

# **RESEARCH ARTICLE**

#### SURGICAL OR CONSERVATIVE MANAGEMENT OF TRACHEOBRONCHIAL INJURY

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#### Abstract

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Key words:-Management, Saudi Arabia, Tracheobronchial Injury

Background: Surgical intervention is considered as the radical traditional management of acute posttraumatic tracheobronchial lesions. The aim of the current study was to assess the effectiveness of conservative and surgical treatments for managing posttraumatic tracheobronchial injury management

Methodology: This is a retrospective study of 27 patients, from January 2009 to December 2015, with posttraumatic tracheobronchial injuries who were managed in King Faisal Medical Complex (trauma hospital) and King Abdul-Aziz specialist hospital (tertiary hospital) in Taif city, Saudi Arabia.

Results: Seventeen (63%) cases were treated conservatively, whereas the remaining 10 (37%) cases were treated surgically, the lesion was repaired with interrupted absorbable sutures. Conservative treatment consisted of endotracheal intubation, adequate ventilation with low tidal volumes, chest tube, prevention of pressure peaks as well as retention achieving a continuous control and Bronchoscopy follow-up. The overall survival rate within our series was 92.6% (25 patients). Two patients (7.4%) in our study died (one was treated surgically and the other conservatively) due to associated Polytrauma.

Conclusions: Conservative treatment is a feasible, safe procedure with a mortality rate as low as that of surgical management, and therefore should be considered as an option in the management of tracheobronchial injuries.

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# Introduction:-

Tracheobronchial injury (TBI) accidentally resulted from penetrating thoracic trauma. These injuries are rare but serious with fatal consequences (Mahmodlou and Sepehrvand, 2015, Cheaito et al., 2016).

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The most common causes of TBI are high-speed crashes, especially those involving cars accidents.TBI could occur as iatrogenic injuries during airway interventions, like intubations and tracheostomies(Balci et al., 2002, Rossbach et al., 1998).

The incidence of TBI is 0.3 to 1% of all patients. In trauma centers, with 2,500 to 3,000 patients admitted annually; two to four tracheobronchial lesions occur annually (Saad et al., 2017). Inpenetrating neck and chest trauma, the cervical trachea and nearby structures are commonly involved (Farley and Schlicksup, 2021). Closed

trauma causes thoracic trachealand bronchiallesions. However, the incidence of traumatic TBIhas been rising in the recent decades because of theincrease in traffic accidents and the growing use of general anesthesia with orotracheal intubation in older patients (Kaloud et al., 1997, Huh et al., 1997).

Recentimprovements in hospital care and transportation have increased the survival rate of patients with this type of trauma who reach the emergency(Bertelsen and Howitz, 1972, Deslauriers et al., 1982). The diagnosis and treatment of these lesions can be challenging, especially in closed trauma in which 25 to 68% of tracheobronchial lesions are not immediately diagnosed(Deslauriers et al., 1982, Kiser et al., 2001)<sup>,</sup> The current study was intended to assess the effectiveness of conservative and surgical treatment approaches in the treatment and management of TBI.

# Methodology:-

### **Ethical considerations:**

This study was approved by the Research Ethics Committee of Directorate of Health Affairs at Taif-Ministry ofHealthSaudiArabia(605, HAP-02-T-067 on 20/09/2021).A written informed patient consent was obtained upon admission.

#### **Study Design:**

This study involved 27 patients with TBIs who were managed in the King Faisal Medical Complex(Trauma hospital) and King Abdul-Aziz specialist hospital (tertiary hospital) in Taif city, Saudi Arabia from January 2009 toDecember 2015.

#### Data collection methods and procedure:

Data were collected from January 2009 to December 2015. We obtained the data viapatients' medical record numbers (MRN) and the radiological system to collect the associated radiological findings that were confirmed by plain chest x-ray, computed tomography (CT), or magnetic resonance imaging (MRI). In addition, the bronchoscopy findings were collected.

#### Data analysis:

Statistical analysis was carried out using the Statistical Package for the Social Sciences program (SPSS 21). Descriptive analysis was carried out to determine the prevalence, mean, and quantitation ofvariables. The chi-squared test was used to assess the correlations between TBI and other variables.

#### **Results:-**

Our study included 27 patients, 23 (85.2%) of whom were males and 4 (14.8%) were females, with a mean age of 31.2 (18-52) years (Table 1). Seventeen (63%) cases were treated conservatively, whereas the remaining 10 (37%) cases were treated surgically. The overall survival rate within our series was 92.6% (25 patients). Out of the 27 TBIs, 17 were bronchial (10 were on the right side and 7 on the left) and 10 were tracheal. The extension of the tears was conducted, with anaverage of 0.77 cm (a range of 0.3-2cm). The indications for conservative treatment were: i) critically ill patients, ii) small lacerations (<2 cm), and iii) refusal to undergo an operation. Conservative treatment included endotracheal intubation for5-27 days, with an average of10.7 days. Conservative treatment prevented pressure peaks as well as retention, achieving continuous control. Bronchoscopy follow-up was done after 6-12 months. No stenosis or mega-tracheawas observed in all the survivors (Table 2). The surgical management consisted of either collar incision for extra-thoracic lesions (Figure 1) or thoracotomy for intra-thoracic lesions depending on the location of the injury. The basic procedure was debridement and primary repair; generally, 4-0 multifilament or monofilament absorbable sutures are preferred in separate stitches and, in some situations, end-to-end anastomosis. Using protective tissue flaps (pericardium, muscle flaps, pleura, and mediastinal fat)was preferred whenever possible to avoid late fistulas. In cases of difficult repair with vascular injury and hemorrhage, pulmonary resection was a good alternative. For anesthesia, it was preferred to use a single-lumen endotracheal tube, which permits easier bronchoscopy whenever necessary. In both conservative and surgical management, chest tube was placed in the effected side under negative pressureand without suction till the complete resolution of pneumothorax and regression of subcutaneous emphysema.

Two patients (7.4%) in our study died, one was treated surgically and the other conservatively, both patients had additional polytrauma (p-value 0.000) (Table 2). The patient who was treated surgically had facial trauma, head trauma, and cardiac tamponade. He was intubated for 21 days and had two endotracheal tube replacements; he died due to the complications of acute respiratory distress syndrome. The second fatal case, whowas treated

conservatively,had facial trauma, head trauma, and flail chest. He was intubated for 14 days and had one endotracheal tube replacement; he died due to ventilator-associated pneumonia complications.

# **Discussion:-**

TBI is rare but has recently becomemore common due to the increasing incidence of motor vehicle accidents and the rapid transportation system, which makes it possible for patients to reach the hospital alive(Malekhosseini, 2005). Twenty-seven TBIs were treated; 23 (85.2%) of the patients were males and 4 (14.8%) were femaleswith an overall mean age of31.2 years old. Ahigh prevalence of TBI in females was suggestivedue to the fact that they have anatomically smaller airway in comparison to males(Lampl, 2004). However, in the current study, a higher prevalence of males was reported due to fact that at the time of this study; females were still not allowed to drive in Saudi Arabia, and so motor vehicle accidents were more common in males.

The right main bronchus injury was found in 37% of the patients and the left main bronchus was involved in 25.9%. The higher incidence of right main bronchus injuries is explained by the fact that the right main bronchus is shorter than the left;however, the right bronchus is also less protected than the trachea or the left bronchus, which are encircled by the aorta and other mediastinal structures(Kiser et al., 2001). Eight (30%) patients were presented with right pneumothorax, 6 (22%) patients with left pneumothorax, and 6 (22%) patients with right and left pneumothorax. These findings agree with a previous report that correlated the TBIsand the persistent air leaks with pneumothorax(Ong and Tan, 2008).

The typical selection criterion or conservative management is that there should be no evidence of respiratory or hemodynamic instability; it was believed that the ength or depth of the laceration is the main criterion (Cardillo et al., 2010). In another study, it was limited to small tears < 2 cm in length or unstable clinical situations (Andrés et al., 2005). Conti et al advocated conservative management in patients who have spontaneous ventilation or when extubating is scheduled within 24 hours of diagnosis (Conti et al., 2007). In our study, conservative treatment was the choice for the majority of patients as theyrefused to undergothe operation. For the remaining patients (37%), surgical repair was approached by collar incision for extra-thoracic lesions and right or left thoracotomy for intra-thoracic lesions, depending on the location of the injury. The basic surgical procedure is debridement and primary repaired. In general, 4-0 multifilament or monofilament absorbable sutures are preferred in separate stitches and, in some situationsend-to-end anastomosis. Tissue flaps (pericardium, muscle flaps, pleura, and mediastinal fat), were used whenever possible to avoid late fistulas as previously suggested (Anderson and Miller, 1995).

In cases of difficult repair with vascular injury and haemorrhage, pulmonary resection was usedasanalternative approach (Mei et al., 2017). For anesthesia, it was preferred to use single-lumen endotracheal tubeswhenever needed, which permitsan easier bronchoscopy (Almeida, 2019). In caseswith mainstem injuries, a selective right or left single-lumen tube were used, whereascross-field ventilation was very useful in extra-thoracic injuries (Sehgal et al., 2014).

Flexion were maintained postoperatively when a chin-to-chest stitch was used forsection until the anastomosis was healed without tension as previously described (Altinok and Can, 2014, Rossbach et al., 1998).

Stricture formation is a complication of TBI that can be managed with or without repair (Mussi et al., 2001). There was no stricture in our study at the 12-month follow-up after the injury. In contrast, stricture was reported in 12.8% and 9.3% of patients in other studies (Alassal et al., 2014, Balci et al., 2002). TBIs were previously thought to be universally fatal. Recently, management can be performed with acceptable mortality. In the current study, 7.4% mortality was recorded which is lower than those reported in other studies (16.6%–19.3%) (Mussi et al., 2001, Balci et al., 2002).

An association between mortality and lesions longerthan 1 cm, additional injuries, and pneumothorax was recorded. The mortality in 2 patients who died in this study, was due to complications of associated injuries like ventilatorassociated pneumonia, acute respiratory distress syndrome, and subcutaneous and mediastinal emphysema (Bejvan and Godwin, 1996, Koenig and Truwit, 2006)and not to the type of selected management, which is similar to the study conducted by(Kumar and Anjum, 2021)

In conclusion, conservative managementis a feasible, safe procedure thathaslower mortality rates than surgical interference, and therefore should be considered as an option in the management of TBIs. An association between

mortality and lesions longerthan 1 cm, additional injuries, and pneumothorax was confirmed. All of the patients who died in this study had died from complications of the respiratory system.

# Figure legends

Fig.1: Collar incision for extra-thoracic tracheal injury



Table 1: Injury variables in relation to management outcome

ariable		Result (outcome)			
		Excellent N, (%)	Death N, (%)	$X^2$	P-value
Type of injury	Trachea	10 (37)	0 (0)	3.672	0.159
	Right main bronchus	8 (29.6)	2 (7.4)		
	Left main bronchus	7 (25.9)	0 (0)		
Additional injury	Orthopedic injuries	7 (25.9)	0 (0)	27.000	0.000*
	Facial & head trauma	3 (11.1)	0 (0)		
	Diaphragmatic rupture	1 (3.7)	0 (0)		
	No injuries	10 (37)	0 (0)		
	Abdominal injuries	3 (11.1)	0 (0)		
	Facial, head trauma & cardiac tamponade	0 (0)	1 (3.7)		
	Facial, head trauma & flail chest	0 (0)	1 (3.7)		
	Abdominal injuries & cardiac tamponade	1 (3.7)	0 (0)		
Sex	Male	21 (77.7)	2 (7.4)	0.376	0.540
	Female	4 (14.8)	0 (0)		
Pneumothorax	No pneumothorax	7 (25.9)	0 (0)	2.093	0.553
	Right	7 (25.9)	1 (3.7)		
	Left	6 (22.2)	0 (0)		
	Right and left	5 (18.5)	1 (3.7)		
Extension of tear in ~ cm (~0.3-2)	0.3 cm	6 (22.2)	0 (0)	17.280	0.002*
	0.5 cm	9 (33.3)	0 (0)		
	1	8 (29.6)	0 (0)		
	1.5 cm	2 (7.4)	1 (3.7)		

		Subjects			
		Survivors N, (%)	Death N, (%)	$X^2$	P-value
Number of endotracheal	None	17 (62.9%)	0 (0%)	6.953	0.031*
tube replacement	Once	7 (25.9%)	1 (3.7%)		
	Twice	1 (3.7%)	1 (3.7%)		
Type of management	Surgical	9 (33.3%)	1 (3.7%)	0.156	0.693
	Conservative	16 (59.3%)	1 (3.7%)		
Complications	No complications	17 (62.9%)	0 (0%)	27.000	0.000*
	Subcutaneous and mediastinal emphysema	7 (25.9%)	0 (0%)		
	Acute respiratory distress syndrome Emphysema	0 (0%)	1 (3.7%)		
	Subcutaneous and mediastinal emphysema				
	Ventilator-associated pneumonia	0 (0%)	1 (3.7%)		
	Emphysema				
	Subcutaneous and mediastinal emphysema				
		1 (3.7%)	0 (0%)		
Bronchoscopy follow up	No stenosis	19 (70.4%)	0 (0%)	5.130	0.024*
after 6-12 months	Not done	6 (22.2%)	2 (7.4%)		

Table 2: Follow-up of patients subjected to either surgical or conservative management of a tracheobronchial injury.

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