

Diagnosis, management and outcomes of thoracic esophageal perforation

Diagnostyka, postępowanie terapeutyczne i skutki perforacji piersiowego odcinka przełyku

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Key words: esophageal perforation, esophago-cutaneous fistula, video-assisted thoracoscopic surgery.

Słowa kluczowe: perforacja przełyku, przetoka przełykowo-skórna, wideotorakoskopia.

Abstract

Introduction: Esophageal perforation has been considered a catastrophic and often life-threatening event.

Aim of the research: To show the results and difficulties in the management of esophageal perforation based on the experience of our department of thoracic surgery as well as data obtained from other hospitals.

Material and methods: We performed a retrospective analysis of the management of 103 patients (mean age: 49.4 ± 3.1) treated during the period of 1997–2011. Open surgery historical control group (94 patients) was compared with patients (9 cases) who had undergone video-assisted thoracoscopic surgery nonresection procedure in our hospital.

Results: Data analysis has revealed that 32 (31%) of all patients were not recognized as a “thoracic esophageal injury” at the first examination. Despite the fact that more than 80% of patients were hospitalized on the first day, in 42 cases (40.8%), surgical treatment was applied after 24 h (52.1 ± 7.8). Sixty-percent patients of control group were complicated by postoperative morbidity resulted in higher ($p < 0.05$) mortality rate (35.1%) and hospital stay time (41.2 ± 6.1 days), then VATS management of patients who had 11.1% postoperative mortality and 26.5 ± 5.6 days of hospital stay.

Conclusions: Esophageal perforations are rare pathology and due to the rarity of this condition and its often nonspecific presentation, the surgical treatment of it is delayed in more than 40% of patients, which leads to death of every third patient. Video-assisted thoracoscopic surgery with adequate drain perforation has had advantages in comparison with standard open surgical techniques in treatment of patients with delayed perforation and severe inflammatory reaction.

Streszczenie

Wprowadzenie: Perforacja przełyku jest ciężkim stanem chorobowym, który często zagraża życiu pacjenta.

Cel pracy: Przegląd skutków i trudności w postępowaniu terapeutycznym w przypadkach perforacji przełyku na podstawie doświadczeń zgromadzonych na oddziale torakochirurgii, z którego pochodzą autorzy, oraz danych pozyskanych z innych placówek szpitalnych.

Materiał i metody: Przeprowadzono retrospektywną analizę postępowania terapeutycznego zastosowanego u 103 pacjentów (średnia wieku: 49,4 ± 3,1 roku) w latach 1997–2011. Historyczną grupę kontrolną, w której zabieg chirurgiczny wykonano metodą otwartą (94 pacjentów), porównano z grupą pacjentów (9 przypadków), u których przeprowadzono zabieg wideotorakoskopowy bez resekcji w szpitalu autorów.

Wyniki: Analiza danych wykazała, że u 32 (31%) spośród wszystkich pacjentów przy pierwszym badaniu nie stwierdzono „uszkodzenia piersiowego odcinka przełyku”. Chociaż ponad 80% pacjentów zostało przyjętych do szpitala już pierwszego dnia, w 42 przypadkach (40,8%) zabieg chirurgiczny przeprowadzono dopiero po upływie 24 godzin (52,1 ± 7,8). U 60% pacjentów z grupy kontrolnej przebieg pooperacyjny był powikłany, co skutkowało podwyższeniem ($p < 0,05$) wskaźnika śmiertelności (35,1%) i wydłużeniem czasu hospitalizacji (41,2 ± 6,1 dnia) w stosunku do grupy pacjentów, u których zabieg przeprowadzono metodą wideotorakoskopową (śmiertelność pooperacyjna – 11,1%, czas hospitalizacji – 26,5 ± 5,6 dnia).

Wnioski: Perforacje przełyku są rzadkim stanem chorobowym. Ze względu na małą częstość występowania i często niespecyficzne objawy leczenie chirurgiczne jest wdrażane z opóźnieniem u ponad 40% pacjentów, co skutkuje zgonem u co trzeciego z nich. Zabiegi wideotorakoskopowe wykazują przewagę nad standardowymi zabiegami chirurgicznymi wykonywanymi metodą otwartą w leczeniu pacjentów z opóźnioną perforacją oraz ciężką reakcją zapalną.

Introduction

Esophageal perforation has been considered a catastrophic and often life-threatening event, with very high morbidity and greater than 20% mortality rates even though appropriate treatment is started on time. About half of esophageal perforations are iatrogenic, mostly as a result of endoscopic instrumentation maneuvers, and more than a third are spontaneous rupture of oesophagus associated with forceful vomiting after overconsumption in food and alcohol which is known as Boerhaave's syndrome. Delay in diagnostics and carrying out of surgical intervention, that occurs in more than 50% of cases, is a major factor of high mortality rate which rises from 40% to 60% if diagnosis and treatment are delayed, but this rate decreases to 10–25% if treatment is carried out within 24 h of perforation [1].

Aim of the research

Our aim was to present the results and difficulties in the diagnosis and management of esophageal perforation based on the experience of our department of thoracic reconstructive surgery as well as data obtained from 6 other hospitals.

Material and methods

We performed a retrospective analysis of the management of 103 patients (mean age: 49.4 ± 3.1 years; 18–82, 80 males and 23 females) treated for thoracic esophageal perforation at our hospital (16 patients) and the other 6 hospitals of (87 cases) during the period of 1997–2011. Nineteen (18.4%) patients (mean age: 64.7 ± 5.7) had comorbidities with a prevalence of the cardiovascular system pathology – in 11 (57.8%), a respiratory disease encountered in 4 (21.1%), diabetes in 3 cases (15.8%) and the digestive system pathology – in 1 (5.3%).

All patients were divided into two groups for analysis of different surgical techniques: the first group (historical control group) – 94 (91.3%) patients who were treated by open thoracotomy or/and laparotomy (“open surgery” – OS) – was compared with the second “video-assisted thoracoscopic surgery (VATS) group” of 9 patients who had undergone VATS non-resection drainage procedure in our hospital.

Chest computed tomography with oral contrast was used in all patients of “VATS group” to confirm oesophageal perforation and its healing after surgery. Videothoracoscopy was carried out through the left pleural cavity for patients with injury in the lowest third thoracic esophageal ($n = 3$) and through the right pleural cavity in case of perforation of a medial part ($n = 6$). Application of a primary repair with a suture of esophagus wound was not indicated because of delay in the surgery (88.1 ± 61.7 h).

Perforation of a low third thoracic esophagus was accompanied by a fistula to the left pleural cavity and pyopneumothorax. At the moment of operation these patients had the expressed clinical symptoms of purulent fever and severe cardiac comorbidity. In this situation it was decided to install drainage for the sanity of any pleural purulent collections. The access to esophagus was carried out through the left pleural cavity by insertion of optics and tools through of the three chest ports (Figure 1). The massive purulent peel on the pleural surface and exudate were determined during an observation of pleural cavities. Endoscopy examination during operation allowed to find the localization of esophageal defect. With the use of the technique developed by us [2], the polyvinyl drainage tube was inserted through a pleural cavity into esophageal perforation and then fixed by means of a nasosejunal tube in esophageal lumen (Figure 2). This method of «fistulazation» allowed to avoid the formation of gastrostoma for feeding and to perform adequate drainage of pus pleural effusion from the area of injury and the pleural cavity. Also, three chest ports accesses were carried out through the

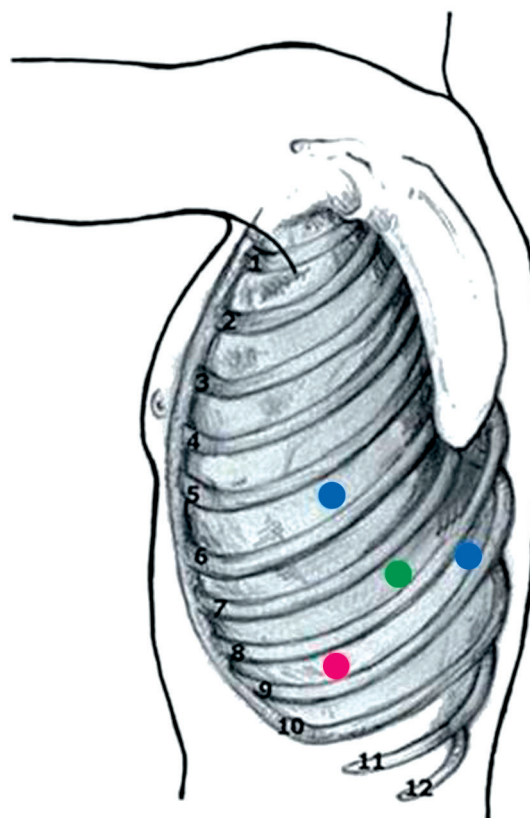
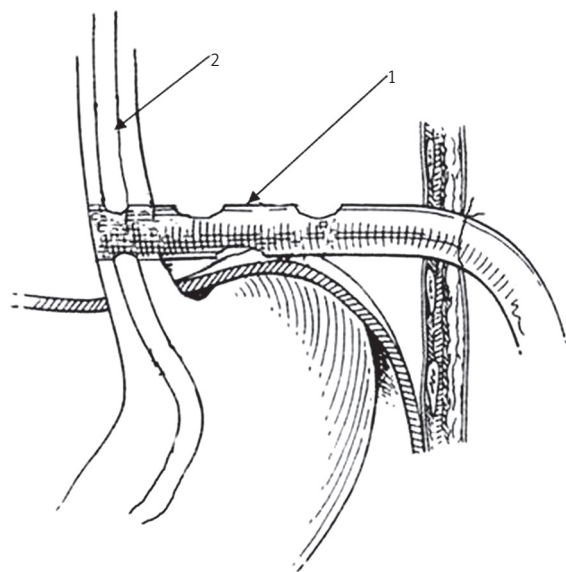


Figure 1. VATS ports placement. The upper three points were used to introduce thoracoscopic instruments, the middle one – for the 12-mm camera. The lowest point is the projection point on the chest wall of the most common localization of esophageal perforation



1 – drainage tube; 2 – feeding nasojejun tube

Figure 2. The controlled fistula like T-drainage**Table 1.** The results of statistical comparison of control and VATS groups

| Patient characteristics | Value of <i>p</i> |
|--|-------------------|
| Age | 0.056596 |
| Gender differences | 0.561333 |
| The structure of diagnoses | 0.576997 |
| Time between start of symptoms and surgery | 0.068883 |

right pleural cavity for the management of patients with median third of the esophageal perforation. The post-operative feeding through the nasojejun tube began on the first day after operation as well as early physical activity of patients. The intrathoracic fistula drainage tube was withdrawn little by little each day as soon as no evidence of leakage into the thoracic cavity was observed by esophagogram.

The open surgical management of esophageal perforation in the control group included a primary repair with (20 cases) or without cervical oesophagotomy and feeding gastrostomy in 54 (57.5%) patients, a thoractomy or laparotomy or cervicotomy to drain and debride the pleural and mediastinal collections with (14 cases) or without oesophageal diversion and gastrostomy in 32 (33.9%), an esophageal resection with cervical oesophagotomy and gastrostomy in 5 (5.3%) and thoractomy with modified by us procedure of the T-tube drainage for a “controlled esophago-cutaneous fistula” in 3 cases (3.3%).

Statistical analysis

Pseudorandomization was made to avoid heterogeneity in the comparison of groups by gender, age, clinical diagnosis and time from the injury of the esophagus until the surgical care. There were no significant differences in age and gender, the structure of diagnoses and time interval after the perforation (Table 1) or presence of comorbidity between the two groups.

The descriptive statistics were summarized as a means for continuous variables (\pm standard error from the mean) and as frequencies and percentages for categorical variables on Microsoft Excel for Window. The Mann-Whitney *U* test was performed to calculate differences in continuous variables and differences between categorical variables were tested with Fisher’s exact test. All differences were considered significant at a *p* value less than 0.05.

Results

The most common localization of thoracic esophageal perforation was the distal third ($n = 58$, 56.4%), followed by the middle third ($n = 28$, 27.2) and the proximal third ($n = 17$, 16.4%).

Most of the injuries of the thoracic esophagus were of iatrogenic nature – 42 (40.7%), due to perforation occurred during the post-burn scar stricture bougienage – 29 patients (28.2%), fibroesophagoscopy patients – 11 (10.6%) and rigid esophagoscopy – 2 (1.9%), respectively. Boerhaave’s Syndrome was detected in 39 cases (38%) and the esophageal foreign body trauma in 16 (15.5%). The remaining 6 cases (5.8%) occurred as a result of the external traumatic agent: 3 patients (2.9%) – a chemical burn of the esophageal wall, in 2 (1.9%) – stabbed and 1 (1%) patient as a result of the explosive injury. There were no significant differences in the etiology of perforation between the two groups.

Eighty-four patients (81.6%) out of 103 were delivered in the first 24 h to the hospital Emergency Department due to the severity of the disease symptoms that made patients to seek medical help within an average pre-hospital period of 20.6 ± 9.6 h.

Despite the fact that more than 80% of patients were hospitalized on the first day, in 42 cases (40.8%), surgical treatment was applied after 24 h with the mean time interval between perforation and operation of 52.1 ± 7.8 h (Table 2).

Data analysis has revealed that 32 (31%) of all patients were not recognized as a “thoracic esophageal injury” during the first examination. The most common initial “mistakes” were perforation of duodenum ulcer and polysegmental pneumonia on 8 cases for each pathology (25%). Four patients (12.5%) were treated on suspicion of pancreatitis, pleurisy or pneumohydrothorax – 3 (9.5%), and as the beginning of neck phlegmonous adenitis – 2 cases (6.3%). Moreover,

Table 2. Patient characteristics

| Group | I control | II VATS |
|---|-----------------|-----------------|
| No. of patients | 94 | 9 |
| Age, median \pm SD [years] | 48.6 \pm 2.9 | 56.6 \pm 7.2 |
| Males, <i>n</i> (%) | 77 (81.8) | 6 (66.7) |
| Iatrogenic – endoscope, bougie, dilation etc., <i>n</i> (%) | 38 (40.4) | 4 (44.5) |
| Apontaneous rupture, <i>n</i> (%) | 36 (38.3) | 3 (33.3) |
| Foreign body perforation, <i>n</i> (%) | 14 (14.9) | 2 (22.2) |
| Posttraumatic injury, <i>n</i> (%) | 6 (6.4) | – |
| Time between the start of symptoms and admission, median \pm SD [h] | 20.7 \pm 9.3 | 15.4 \pm 8.7 |
| Hospital admission more than 24 h after the onset of symptoms, <i>n</i> (%) | 17 (16) | 2 (22.2) |
| Surgical treatment more than 24 h after the onset of symptoms, <i>n</i> (%) | 36 (38.3) | 6 (66.6) |
| Time between the start of symptoms and surgery, median \pm SD [h] | 40.8 \pm 13.9 | 88.1 \pm 61.7 |
| Esophageal perforation cases diagnosed in the hospital Emergency Department (%) | 71.8 | 77.7 |



Figure 3. Chest X-ray of the patient with spontaneous rupture of a supradiaphragmatic segment of the esophagus. Left-sided hydro- and pneumothorax

one case of paratonsillitis, myocardial infarction, gastric bleeding, decompensated pyloric stenosis, caustic esophageal burn, an esophageal foreign body without perforation and acute hepatitis have been wrongly diagnosed at the first examination. These diagnostic mistakes led to unnecessary surgery in 13 patients such as diagnostic laparotomy – 10 cases, drainage of the pleural cavity in 2 and the resection of the stomach in one case.

An initial chest X-ray in the emergency department led to raising suspicion for oesophageal perforation in 55 out of 78 patients (68%) so as most X-rays had more than one sign of abnormality: unilateral pleural effusion and/or pneumothorax (Figure 3), pneumomedi-

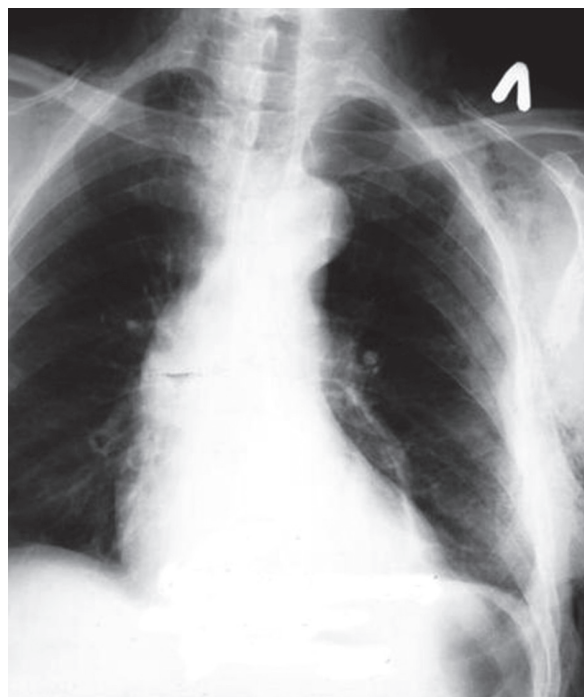


Figure 4. Chest X-ray of the patient with a middle third esophageal perforation. Subcutaneous emphysema and pneumomediastinum

astinum, subcutaneous emphysema (Figure 4). In the remaining 23 patients, however, chest X-rays didn't show any abnormalities or radiological findings were misidentified as infiltrative changes in the lungs.

Eighty-one (78.6%) out of the 103 patients underwent oesophagography with water-soluble contrast to confirm perforations, 66 (81.5%) of which definitely confirmed the pathology showing contrast leakage through esophageal wall into pleural cav-

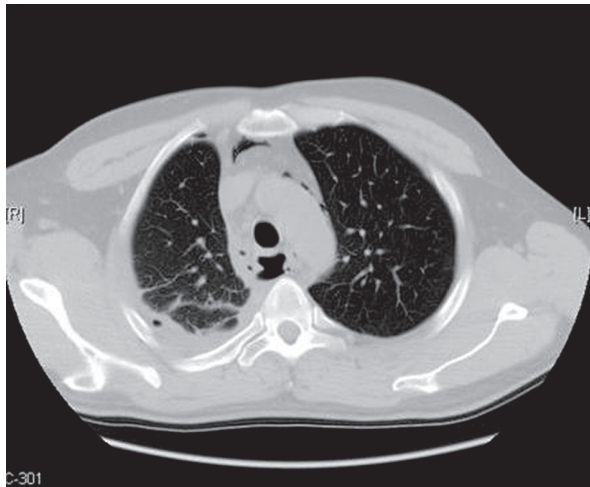


Figure 5. CT showing breakage in the middle third of the esophageal posterior wall

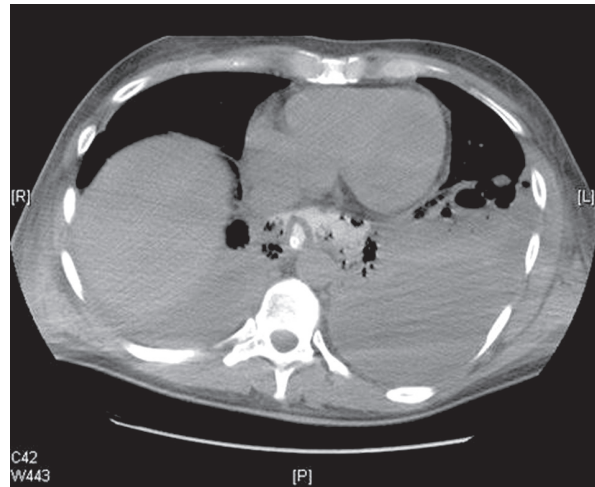


Figure 6. The thoracic CT scan reveals leakage contrast into the mediastinum and left pleural cavity

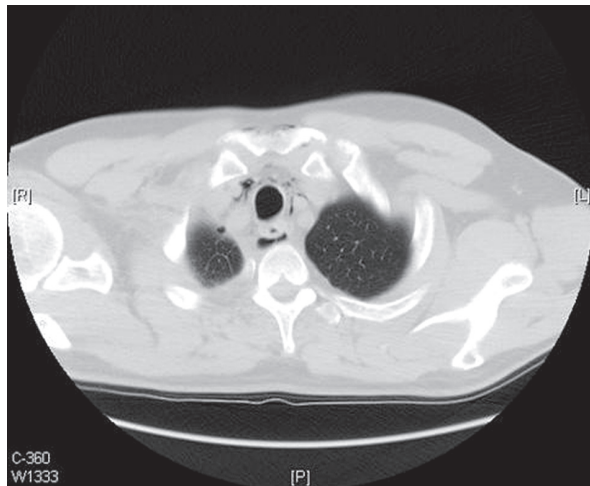


Figure 7. CT showing pneumomediastinum

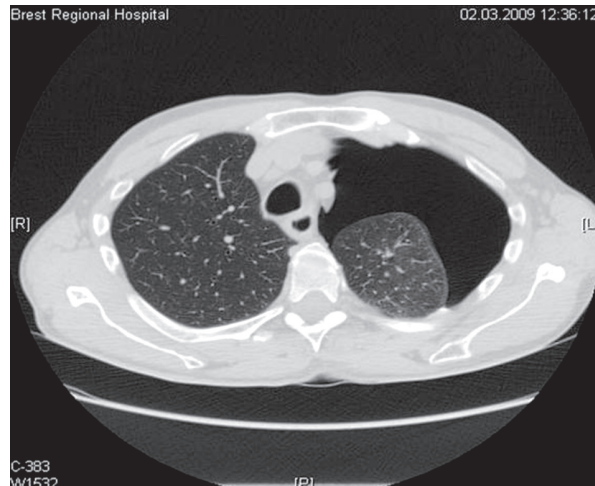


Figure 8. The CT scan image pneumothorax and collapse of the left lung

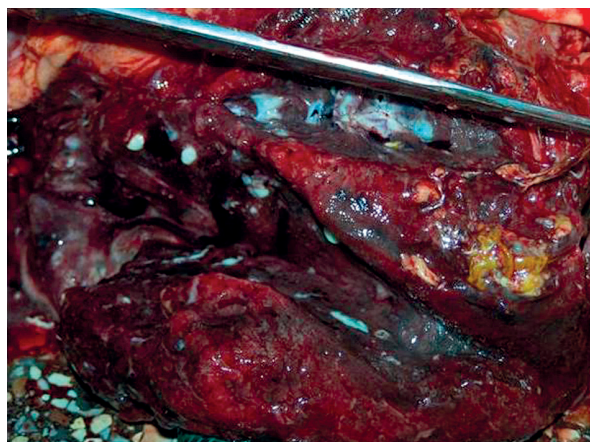


Figure 9. The lungs autopsy in VATS-group patient. The lungs are edematous, airless and the bronchial lumens are completely filled with purulent exudates

ity and pneumo- and hydrothorax. Ten foreign body perforation patients and five iatrogenic etiology (3 – bougie, 2 – endoscope) had false negative oesophagographies. Furthermore, an incorrect interpretation of the patient condition and the choice of inadequate treatment were undertaken in 3 (3.7%) patients with negative imaging results. Thirteen patients (12.6%) underwent chest computed tomography (CT) scans with 100% diagnostic efficiency in patients with atypical presentations by means of imaging direct radiological evidence of esophageal perforation such as esophageal wall discontinuity (Figure 5) and a contrast leak (Figure 6) or/and indirect signs which include pleural effusion, pneumomediastinum (Figure 7), subcutaneous emphysema, hydrothorax, pneumothorax and collapse of the lung (Figure 8).

Forty-one patients (38.9%) required a flexible oesophagoscopy to confirm the perforation because the

chest X-ray and contrast swallow results were equivocal, or when CT scans with orally administered contrast medium were impossible for technical reasons. In all cases during diagnostic endoscopy the defect of esophageal mucous membrane was revealed, and two of them had a fistula to the pleural cavity.

Sixty-five (69.2%) patients of the control group were complicated by postoperative morbidity that included postoperative leakage, pleural empyema, pneumonia, pulmonary embolism, pericardial effusion, gastric bleeding, a Esophagus fistula with osteomyelitis of the rib and wound infections that resulted in high mortality rate (33 cases). The median hospital stay to discharge or death was 50.9 ± 8.7 among those patients who had postoperative morbidity whereas without these complications it was 29.7 ± 4.44 days.

Postoperative leakage occurred in 32 patients among 54 (62.3%) who underwent primary repair of the thoracic esophagus perforations, more over the primary repair delayed for more than 24 h resulted in doubling of the postoperative leakage rate (22 cases).

For the VATS group of patients, the postoperative morbidity and mortality rates were lower (11.1% and 11.1%, $p < 0.05$), as only one patient with delayed diagnosis of Boerhaave's syndrome, died on the 28th postoperative day of respiratory failure, which was caused by a postoperative hospital-acquired pneumonia, mediastinitis and systemic sepsis (Figure 9).

The median time in surgery and the in-hospital stay also was shorter ($p < 0.05$) in the VATS-surgery group (64.2 min and 26.5 ± 5.6 days) than in the open-surgery group (116.6 and 41.2 ± 6.1 respectively) (Table 3).

Discussion

Esophageal perforations, particularly spontaneous, are difficult to diagnose because they can masquerade many clinical conditions like acute myocardial infarction, acute aortic dissection, tension pneumothorax [3], pneumoperitoneum [4] or different digestive system pathology as it has been presented in our study.

That is why the diagnosis can easily be missed or delayed, leading to delaying in the treatment in more than 50% of cases which accounts for the high mortality rate of 20–75% or 100% if left untreated [5].

As can be seen from our series, the delayed surgery in 42 patients (41%) is fraught high postoperative morbidity (66 patients, 64%) and 52% ($n = 22$ out of 42) in-hospital mortality, whereas overall mortality rate was 33% ($n = 34$ out of 104).

Several studies have also found that late (> 24 h) diagnosis and diagnosis of perforations may take place at centers away from the ones being appropriately managed are the main factors associated with poor outcomes [6, 7].

The most common misdiagnosis is perforated ulcer, myocardial infarction, pulmonary embolism, dis-

Table 3. Postoperative data

| Group | I control | II VATS |
|----------------------------------|----------------|----------------|
| No. of patients | 94 | 9 |
| Operation time [min] | 116.6 | 64.2 |
| Postoperative morbidity, n (%) | 65 (69.2) | 1 (11.1) |
| Hospital mortality, n (%) | 33 (35.1) | 1 (11.1) |
| Hospital stay [days] | 41.2 ± 6.1 | 26.5 ± 5.6 |

secting aneurysm and pancreatitis [8, 9]. In our data collective, thirteen patients were undergone unnecessary exploration surgery because of initial diagnostic mistakes and most often it was done in hospitals with inadequate clinical experience in thoracic surgery. The most common reasons for a delay in diagnosis were initial misdiagnosis and in 2 cases there were late presentations of patients.

We support the opinion of other researchers that diagnosis can be made earlier and more accurate with CT scan [10, 11], because the use of CT with contrast may expedite the diagnosis even in critically ill patients with atypical symptoms which might impede rapid identification of esophageal perforation. More over we consider, that up today CT scans may be useful not only for study of fluid and air collections, the extent of a surrounding inflammatory process but it can precisely enough localize the site of the perforation before VATS surgery and illustrate the postoperative healing of a esophageal perforation. Thus, from our point of view, CT with water-soluble contrast may become the "gold standard" in the diagnosis and management of esophageal perforation.

Despite this the endoscopy has sensitivity of 100% with specificity of 83% [12]. we recommend performing upper endoscopy only if perforation is not found with the contrast X-ray and/or CT, because it can increase the size of the already existing perforation and also introduce more air into the mediastinum.

We agree with many authors that for detected early perforations (less than 24 h from injury), the best treatment is primary repair [13–15].

However, we disagree with the view of Jougon *et al.* [16] that primary repair may have satisfactory results regardless of the time interval from injury to repair.

Our experience is that nobody of the VATS-group patients was fit for attempted primary surgical repair because the esophageal wound edges were oedematous, friable and also there was often associated mediastinitis and/or empyema rendering primary repair too risky. Depending on the localizations of thoracic esophageal perforations we decided to use either a left – or right-sided VATS approach for adequate surgical debridement and drainage of the mediastinum by the like T-tube drainage procedure. Our experience with VATS forming esophagocutaneous fistula shows that

this approach could be used as the first choice for management of esophageal perforations regardless of etiology and it is effective by minimizing additional surgical trauma in these high morbidity patients. More over, the survival results were much better than those for open surgery, however, less than hundred percent as Vogel *et al.* have published [17].

Conclusions

Esophageal perforations is a rare pathology and due to the rarity of this condition and its often non-specific presentation, the surgical treatment of this is delayed in more than 40% of patients, which leads to a death of every third patient.

Computer tomography with the oral contrast swallow must be the first-line investigation of patients who present signs or are suspected of esophageal perforation to speed up diagnosis and get confirmation of the site and extent of perforation in order to expedite the choice of an optimal treatment.

The developed by us video-assisted thoracoscopy method of treatment of the delayed (more than 24 h) esophageal perforation possesses a smaller operation trauma in comparison with the standard open surgical techniques which allows to apply this method to the treatment of patients in bad condition with an accompanying pathology and with severe inflammatory reaction.

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