THE EFFECTIVENESS OF MINIMAL INVASIVE PROCEDURES OF PREVENTING INTRATHORACIC INFECTIONS AFTER TUBE THORACOSTOMY FOR TRAUMATIC PNEUMO AND HAEMOTORACES –THE EXEPERIENCE OF ONE EMERGENCY COUNTY HOSPITAL

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Abstract

The aim of the paper is to observe the effectiveness of minimal invasive procedures versus iterative thoracostomy in preventing empyema thoracis and pneumonia after tube thoracostomy for traumatic pneumo and haemotoraces. It is an observational retrospective study over ten years (2002-2011) conducted in The Emergency County Hospital Oradea, on 939 trauma patients who underwent an initial tube thoracostomy for traumatic collections and in case of retained/persistent collections were treated either by a second conservative thoracostomy or by a minimal-invazive surgical exploration of the pleural space. The exploration of the pleural space (VATS), was effective in reduceing septic intrathoracic complications and was cost-efficient, with few extra morbidity and no mortality. VATS should be favoured instead of iterative tube thoracostomy if general anaesthesia and single lung ventilation are not prohibited. VATS equipment should belong to the standard armamentarium of the operative suite of any emergency county hospital.

Key words: minimal invasive procedures, tube thoracostomy, trauma, empyema, pneumonia

INTRODUCTION

Most of the thoracic trauma cases are treated without thoracotomy(1,2,3,4,5,6). Tube thoracostomy is the definitive treatment for 85-90% of trauma pneumo or/and haemothoraces(1,2,3,4,5,6). Trauma lowers immunity, jeopardises tissuees making them vulnerable to infection and colonises spaces that are normaly sterile. Thoracostomy itself can bring infection into the thorax either by procedural contamination or by missing complete evauation of collections that afterwords may becom infected. Forty percent of traumatic hemothoraces which become complicated by respiratory failure, empyema or fibrthorax need thoracotomy with the associated morbidity(2). In trauma setting the incidence of pneumonia and

empyema after tube thoracostomy may be 2-38%, with specific mortality as high as 30%(3,4). Preventing such evolution should take into account both surgical strategy and specific measures against pathogens. When the second chest tube fails the complete drainage, the minima-invazive exploration of the plerual space is efficient and avoids thoracotomy(2).

MATERIAL AND METHOD

It is an observational retrospective study, over ten years between 2002-2011, on trauma cases who underwent tube thoracostomy for pneumo or hemothoraces, exlusive the cases whom needed urgent thoracotomy in the first 48 hours.

We identified the patients who underwent a second surgical procedure for a persistent/retained collection after the first tube thoracostomy: either conservative (the second chest drain) or a minimal-invazive proecdure such as open thoracostomy, or since 2008 and only on sellected patients a VATS procedure. We noticed the administration and the non-administration of antbacterial drugs, the occurrence of pneumonia and/or empyema 48 hours or longer after the closed tube thoracostomy, and mortality events.

The statistical analysis surched for correlations between the presence of the risk factors for intrathoracic infection after a selected list(7,8,9,10,11) (COPD, TB, diabetes mellitus, heart diseases, liver diseases, renal diseases, neoplasms, alcohol consumption, obesity, age over 65 years, leucocytosis, polytrauma, multiple rib fractures or flail chest, more then one chest drain) and the occorrence of pneumonia and/or empyema. We compared the inhospital lengths of stay, the lengths of stay in the ICU, the costs of care, the inefctious morbidity and overall and specific mortality for patients treated with and without antibacterials, and for those who underwent conservative versus minimal-invazive surgical procedures. Because both the dedicated trauma severity scores (AIS, ISS…) and the physical and physiological status scores (ASA, APACHE) were seldomly evaluated both in the preshospital and inhospital settings, we assessed the case severity as the presence of serious traumatic lesions in more than one anatomical region of the body (polytrauma). The statistical analysis was performed with MedCalc 9.4.2.0 (MedCalc® Software, Mariakerke, Belgium). The results were presetnted as ‘nul’ hypotesis probability (p), which value <0,05 proved statstical significance of the variables.

RESULTS AND DISCUSSION

In our hospital, during the ten years period between 01.01.2002 and 31.12.2011, were admitted 939 patients with thoracic trauma who underwent tube thoracostomy with the intent of definitive treatment of penumo and/or hemothoraces. Of the 234 cases who evoluated with persistent/retained pleural collections, 71 patients underwent the second conservative closed chest tub thoracostomy, but 3 of them died and 6 suffered intrathoracic infectious morbidity. So that, the failures of the second chest tube were 9 (12,7%), and the success rate was 87,3% (n=62). Only 163 out of 939 patients were afforded a second, minimal-invasive procedure with general anaesthesia as a definitive treatment for persistent/retained traumatic collections. None of these patients died, but among them occurred one postoperative pneumonia and 8 intraoperative conversions to thoracotomy, so that the minimal-invasive procedure success rate was 94,4% (n=154), with a failure rate of 5,6%. Out of 705 patients who managed without persistent/retained collections after the initial thoracostomy, 33 became failures of the procedure as intrathoracic infections and 25 as deaths. However 6 of the them died with infections, so that the final failure rate of the procedure was 7,3% (n=52) and the success rate, 92,7% (n=653).

Morbidity: We identified 42 septic complictions in 40 patients (4,25%). Two of the patients associated pneumonia with empyema. Six of the septic patients belonged to the group treated with the second chest tube (n=71) and 1, to the minimal-invazive procedure group (n=163). Thirty-four out of 40 patients with intrathoracic infections (85%) recovered with the treatemnt, and 6 (15%) died. The operative morbidity (by pneumonia and empyema) of the initial tube thoracostomy group was 4,7% (33 out of 705), the morbidity for the secondary chest tube insertion was 8,5% (6 out of 71), and was 0,6% (1 out of 163) for the minimal-invazive procedures. The retrospective analysis with logistic regresion did not find the prophylactic or curatve antibiotic prescribing to lower the risk for infection outcomes (OR=0,4087; IC 95%: 0,09-1,72 *p=0,3193*). However, the minimal-invasive surgical procedures were found to associate significantly lower morbidity by intrathoracic infections (OR=0,0669; IC95%:0,0079-0,5664 *p=0,0048*) and significantly lower morbidity specifically by empyema (OR=0,0973; IC 95%:0,01-0,88 *p=0,0512*).

Mortality: Twenty-eight out of 939 patients (3%) died. Six of the dead patients had intrathortacic infections. Twnty-five of the deaths occurred among the 705 group of patients without persistent/retained pleural

collections and 3 of them among the 71 who underwent the second tube thoracostomy. There were no deaths among the minimal-invasive surgical exploration group. The operative mortality of the first tube thoracostomy was overall 3%, but specifically it was 3,5% for the initial tube thoracostomy (25 deaths out of 705 procedures), 2,3% for the second tube thoracostomy and 0 for the minimal-invasive procedures.

The conservative procedure ('the second chest tube') adressed to the persistent collections after the first tube thoracostomy (n=71) entailed a median length of stay in the hospital (12days CI95%:10-14) significantly (*p=0,0047 Mann-Whitney test*) longer than (10days CI95%:9-10) of the cases recovered with first thoracostomy (n=705). The cost of care (3505RON, CI95%:2812-4155) of the patients who received conservative treatment was siginficantly (*p=0,0111 Mann-Whitney test*) higher than (2770RON,CI95%:2560-2847) the cost of care for the cases without persistent collections.

The cases afforded minimal-invasive procedures (n=163) had median inhospital legths of stay (7days CI95%:6-7) significantly (*p=0,0001 Mann-Whitney test*) shorter than (12days, CI95%:10-14) the patients treated with conservative iterative thoracostomy (n=71) and had median cost of care (1927 RON CI95%:1767-2192) significantly (*p=0,0001 Mann-Whitney test*) lower then patients who underwent the second closed chest drain (3505 RON CI95%:2812-4155). Also, the logistic regression analysis found the minimal invazive procedures to lower the morbidity by intrathoracic infections after drainage.

The tube thoracostomy is a simple procedure performed under local anesthesia and frecquently indicated for traumatic pleural collections (1) like pneumo and hemothoraces. Sometimes it becomes source of infection as a matter of iatrogenic contamination, of the high virulence or resistnace of bacterial pathogens, and by failure of the defending mecanisms of the host or a combination of all these factors (7,11). Empyema and pneumonia occurr in 2-38% of cases after tube thoracostomy for trauma (3,4,11). The pathogenic mecanism of traumatic empyema may incumb retained hemothorax, persistent pneumothorax, nosocomial pneumonia (2) and seldomly an ignored diaphragmatic effraction. The tub thoracostomy is not always a definitive solution in trauma because allows persistent collecions: 18-30% of traumatic hemotoraces progress to retained hemothorax after drainage (1,2,12) and 4-24% of the drained traumatic pneumothoraces may progress to persistent pnuemothorax due to prolonged air leaks (2,13). When the second chest tube insertion failed, thoracotomy was necessary in 40% of the retained cloted hemotroaces in order to avoid complications like respiratory failure, empyema or fibrothorax (1,2,5).

Empyema correlates more directly with the effectiveness of the drainage than with the antibacterial use (6,17). Accordingly the key measures to prevent empyema are the drainage of the collections, the complete lung reexpansion and of obliteration of residual/dead pleural space (5). VATS (video assissted thoraci surgery) is ideal for all these aims.

Missing VATS equipment, we limitted the performance of the procedure to 72 cases where the patients afforded the rent of a mobile suit during the latest 4 years of our study. We performed alternatively 91 open thoracostomy procedures when indicated, assited by ultrasound or CT guidance and labling preoperatively. The success rate of minimal-invasive procedures was 94,4%, compartively to 87,3% for the second chest tube, and 92,6% for the initial closed chest tube thoracostomy. The operative morbidity by intrathoracic infections was 0,6% for the minimal-invasive procedures, as compared to 8,5% for 'the second chest drain' and 4,7% for the initial tube thoracostomy. The operative mortality was 0 for the minimal-invasive procedures, as comparetd to 2,3% of the 'second chest drain' and to 3,5% of the initial chest tube. Taking into account also the lengths of stay and costs of care, it results that the second chest drain is the least effective solution because implies the highest costs, morbidity and lengths of stay of all the procedures considered in our study. The excess of costs in the absence of operative room expenses is explained by the length of stay in the hospital. The retrospective analysis with logistic regression did not demonstrate that the use of antibacterials lowered the risk for intrathoracic infection outcomes neither in prophylactic, nor in the curative regimen; however the minimal-invasive surgical procedures managed to do this for both infectious oucomes and specifically for empyema as compared to 'the second chest drain'.

CONCLUSIONS

1. The tube thoracostomy successfully managed with more then 75% of the throracic traumatic collections
2. The open chest tube thoracostomy optimally approached aided by preoperative US or CT guidance, is a feasible solution, safe and more effective than the second closed chest tube thoracostomy for draining persistent/retaind traumatic collections, preventing pleural space infection and avoiding thoracotomy
3. The videoassited thoracic surgery is even more safe and cost-efficient than open tube thoracostomy for the management of the thoracic traumatic retained collections. It deserves precedence to open thoracostomy or second closed chest tube thoracostomy when

general anesthesia and single lung ventilation are not contraindicated, because it lowers significantly the risk of morbidity and the risk for thoracotomy together with lowering the costs of care.

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