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Management of Post-intubation Tracheal Stenosis

Mohamed Ezzat Helmy, Mostafa Abdelsattar Kotb, Mohamed Atef Ghaly, Kareem Mohamed Elfakharany

Cardiothoracic Surgery Department, Faculty of Medicine, Zagazig University, Egypt.

Corresponding author: **Mohamed Ezzat Helmy**, Email: Drmohamedezzat1@gmail.com

ABSTRACT

Background Surgical resection and re-anastomosis are considered the most appropriate approaches to treat post-intubation tracheal stenosis (PITS). Bronchoscopic methods can be utilized as palliative therapy in patients who are ineligible for surgical treatment or who develop post-surgical re-stenosis. This study aimed to evaluate surgical intervention in post-intubation tracheal stenosis patients either open or endoscopic in management of post-intubation tracheal stenosis and to evaluate efficiency of repeated bronchoscopic dilatation. **Patient and methods:** A prospective and retrospective cohort study included 20 cases with tracheal stenosis admitted to cardiothoracic surgery department, Zagazig university hospitals. Patients divided into two groups; surgery group included 10 patients underwent surgical tracheal resection and re-anastomosis, and bronchoscopy group included 10 patients underwent repeated rigid bronchoscopy tracheal dilatation. **Results**: No significant differences were observed in length of stenosis, or vocal cord distance between the two groups, recurrence was higher in bronchoscopy group than surgery group and there was statistically significant increase in duration before recurrence in surgery group than endoscopic group, also complications in surgery group were vocal cord paralysis, surgical emphysema, surgical site infection, hematoma, and anastomotic leakage, in comparison to hypoxemia in in bronchoscopy group. **Conclusion** Tracheal resection and re-anastomosis are the most efficient techniques in management of tracheal stenosis with lower failure and recurrence rates than bronchoscopy group.

Key words Tracheal resection and re-anastomosis; PITS; Tracheal bronchoscopy.

INTRODUCTION

The incidence rate of post-intubation tracheal stenosis (PITS) varies from country to country due to various reasons, like the varying prevalence of the etiological factors, expertise of pre-hospital emergency medical staff, number of ICUs, the experience of ICU staff with non-traumatic intubation, and the quality of the equipment. It was estimated to be 4.6% in the United Kingdom, and 20% in India **(1)**.

Despite advances in care postintubation tracheal stenosis remains a challenging problem. Laryngotracheal resection and tracheostomy lead to worse outcomes. Excellent surgical results can be obtained for postintubation tracheal stenosis. Good results require careful evaluation, management of comorbid conditions, meticulous technique, minimizing tension, and preservation of blood supply **(2)**.

Mechanism of post-intubation tracheal stenosis can be explained by the direct pressure of the cuff and/or the tip of the tube on the mucosa during the period of intubation and the subsequent ischemia stimulate an inflammatory reaction, leading to mucosal edema, granulation

tissue formation, fibrosis, cartilage destruction, and finally, tracheal stenosis after extubation. Another mechanism could be direct trauma subsequent to a forceful intubation of critically injured patients by less experienced medical staff **(3)**.

Tracheal resection and reconstruction (TRR) and laryngotracheal resection and reconstruction (LTRR) can be performed safely and successfully in the majority of patients. Complications-particularly those related to the airway anastomosis—are infrequent but can be devastating (**4)**. Several factors, including length of resected trachea, preexisting tracheal appliance, prior tracheal resection, and medical comorbidities such as diabetes have been shown to increase the risk of anastomotic complications. Careful preoperative planning, intraoperative technique, and postoperative care mitigate but do not eliminate this risk. Early recognition is the key to effective management of complications **(5)**.

Special emphasis is placed on securing a stable airway, which may in turn require a temporary endotracheal tube or airway appliance. When an anastomotic complication is addressed promptly most patients will go on to have a good outcome. However, the presence of an anastomotic complication increases the risk of perioperative mortality and long-term morbidity substantially compared to an uncomplicated operation (**6)**.

The current study aimed to evaluate surgical intervention in post-intubation tracheal stenosis patients either open or endoscopic in management of post-intubation tracheal stenosis and to evaluate efficiency of repeated bronchoscopy in patient not fit for surgery.

PATIENTS AND METHODS

A prospective and retrospective cohort study included 20 cases with tracheal stenosis admitted to cardiothoracic surgery department, Zagazig university hospitals. Patients divided into two groups; surgery group included 10 patients underwent surgical tracheal resection and re-anastomosis, and bronchoscopy group included 10 patients underwent repeated rigid bronchoscopy tracheal dilatation.Clear explanation of the study was made for all cases and a written informed consent was taken from each. The study protocol was approved for Institutional Review Board (IRB) of Zagazig University.

Inclusion criteria:

Repeated bronchoscopic dilatation group included patients with non-circumferential tracheal stenosis and tracheal stricture not exceeding 2 cm in length. Patients of surgical resection and re-anastomosis group involved the subglottic region and complex or long (>3 cm) tracheal stenosis.

Exclusion criteria:

Patients with complex or long (>3 cm) tracheal stenosis in bronchoscopic dilatation group.

Patients who are not fit for surgery regarding associated medical condition in other group.

Patients refused to participate in the study.

Operative Assessment:

All patients were subjected to full history taking, general and local examination, radiographic assessment included US examination of the neck and chest was performed. Chest

CT examinations were performed using 128 slice spiral CT scanners. Laboratory investigation included CBC, blood glucose, bleeding time, activated partial thromboplastin time, prothrombin time, thrombin time, Kidney & Liver function test and urine analysis were done. Bronchoscopy used for assessment of the appearance and movement of the cords was done. A final assessment of the airway was performed ensure adequate hemostasis.

Surgical maneuvers

I. Repeated Bronchoscopic Dilatation:

Patients in this group underwent repeated bronchoscopic dilatation. The upper airway was anesthetized with 5 mL of 1% lidocaine solution administered orally by nebulization, and additional small quantities of lidocaine were instilled through the bronchoscope as required to control coughing. A variety of inflatable balloons was used with diameters of 5–14 mm and lengths from 2 to 4 cm. Under bronchoscopic guidance, the balloon was placed across the stenosis using an adapted modification of Seldinger's technique. Then, the balloon was gradually inflated with saline solution using the basic inflation syringe to maximum balloon pressure psi and was held for 30s. After deflation, if the airway was still narrow, and if the patient tolerated the dilatation with respect to oxygen saturation and hemodynamics, the procedure was repeated either with the same balloon or one with a larger diameter.

II. Tracheal resection:

The other group underwent tracheal resection, release and pull up and down of distal and proximal ends of trachea respectively and re-anastomosis of them using PDS sutures. General anesthesia was administered, and the patient was placed supine, and a shoulder roll was placed to enhance neck extension. The neck and chest are draped in a sterile fashion. A horizontal collar incision is made through the skin and platysma. Subplatysmal flaps were raised superiorly to the hyoid bone and inferiorly to the sternal notch. The strap muscles were divided along the median raphe and retracted laterally. The thyroid isthmus was divided, and the anterior border of the thyroid cartilage, cricoid, and trachea down to the sternal notch were defined. Fine dissection was performed to isolate the tracheal stenosis region with care not to compromise the lateral blood supply and the recurrent laryngeal nerves. Once the segment to be excised had been identified and isolated superiorly, laterally, and inferiorly, the airway was entered. A wire-reinforced endotracheal tube was then passed into the distal trachea and connected to the ventilator circuit. A suture was placed through the distal trachea to secure it to the endotracheal tube. Until continuity was re-established, the patient was ventilated through the distal tracheal intubation. A horizontal incision was made across the superior aspect of the desired resection. Both the inferior and superior incisions were extended through the posterior wall until the party wall fascia was identified.

Dissection was performed along the party wall between the superior and inferior posterior party wall incisions. The stenotic segment was then dissected free from the esophagus posteriorly and the surrounding tissue laterally. The proximal and distal trachea was then reapproximated

and re-anastomosed. This started by managing the endotracheal tube. Bracing sutures can be used to help reduce tension between the proximal and distal trachea during anastomosis. With the tracheal ends in close approximation, the posterior membranous wall was addressed first using simple, interrupted absorbable 3-0 PDS stitches placed 3 mm apart and 3 to 4 mm from the cut edge submucosally with the knots cinched outside the lumen. Once the posterior wall was repaired, the distal segment is extubated, and the circuit was connected to the proximal circuit as the endotracheal tube was advanced until the ETT cuff is below the anastomosis. The ETT should be secured, and the measurement at the lip or teeth recorded. The cartilaginous trachea is then reapproximated with interrupted 3-0 PDS and the knots cinched outside the lumen. Before sealing the anastomosis, it was important to confirm that the inflated cuff is not against the anastomosis. To verify an air-tight closure, the wound was submerged in sterile saline, and insufflation pressure is elevated to 40 cm water. A closed suction drain or Penrose was placed. The skin is closed in a multi-layer fashion by reapproximating the platysma and skin closure.

Meticulous follow up:

Both study groups were followed up in early and late post-operative course. Data was collected concerning post-operative air-way compromise, wound infection, sepsis suture line dehiscence and defective healing. Endoscopic assessment within 6 months to asses air-way patency and exclude recurrence of stricture.

Statistical analysis:

Data analyzed using Microsoft Excel software and Statistical Package for the Social Sciences (SPSS version 20.0). According to the type of data qualitative represent as number and percentage, quantitative continues group represent by mean ± SD. Differences between quantitative independent multiple by ANOVA or Kruskal Wallis. P value was set at <0.05 for significant results &<0.001 for high significant result.

RESULTS

The present results showed age in surgery group ranged from 18 to 49years and the mean ± SD was 33.10±11.49 years, while in bronchoscopy group the age ranged from 18 to 55 years and the mean ± SD was 32.60±11.155 years **(Figure 1)**. The gender was distributed in surgery group (60%) males, (40%) females and in bronchoscopy group (50%) males, (50%) females with no significant difference (p>0.05) **(Figure 2)**.

Reason for admission where 4(40%) cases had motor vehicle accident in surgery group and 4(40%) case also in bronchoscopy group, 2(20%) cases in surgery group with COVID 19 in comparison to 4(40%) cases in bronchoscopy group, 1(10%) case with occupational injury in surgery group, and 1(10%) case had heart surgery in surgery group and 1(10%) case had a stab in surgery group,1(10%) case also in bronchoscopy group, and 1(10%) case had suicidal attempt in surgery group, and finally one case fall from height in bronchoscopy group. There was no statistically significant difference between the two groups as regards reason for admission (p>0.05) **(Table 1)**.

Comparison between two groups as regards Meyer–cotton grade of stenosis, in surgery group it was grade II in 1(10%) case, grade III in 5(50%) cases and grade IV in 4(40%) cases, in comparison to grade II in 5(50%) cases, grade III in 4(40%) cases and grade IV in 1(10%) case in bronchoscopy group. There was no statistically significant difference between the two groups as regards Meyer–cotton grade of stenosis (p>0.05) **(Table 2)**.

Duration of intubation (days) in surgery group ranged from 12 to 24 days and the mean ± SD was 15.90 ± 3.54 days, while in bronchoscopy group ranged from 13 to 23days and the mean ± SD was17.80±3.36 days. Distance from main carina in surgery group ranged from 4 to 6 cm and the mean ± SD was5.30±0.67 cm, while in bronchoscopy group ranged from 3 to 8 cm and the mean ± SD was5.60±2.27 cm. Length of stenosis in surgery group ranged from 0.5 to 5 cm and the mean ± SD was1.700±1.25 cm, while in bronchoscopy group ranged from 1 to 5 cm and the mean ± SD was2.55±1.21cm. There was no statistically significant difference between the two groups (p>0.05) **(Table 3)**.

Distance from vocal cords in surgery group ranged from 2 to 7 cm and the mean ± SD was3.70±1.70 cm, while in bronchoscopy group ranged from 1 to 5 cm and the mean ± SD was2.90±1.20 cm. There was no statistically significant difference between the two groups as regards distance from vocal cords (p>0.05) **(Figure 3)**.

Although failure was higher in bronchoscopy group than surgery group, but there was no statistically significant difference between the two groups as regards outcome (p>0.05) **(Figure 4)**. Comparison between two groups as regards complication, 6(60%) cases had complications in surgery group where there was vocal cord paralysis in 1(10%) case, surgical emphysema in 1(10%), surgical site infection in 2(20%), hematoma in 1(10%), and anastomotic leakage in 1(10%), in comparison to hypoxemia in 3(30%) cases in bronchoscopy group. There was no statistically significant difference between the two groups as regards complications (p>0.05) **(Table 4)**. As regards recurrence, in surgery group 2(20%) case had recurrence in comparison to 4(40%) cases in bronchoscopy group. Although recurrence was higher in bronchoscopy group than surgery group, but there was no statistically significant difference between the two groups as regards recurrence (p>0.05) **(Table 5)**.

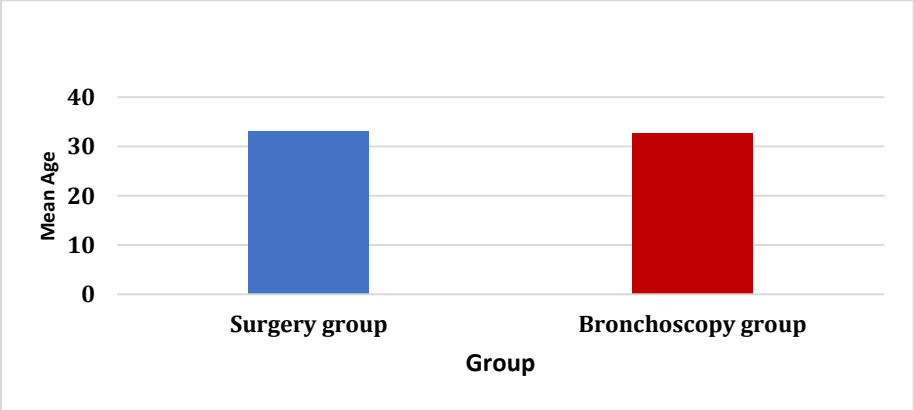

Figure (1): Comparison between two groups as regards age

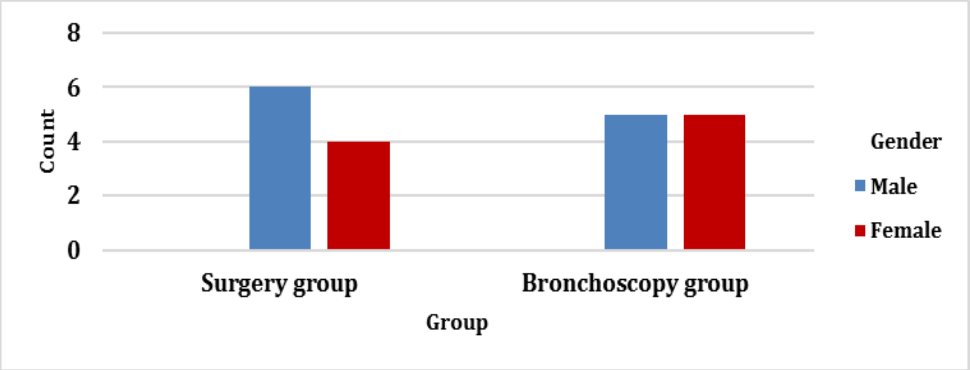

Figure (2): Comparison between two groups as regards gender

Table (1): Comparison between two groups as regards reason for admission

Reason for admission	Surgery group (n = 10)		Bronchoscopy group (n = 10)		Total		X^2	P-value
	N	%	N	%	N	%		
Motor vehicle accident	4	40.0%	4	40.0%	8	40.0%	4.67	0.587
COVID 19	2	20.0%	4	40.0%	6	30.0%		
Occupational	1	10.0%	0	0.0%	1	5.0%		
Heart surgery	1	10.0%	0	0.0%	1	5.0%		
Stab	1	10.0%	1	10.0%	2	10.0%		
Suicidal attempt	1	10.0%	0	0.0%	1	5.0%		
Fall from height	0	0.0%	1	10.0%	1	5.0%		
Total	10	100.0%	10	100.0%	20	100.0%		

(χ2): Chi-square Test, p value>0.05 is non-significant

Table (2): Comparison of Meyer-cotton grade of stenosis between the two groups

Meyer–cotton grade of stenosis	Surgery group (n = 10)		Bronchoscopy group (n = 10)		Total		X^2	P-value
	N	%	N	%	N	%		
II	1	10.0%	5	50.0%	6	30.0%	4.58	0.101
III	5	50.0%	4	40.0%	9	45.0%		
IV	4	40.0%	1	10.0%	5	25.0%		
Total	10	100.0%	10	100.0%	20	100.0%		

(χ2): Chi-square Test, p value>0.05 is non-significant

Table (3): Comparison between two groups as regards duration of intubation, distance from main carina and length of stenosis

	Surgery group (n = 10)			Bronchoscopy group (n = 10)			t	P-value
Duration of intubation (days)								
Min – Max	12		24	13		23	-1.231	0.234
Mean ± SD	15.90	±	3.54	17.80	±	3.36		
Distance from main carina (cm)								
Min – Max	4		6	3		8	-0.400	0.694
Mean ± SD	5.30	±	0.67	5.60	±	2.27		
Length of stenosis (cm)								
Min – Max	0.5		5.0	1.0		5.0	-1.543	0.140
Mean ± SD	1.70	±	1.25	2.55	±	1.21		

(χ2): Chi-square Test, p value>0.05 is non-significant

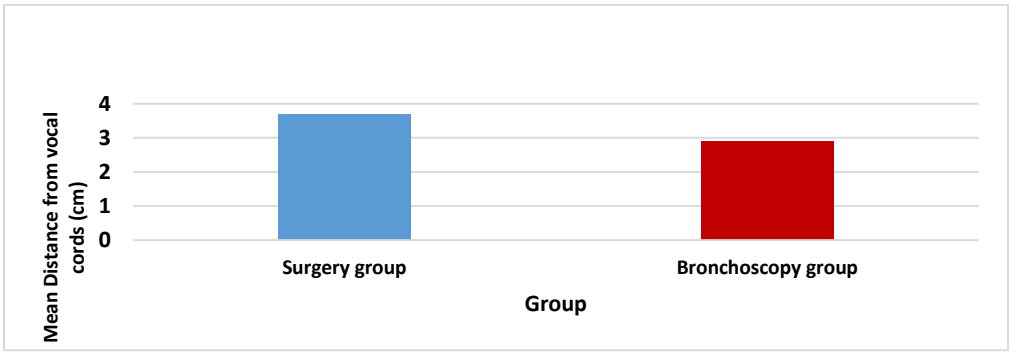

Figure (3): Comparison between two groups as regards distance from vocal cords (cm)

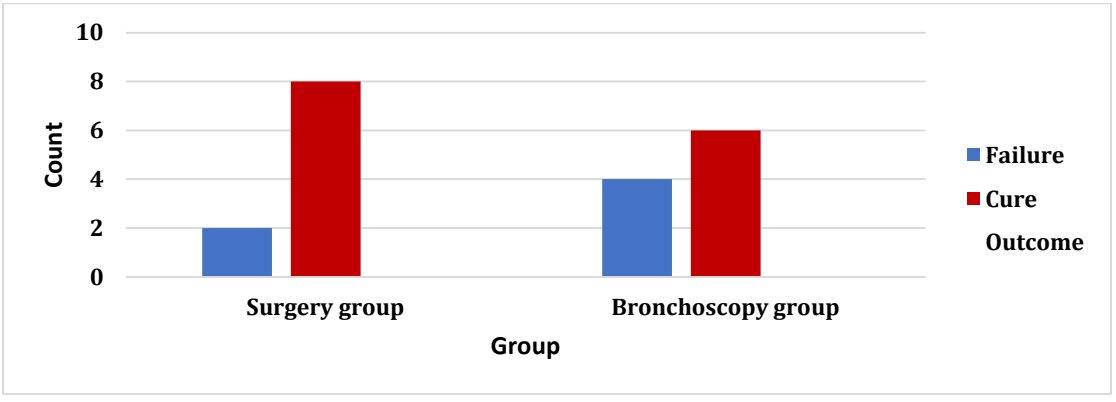

Figure (4): Comparison between the two groups as regards outcome

Table (4): Comparison between the two groups as regards complication

Complication	Surgery group (n = 10)		Bronchoscopy group (n = 10)		Total		X^2	P-value
	N	%	N	%	N	%		
None	4	40.0%	7	70.0%	11	55.0%	9.82	0.133
Vocal cord paralysis	1	10.0%	0	0.0%	1	5.0%		
Surgical emphysema	1	10.0%	0	0.0%	1	5.0%		
Surgical site infection	2	20.0%	0	0.0%	2	10.0%		
Hematoma	1	10.0%	0	0.0%	1	5.0%		
Anastomotic leakage	1	10.0%	0	0.0%	1	5.0%		
Hypoxemia	0	0.0%	3	30.0%	3	15.0%		
Total	10	100.0%	10	100.0%	20	100.0%		

(χ2): Chi-square Test**,** p value>0.05 is non-significant

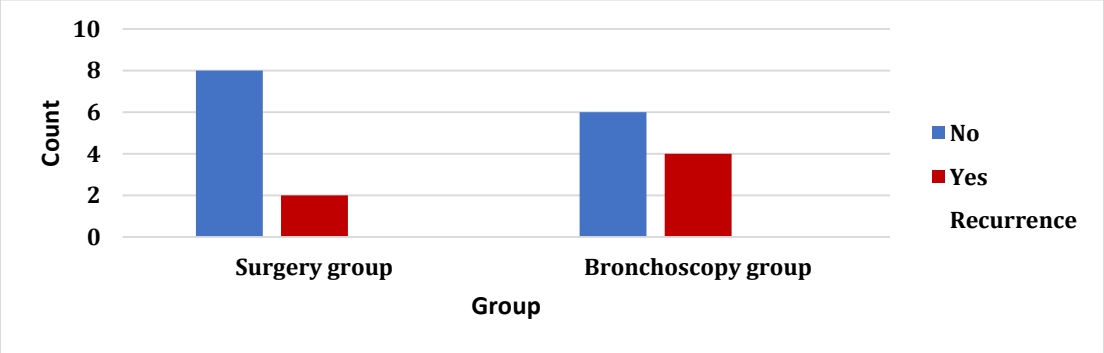

Figure (5): Comparison between the two groups as regards recurrence

DISCUSSION

Post-intubation tracheal stenosis is the most common type of tracheal stenosis these days. With the introduction of an endotracheal tube with a high-volume low-pressure cuff in the 1970s, the risk of post-intubation tracheal stenosis has decreased **(7)**. The standard care for tracheal stenosis is tracheal resection with end-to-end anastomosis; however, not all patients seem to benefit from the surgery **(8)**.

In particular cases, endoscopic procedures can be used instead of open surgery. However, these endoscopic procedures may require repeated interventions. If stenosis recurs after a primary intervention, treatment becomes complicated, and the prognosis tends to be poor **(9)**.

Recently, with increasing number of patients requiring ICU admission and mechanical ventilation due to COVID-19 pandemic, much attention should be played for such cases to put an eye on causes and risk factors, avoid its occurrence and to find the best, most reliable and applicable solutions. In this study we are comparing 2 different methods for management of PITS, either repeated bronchoscopic tracheal dilatation or surgical resection and re-anastomosis.

Rigid bronchoscopy and dilatation of the stenosis is the best initial management and could be repeated several times as required. The main aim of the study was to evaluate the efficacy of two different methods in managing Post-intubation tracheal stenosis.

Our study is compared with the study of **Nosair et al. (10)** which included 40 patients with symptomatic tracheal stenosis indicated for BBD. The patients' age ranged from 18 to 60 years with a mean age of 34.5 ± 12 years. Thirty out of them were males. Specific symptoms as stridor or dyspnea (70%), retention of secretions (12.5%), retention pneumonia (10%), and atelectasis (7.5%) of cases.

Endotracheal intubation in the ICU is a high-risk procedure, resulting in significant morbidity and mortality. Up to 40% of cases are associated with marked hypoxemia or hypotension. The ICU patient is physiologically very different from the usual patient who undergoes intubation in the operating room, and different intubation techniques should be considered. The common operating room practice of sedation and neuromuscular blockade to facilitate intubation may carry significant risk in the ICU patient with a marked oxygenation abnormality, particularly when performed by the non-expert. Pre-oxygenation is largely ineffective in these patients and oxygen desaturation occurs rapidly on induction of anesthesia, limiting the time available to secure the airway **(11)**.

In comparison with our findings, the study of **Wang et al. (12)** reported that across the five imputations we linked a mean of 11,255 successful ETI to hospitalization records. The mean age was 61 years (95% CI: 60–63), and the cohort was mostly male (56%; 95% CI: 55–57%). Of the hospitalized patients, the leading primary diagnosis groups were circulatory diseases (32.0%, 30.2–33.7%), respiratory diseases (22.8%, 21.9–23.7%), and injury or poisoning (25.2%; 22.7–27.8%), collectively comprising over 80% of the hospitalized cases. Prominent primary diagnosis subgroups included: asphyxia and respiratory failure (15.2%), traumatic cerebral injury and skull fractures (11.3%), acute myocardial infarction and ischemic heart disease (10.9%), poisoning, drug and alcohol disorders (6.7%), dysrhythmias (6.7%), hemorrhagic and non-hemorrhagic stroke (5.9%), acute heart failure and cardiomyopathies (5.6%), pneumonia and aspiration (4.9%), and sepsis, septicemia and septic shock (3.2%).

In the present study; comparison between two groups as regards site of stenosis, in surgery group it was cricotracheal in 4(40%) cases, and tracheal in 6(60%), in comparison to cricotracheal in 5(50%) cases, and tracheal in 5(50%) in bronchoscopy group. **Nosair et al.(10)** found the level of stenosis in 26 patients (70%) in the upper 1/3 of the trachea, 5 patients (12.5%) had tracheal stenosis between the upper and middle third of the trachea, and 5 patients (12.5%) had middle third tracheal stenosis (three of them needed tracheal stenting), while the other two patients (5%) had lower third tracheal stenosis and were managed successfully using balloon dilation alone In the present study; comparison between two groups as regards Meyer–cotton grade of stenosis, in surgery group it was grade II in 1(10%) case, grade III in 5(50%) cases and grade IV in 4(40%) cases, in comparison to grade II in 5(50%) cases, grade III in 4(40%) cases and grade IV in 1(10%) case in bronchoscopy group. There was no statistically significant difference between the two groups as regards Meyer–cotton grade of stenosis ($p>0.05$).

Ozkul et al. (2016) aimed to present retrospective experience in Meyer-Cotton grade 3 tracheal stenosis of 17 patients treated by T-tube, considering the characteristics of the treated stenosis, surgical procedures performed, and post-operative outcomes and complications and reported that according to the Myers-Cotton classification, all patients were at stage 3. Mean length of the stenosis was 26.58 ± 12.02 (range =15-70) mm, **Gelbard et al. (14)** reported that when stratified via Cotton-Myer staging (based on the degree of luminal obstruction), significantly more patients with grade III (90%) and grade IV (90%) lesions were tracheostomy dependent at last follow-up compared to those in either the grade II (38%) or grade I (32%) groups. ($p<0.001$). When staged according to the McCaffrey classification system (based on both stenosis location and length), increased stage was associated with progressively increased risk of tracheostomy ($p<0.01$).

In comparison with the study of **Mokhber Dezfuli et al. (15)** in which most patients (36%) the duration of intubation was 1–14 days. Also, there was a history of more than 30 days intubation period in 30% of the patients. There was no significant difference between groups of intubation-duration ($P = 0.47$).

While, as regard distance from vocal cords; we found that in surgery group ranged from 2 to 7cm and the mean ± SD was 3.70±1.70 cm, while in bronchoscopy group ranged from 1 to 5 cm and the mean±SD was 2.90±1.20 cm, distance from main carina in surgery group ranged from 4 to 6 cm and the mean ± SD was 5.30±0.67 cm, while in bronchoscopy group ranged from 3 to 8 cm and the mean ± SD was 5.60±2.27 cm. There was no statistically significant difference between the two groups as regards distance from distance from main carina and distance from vocal cords ($p>0.05$). In comparison with our findings, the study of **Zias et al. (16)** reported that Distance from vocal cords (cm) was 3.1 (2–7) and 2.7 (1–5) in post tracheostomy and post intubation group respectively, while distance from main carina (cm) was 5.5 (5–6) in pot-tracheostomy group and was 5.5 (3–8) in post intubation group, There was no statistically significant difference between the two groups as regards distance from distance from main carina and distance from vocal cords ($p>0.05$).

In the current that length of stenosis in surgery group ranged from 0.5 to 5cm and the mean±SD was 1.700±1.25 cm, while in bronchoscopy group ranged from 1 to 5 cm and the mean ± SD was 2.55±1.21cm. There was no statistically significant difference between the two groups as regards length of stenosis ($p>0.05$). However, **Zias et al. (16)** reported in their study that mean length of the stenosis was greater in the PI group due to the (common) formation of a web-like stenosis along the distribution of the endotracheal tube cuff. The mean length of the stenosis was greater in the PI group due to the (common) formation of a web like stenosis along the distribution of the endotracheal tube cuff. Patients with PI stenosis had a mean duration of intubation of 5.2 days. Not surprisingly, patients with tracheal stenosis following tracheostomy had a much longer duration of cannulation, with a mean of 54.5 days.

In our study, although failure was higher in bronchoscopy group than surgery group, but there was no statistically significant difference between the two groups as regards outcome ($p>0.05$). **Nosair et al. (10)** revealed that the success rate of balloon tracheoplasty is much higher

when used for benign non-inflammatory stenosis, especially annular stenosis. Also, the 32 monthly follow ups to assess the long-term efficacy regarding the balloon tracheoplasty especially in benign stenosis were reported to be 43%. The failure rate of surgery is reported to be less than 15% as reported by **Bonette et al. (17)** after following 340 patients who underwent tracheal resection with end-to-end anastomosis.

On the other hand, comparison between two groups as regards complication, 6(60%) cases had complications in surgery group where there was vocal cord paralysis in 1(10%) case, surgical emphysema in 1(10%), surgical site infection in 2(20%), hematoma in 1(10%), and anastomotic leakage in 1(10%), in comparison to hypoxemia in 3(30%) cases in bronchoscopy group. There was no statistically significant difference between the two groups as regards complications ($p>0.05$). **Farahnak and Moghimi (18)** reported that the average length of resected site was 3-6 rings (1/5-3CM), a total of 22.7% of patients had postoperative complications, 14.5% had wound infections and 8.2% had recurrent stenosis.

While**, Kiran et al. (19)** reported that among postoperative complications two patients of ST had minor bleeding defined as bleeding less than 100 ml, which was managed conservatively with stomal packs. Subcutaneous emphysema was noticed in two patients of ST. One patient had excessive purulent exudate at stoma in the ST group. In the GWDF group 03 patients had hematoma formation which was managed conservatively. In the PT group 02 patients had hematoma formation and 02 patients developed small subcutaneous emphysema which was managed conservatively.

Finally, as regards recurrence, we found that in surgery group 2(20%) case had recurrence in comparison to 4(40%) cases in bronchoscopy group. Although recurrence was higher in bronchoscopy group than surgery group, but there was no statistically significant difference between the two groups as regards recurrence ($p>0.05$). duration of recurrence (days) in surgery group ranged from 35 to 40 days and the mean ± SD was 37.50±3.54 days, while in bronchoscopy group ranged from 21 to 30 days and the mean ± SD was 25.75±4.03 days. There was no statistically significant difference between the two groups as regards duration of recurrence ($p>0.05$). **Mokhber Dezfuli et al. (15)** found that a total of 10 re-stenosis was reported, of which 8 patients were treated with dilatation, and corticosteroids and tracheostomy were performed for two patients. No recurrence of stenosis was reported in patients who underwent type I surgery. Out of 20 patients who underwent type II surgery, 3 patients had a recurrence of stenosis, and during follow-up, one patient had to undergo tracheostomy.

In brief, let us work to eliminate this high complication rate of ICU intubation. Tracking of ICU intubation complications should become an essential quality improvement process. The efficacy of two different methods in managing Post-intubation tracheal stenosis was with no statistically significant differences as regard each of outcomes; complications and recurrence rate.

Interventional bronchoscopy should be the first approach in the treatment sequence of these patients, and may be the only required treatment in the majority of patients. Prospective

carefully designed controlled studies are needed to better define the role of predisposing factors and co-morbidities in determining appropriate treatment for tracheal stenosis.

CONCLUSION

Tracheal resection and re-anastomosis are the most efficient techniques in management of tracheal stenosis with lower failure and recurrence rates than bronchoscopy group.

No Conflict of interest.

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