were in a good condition (Eastern Cooperative Oncology Group (ECOG)  $\leq 2$ ).

### Statistical analysis

Data are expressed median with ranges for continuous variables. Data have been analysed in SPSS software version 14.

## RESULTS

### Patient characteristics

The patient characteristics are depicted in Table 1. The thirty males and ten female patients had a median age of 67 years with a range of 48 to 80 years. Tumors were located in the thoracic esophagus (34 patients) and gastro-esophageal (GE)-junction tumors (6 patients) and were found resectable by Computed Tomography- scan of thorax and abdomen, endoscopic ultrasound and Positron Emission Tomography-scan (PET). Fifteen patients had a squamous cell cancer and 25 an adenocarcinoma.

Neoadjuvant therapy consisted of chemoradiotherapy with weekly administration of Paclitaxel 50 mg/m<sup>2</sup> and Carboplatin AUC= 2 for 5 weeks and concurrent radiotherapy (41,4 Gy in 23 fractions, 5 days per week). A small group of seven patients were treated with pre-operative chemotherapy alone according to the MAGIC protocol<sup>6</sup>. After the neoadjuvant treatment, an interval of six weeks was maintained before operation.

### General outcome

Table 2 depicts general outcome. Median operative time of the thoracoscopic approach was 130 minutes (range 100 to 140 minutes), with a total operative time of 290 minutes (range 240 to 450 min). Blood loss was 230 ml (range 150 to 400 ml).

In one patient conversion to thoracotomy was necessary because of a combination of difficulty in developing a surgical plane along the aorta and due to moderate bleeding. The patient was turned to a left lateral position and conventionally approached. Venous bleeding came from a venous plexus located between the aorta and azygos vein. In twenty-five patients, the abdomen was approached laparoscopically, and in fifteen patients it was performed through a median upper laparotomy because of relative contra-indications for laparoscopy, such as previous laparotomy, extreme obesity and PET positive lymph nodes at the prepyloric small curvature in GE-junction tumors.

In one patient, conversion from laparoscopy to laparotomy was required due to the presence of extensive fibrosis in the celiac trunk after chemotherapy.

Pathological examination showed a R0 resection in 36 patients (90%) with a complete response after chemoradiotherapy in eight patients (20%). Median number of LN resected in this two field LN operation were 21 (range 15 to 33).

### Morbidity

Post-operative complications were observed in 10 patients (25%). In the major complications group, three patients had an anastomotic leakage at the cervical anastomosis; the next two had moderate chylous leakage and were treated conservatively by means of medium chain triglycerides (MCT) diet. In the last patient the proximal 4 cm of the gastric tube was found to be necrotic at endoscopy which was performed because of respiratory insufficiency. The patient was re-operated through a combined cervico-laparotomy, the necrosis was resected and the gastric tube-esophagus re-anastomosed after extra gastric mobilization. In addition, an endoscopic stent was placed in this patient. No in-hospital mortality was observed in this series.

**Table 1.** Patient characteristics.

		Thoracoscopic esophageal resection in prone decubitus position (n=40)
Age (years)		67 (48-80)
Gender		
	Male	30
	Female	10
Histology of tumor		
	Squamous cell carcinoma	15
	Adenocarcinoma	25
Tumor location		
	Thoracic esophagus	34
	Gastro-esophageal junction	6
TNM classification		
	T2N1	2
	T3N0-1	38
Neoadjuvant therapy		
	Chemoradiotherapy	30
	Chemotherapy alone	7

**Table 2.** General outcome.

		Thoracoscopic esophageal resections in prone decubitus position (n=40)
Operation time thoracoscopy (minutes)		130 (100-140)
Blood loss (ml)		230 (150-400)
ICU stay (days)		1 (1-37)
Hospital stay (days)		14 (12-69)
R0 resection		36 (90%)
Complete response		8 (20%)
No. of retrieved lymph nodes		21 (15-33)

ICU, Intensive care unit

**Table 3.** Morbidity.

	Thoracoscopic esophageal resections in prone decubitus position (n=40)	Management
Anastomotic leakage	3	Conservative
Moderate chylus drainage	2	Medium Chain Triglycerides diet
Necrosis of proximal 4 cm of gastric tube	1	Re-operation
Pneumonia (not related to other complications)	4	Antibiotics



## DISCUSSION

This study evaluated the initial results of thoracoscopy in prone position for esophageal cancer. Short term results were analyzed in 40 patients. Both pathological and post-operative morbidity were investigated.

Dallemagne introduced the thoroscopic approach for esophageal cancer in 1991.<sup>7</sup> The right lateral thoroscopic approach with total lung block was used in order to visualize and dissect the esophagus.<sup>1</sup> However, initial reports showed a high conversion rate to thoracotomy of 10 to 17% and a high respiratory morbidity of 17 to 42%.<sup>2-4</sup> Searching for reduction of the conversion rate and the respiratory infection rate, Cuschieri et al. designed the thoroscopic approach in prone decubitus position to avoid a total collapse of the lung for dissecting the esophagus and in this way reducing respiratory infections.<sup>5</sup>

Prone decubitus position for conventional lung resection for cancer was initially described by Overholt in 1949 and later modified by Nacleiro in 1955.<sup>8,9</sup> In comparison with the standard right thoracotomy, the advantages of this approach were: a) the attainable range of thoracic cage and diaphragmatic excursion is greater than in the side position; b) the amplitude of mediastinal swing or displacement is less; c) exposure of the posterior aspect of the hilum and esophageal area is facilitated; d) the weight of the lung itself allows it to fall forward; and e) in the event of haemorrhage the blood flows away from its source, thus permitting its control with greater ease. The approach had not been used again prior to the introduction of the esophageal approach by prone decubitus right thoracoscopy.

Controversy exists which of the two main thoroscopic approaches offers maximal advantages to the patient. In both approaches, a change of position from lateral or prone to supine position is necessary in order to finalize the procedure. Perhaps conversion to thoracotomy will be more difficult, in the event of bleeding in the prone position. Change of position from prone to lateral may be hazardous. The most striking difference between the two approaches is the use of a complete block of the right lung by the lateral thoracoscopy (double lumen intubation) versus the limited block and normal intubation in the prone position. When comparing the prone and the lateral thoroscopic approaches, the prone position may cause fewer respiratory complications.<sup>10</sup> Luketich et al reported, in a series of 222 patients, an incidence of respiratory complications of 7.6% of the patients and Palanivelu et al, using the prone position in 134 patients, reported 1.54% in his series.<sup>11,12</sup> In contrary Hulscher et al. observed 57% respiratory infections in their transthoracic group.<sup>13</sup> Possible factors for the better outcome in prone position could be the use of a single endotracheal tube with two-lung ventilation without total collapse of the right lung. The partial ventilation of the right lung reduces the possibility of arterio-venous shunt. Moreover, in prone position the functional residual capacity may be greater than in supine position, the ventilation-perfusion ratio is maintained and hypoxia and hypercarbia are avoided.<sup>14</sup> This may reduce the extent of atelectasia and infection post-operatively. Other important advantages of the prone position may be shorter anaesthesia time, a decrease lung injury, an excellent exposure of the operative field, and a better ergonomy for the surgeon.

The short-term results in this series of 40 patients show the safety and feasibility of a thoroscopic esophagectomy in prone position in our center. Pathologic outcome seems to be similar with open resection. Respiratory complications are reduced when comparing with other series. This improved morbidity seems to enhance recovery, 14 days hospital stay. Technical complications like anastomotic leakage, recurrent nerve lesion and chylothorax, related to esophageal dissection and creation of gastric tube, are expected, to remain the same as open conventional approach. It is however clear from this series that a multicenter randomized protocol has to be performed in which the thoroscopic approach in prone position will need to be compared to the open posterolateral thoracotomy and laparotomy.

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