

INDICATIONS AND COMPLICATIONS OF TRACHEOSTOMY AT A TERTIARY CARE INSTITUTE: A PROSPECTIVE AND OBSERVATIONAL STUDY

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ABSTRACT

Objective: The aim of the present study was to present an analysis of indications and complications of tracheostomy in tracheostomized patients.

Methods: This was a single center, hospital-based prospective, non-randomized, and non-comparative study involving 60 tracheostomized patients carried out from February 2021 to March 2022 at Geetanjali Medical College and Hospital, Udaipur, India.

Results: Out of 60 tracheostomies performed most common indications were Laryngo-tracheal trauma (26.7%), organophosphorus poisoning (25%), malignancy of Larynx (11.67%), post-intubation stenosis (6.7%), bilateral abductor paralysis (6.7%), head injury (6.7%), meningitis (5%), acute laryngo-traheo-bronchitis (3.33%), hypoxic-ischemic-encephalopathy (3.33%), cerebrovascular accidents (1.67%), faucial diphtheria (1.67%), and GB syndrome (1.67%). Out of 60 tracheostomies performed, 18 complications were encountered. The most common complication was granulations of tracheostoma which occurred in 5 cases (8.3%), three cases of tube occlusion (5%), three cases had difficult decannulation (5%), three cases developed infection of stoma (5%), two cases developed surgical emphysema (3.3%), one case of tracheostomy scar hypertrophy (1.6%), and one case developed tracheal stenosis (1.6%).

Conclusion: Tracheostomy is the procedure of choice especially in cases. Where it is needed to provide prolonged positive pressure ventilation and tracheobronchial toilet. Thorough anatomical knowledge of trachea and adjacent structures, skill of surgeon, sterile technique, meticulous surgery, use of high-volume low pressure cuffed Portex tracheostomy tubes, and good bedside tracheostomy care results in minimal complications. Complications of tracheostomy are largely preventable.

Keywords: Tracheostomy, Indications, Complications.

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INTRODUCTION

Tracheostomy is a lifesaving procedure which has stood the test of time. Before the birth of Christ, until the early part of the nineteenth century, the procedure was considered hazardous and was rarely performed. Only during past three decades, the operation has assumed its rightful place as a safe and simple procedure with wide range of usefulness.

In recent years, there has been a considerable shift in emphasis regarding the indications for tracheostomy with recognition of the more physiologic and functional indications in addition to those of a strictly obstructive nature.

Tracheostomy is being performed with ease, with better knowledge of anatomy and by adopting the classical technique advocated by Jackson during the early years after 1900.

In the modern era of the operation, Jackson and others have stressed the importance of a clear airway following tracheostomy and have recognized that the tracheostomy is not the objective in treatment, but only a means to the end of securing proper ventilation.

During recent years, the complications and deaths due to tracheostomy are reduced to minimal because of refinement of technique and better post-operative care. However, still the problems like difficult decannulation are not solved.

The development of Tracheostomy has been divided into five periods historically [1]:

1. The "Period of Legend" dating from 2000 BC to AD 1546.
2. The "Period of Fear" dating from 1546 to 1833, during which operation was performed only by a brave few, often at the risk of their reputation.

3. The "Period of Drama" from 1833 to 1932 during which the procedure was generally performed only in emergency on acutely obstructed patient.
4. The "Period of Enthusiasm" from 1932 to 1965, during which the adage.
5. 'If you think tracheostom y....., do it'.
6. The "Period of rationalization" from 1965 to the present during which the
7. Relative merits of intubation versus tracheostomy were debated.

The earliest known references to tracheostomy are made in the Rigveda, a sacred Hindu book, published around 2000 BC [2].

The word "Trachea" is derived from the Greek Language and originally meant rough. Other names for the trachea included "Arteria aspera". The early history of tracheostomy starts with Galen and Aretaeus, both of whom referred to either cutting the larynx or making an incision in the arteria aspera are of the terms then used for the windpipe or trachea [2].

Needless to say this surge of interest in tracheostomy was not without complications, the chief of which was stenosis of the trachea. Polyvinyl chloride (PVC) tubes for per nasal or per oral use, were invented by Peter Biesalski (1915) of Mainz in 1958. These enabled prolonged intubations as an alternative to tracheostomy. The early PVC tubes had rather stiff cuffs and tended to give rise to stenosis. These in turn were replaced by soft seal cuffs which have greatly diminished to problem [3].

Anatomy of trachea

The Trachea is a tube formed of cartilage and fibromuscular membrane, linked internally by mucosa. It is about 10–11cm long, descending from the larynx, extending from the level of sixth cervical vertebra to

the upper border of the fifth thoracic vertebra (lower end of cricoid cartilage to the second costal cartilage or manubriosternal angle), where it divides into right and left principal (pulmonary) bronchi.

Its external transverse diameter is about 2 cm in adult males and 1.5 cm in adult females. In children, it is smaller, more deeply placed, and more mobile. The lumen in live adults is about 12 mm in transverse diameter, although this increases after death due to relaxation in the smooth muscle at its posterior aspect. The anteroposterior diameter average about 14.5 mm in adults.

In the first post-natal year, the tracheal diameter does not exceed 6 mm, while during later childhood, its diameter in millimeters is about equal to age in years. The transverse shape of the lumen is variable, especially in later decades, being round, lunate, or flattened [4-8].

What is tracheostomy?

Tracheostomy is an incision into the trachea (windpipe) to form a temporary or permanent opening. The opening or hole is called stoma.

Sometimes, the terms tracheotomy and tracheostomy are used interchangeably.

The tracheal opening is made either in the second, third, fourth, or fifth tracheal ring and a tube is inserted through the opening to allow passage of air which also helps in removal of secretions [1].

Indications for tracheostomy [9-13].

Upper airway obstruction

Infections – Acute laryngo-tracheobronchitis, acute epiglottitis, diphtheria, Ludwig's Angina, peritonsillar, retropharyngeal or parapharyngeal abscess, and tongue abscess.

Trauma – External injury of larynx and trachea, trauma due to endoscopies, especially in infants and children, fractures of mandible, or maxillofacial injuries.

Neoplasms – Benign and malignant neoplasms of larynx, pharynx, upper trachea, tongue, and thyroid.

Foreign body larynx

Oedema larynx – Due to steam, irritant fumes, or gases, Allergy (angioneurotic or drug sensitivity), and radiation.

Bilateral abductor paralysis

Congenital anomalies – Laryngeal web, cysts, trachea-esophageal fistula, and bilateral choanal atresia.

Removal of secretions

Inability to cough

Coma of any cause, for example – head injuries, cerebrovascular accidents, narcotic overdose.

Paralysis of respiratory muscles, for example, spinal injuries, Polio, Guillain- Barre syndrome, and myasthenia gravis.

Spasm of respiratory muscles, tetanus, eclampsia, and strychnine poisoning.

Painful cough

Chest injuries, multiple rib fractures, pneumonia, aspiration of pharyngeal secretions.

Bulbar polio, polyneuritis, and bilateral laryngeal paralysis.

Respiratory insufficiency

Chronic lung conditions, namely, emphysema, chronic bronchitis, bronchiectasis, and atelectasis.

As part of another procedure

Major resections involving the oral cavity or pharynx.

Common indications of tracheostomy in pediatric age group [14-16].

In infants

Subglottic hemangioma, Subglottic stenosis, Laryngeal cyst, Glottic web, and Bilateral vocal cord paralysis.

In children

Acute laryngo-tracheo-bronchitis, epiglottitis, diphtheria, laryngeal oedema (chemical/thermal injury), external laryngeal trauma, prolonged intubation, and juvenile laryngeal papillomatosis.

Operative procedure [1,10,12,17]

Types of tracheostomies

Tracheostomy may be elective or emergency. In the former, there is enough time for preparation and done in a well-planned way under ideal operating conditions. It may be either temporary tracheostomy when the tracheostoma is situated between 3rd and 4th rings of the trachea, while in permanent tracheostomy, the opening is situated lower down [1].

Instructions to the patients

- The patient/relatives are counseled, and proper informed consent is obtained.

Position of the patient

The position of the patient for any type of tracheostomy is of greatest importance.

The patient should be positioned on his back and a pillow of suitable size placed well under the shoulders to allow maximal extension of the neck so that the trachea is well projected forwards, becomes more superficial, and the length of the trachea in the neck is increased.

After extension of the neck patient should be placed so that, the nose, chin, and the supra sternal notch lie in the same median plane.

Anesthesia

Tracheostomy may be performed either under local or general anesthesia and anesthesia is unnecessary in unconscious patients. A local anesthetic is usually all that is necessary for conscious patient. General anesthesia can be used for elective tracheostomy and when endotracheal tube is in position for administration of the adequate ventilation throughout the operation.

Incision

The skin incision is determined by the circumstances of the situation. Usually, a vertical midline incision is preferred and should be employed whenever the operation is urgent or the operator is inexperienced, to obtain rapid access with a minimum of dissection and bleeding. When the operation is combined with a head-and-neck procedure, the incision is placed in accordance with the proposed procedure. In elective tracheostomy, transverse incision measuring 5 cm. Following Lange's lines are preferred for better cosmetic results and are taken approximately two fingers breadth above the sternal notch.

Procedure

The surgeon stands on the right side of the patient and grasp the larynx with thumb and middle finger of the left hand, while resting the fore finger as a guide on the thyroid notch. Vertical incision is put in midline from center of the thyroid cartilage to the suprasternal notch. The skin incision is deepened until the inner border of the strap muscles are encountered. The strap muscles are separated vertically by blunt dissection in the midline and retracted laterally. This will expose the pre-tracheal fascia covering the trachea and the thyroid isthmus. Separation of the individual layers is avoided least, emphysema may occur. Confining the dissection to the midline vertical plane avoids numerous

veins descending in the fascia from the thyroid gland. Throughout the dissection, the position of the trachea should be ascertained by palpation. The thyroid isthmus is almost always situated above the third tracheal ring, and usually it is possible to retract the isthmus slightly upward with a small blunt retractor to expose the trachea. Retraction should be avoided in exceptionally wide isthmus, where there is tendency for the tube to slip out of position when the isthmus is released. In such instances, the isthmus should be divided, preferable between Kelly clamps and suture ligatures should be placed for better hemostasis.

Fixation of trachea

The trachea should be fixed by inserting a hook in the inter-annular membrane between first and second ring, pulling the trachea in an upward and outward direction.

Tracheal incision

After confirming trachea, before making the opening, few drops of 4% xylocaine are injected into the tracheal lumen by hypodermic syringe and needle. This minimizes the spasmodic coughing occasioned by the opening of the trachea. Transverse slit is made in between the rings of the trachea, which is followed by hiss of air. The edges are caught by the forceps to make an oval window over the third and fourth rings of the trachea. The opening should be large enough to hold tracheostomy tube of appropriate size. Opening should neither be too small to cause the pressure necrosis, nor too big to allow the escape of air around the tube. Some surgeons advocate after excision, stitching of the anterior tracheal flap to the skin to prevent the displacement of the tube into the pre-tracheal space.

Insertion of the cannula

Making a window into the tracheal wall after anaesthetizing the lumen immediately releases the dyspnea and aids in introducing the tracheal cannula without causing discomfort to the patient. If necessary, tracheal dilator can be used for the better facilitation. Suction through the cannula is essential, to clean the secretions and blood clots as soon as it is introduced. Then, the tube is fastened around the neck.

Dressing

A pad made of several layers of folded gauze is split half way so as to sit snugly around the cannula. Small gauze pieces are avoided. No wick or drainage tube is necessary.

Common errors and difficulties [18-22]:

- Hurried procedure without adequate assistance.
- Improper hemostasis before opening of the trachea.
- Injury to posterior wall of trachea because of carelessness in holding the knife.
- False passage of the cannula beneath the mucous membrane because of the incomplete opening.
- Complete closure of wound up to the cannula which precipitates emphysema, false passage of cannula, and difficulties during dressing.

Tracheostomy in infants and children

Great care and caution are required while doing tracheostomy in this age group, lest it is attended with complications that can be avoided [15,17,23].

Complications of tracheostomy

This may be divided into immediate, intermediate and late complications (according to Conley 1979).

The overall complications range from 5% to 40% [1].

Immediate (During the operation or immediately after) [24-27]:

- Hemorrhage
- Air embolism
- Apnea
- Cardiac arrest
- Local damage to thyroid cartilage/cricoid cartilage/recurrent laryngeal nerve.

Intermediate (during the patient's stay in the Hospital) [10,24-26]:

- Displacement/Dislodgement of tube
- Surgical emphysema of the neck
- Pneumothorax/Pneumomediastinum
- Obstruction of the tube
- Infection
- Tracheal necrosis
- Tracheo-arterial fistula
- Tracheo-esophageal fistula

Late (When the patient has gone home) [23,28-38]:

- Stenosis of trachea.
- Difficulty with decannulation
- Tracheo-cutaneous fistula
- Hemorrhage
- Tracheostomy scar
- Corrosion of tracheostomy tube and aspiration of its fragments into the Tracheo-bronchial tree.

Use of oversized tubes impinges pressure on the tracheal wall and cause trauma to cricoid cartilage and tracheal rings causing laryngeal and tracheal stenosis.

Tracheal stenosis is avoided by careful construction of the stoma by oblique transection of the trachea, removal of fat and skin. In laryngectomy, the trachea is divided below the tumor and a tracheostoma is fashioned by bringing out the trachea through a separate skin incision above the sternum and anchoring it.

Objectives of the study

The objectives of the study are as follows:

1. To study indications of tracheostomy.
2. To study the complications following tracheostomy.

METHODS

Study design

This was a single center, hospital-based prospective, non-randomized, and non-comparative study. The Institutional Ethics Committee approval was obtained.

Study settings

The study was conducted at the Department of Otolaryngology, Geetanjali Medical College, Udaipur, Rajasthan, India.

Study duration

The study was conducted from February 2021 to March 2022.

Study outcomes

Various Indications of Tracheostomy.

Various Complications following Tracheostomy.

Sample size calculation

Sample size of 60 was calculated using software Epi info TM-7 with assumption of alpha error of 5%, that is, confidence level 95% and beta error to be 20%, that is, power of error to be 80%. Following this, a total of 60 patients were included in this study.

Standard statistical analysis was done and Statistical Package for the Social Sciences (IBM SPSS Statistics, version 21, Somers NY, USA) Software was used to analyze the data. Microsoft (MS) Excel and MS word was used to obtain various types of graphs. The p-value (Probability that the result is true) of <0.05 was considered as statistically significant after assuming all the rules of statistical tests.

Inclusion criteria

- i. Patients/relatives who consented to participate in the study were included in the study.

Exclusion criteria

- i. Participants who refused to participate in the study were excluded from the study.

Sampling methodology

Non-probability, purposive, and convenience sampling methodology was employed to recruit participants for the present study. All patients fulfilling the selection criteria were approached for recruitment into the study throughout the period of participants recruitment. These are consecutive and unselected cases comprising of varying age groups with different indications.

The data were collected from the patients who had undergone either elective or emergency tracheostomy at the above-mentioned hospital.

Informed consent

The consent form printed in patient's own preferred language was given to all the participants/relatives to read. Thereafter, the contents of the consent form were explained to all the prospective participants/relatives in their preferred language. All the questions from participants/relatives about the study, procedure, risk, and data privacy were answered to the best of the author's knowledge. The participants were informed and explained that they have the right to withdraw from the study at any point in time. Thereafter, willing participants/relatives were asked to sign the consent form.

Source of data

The source of data for the present study was the clinical records of the patients. Indications for tracheostomy as mentioned in the clinical records and Complications encountered during/post-surgery as documented in the operative notes/clinical records were obtained for the study.

Plan and procedure

Selected patients were subjected to investigations preoperatively and postoperatively for:

- X-ray soft tissue neck – Lateral view.
- X-ray chest PA view.
- Routine blood and urine investigations.
- Flexible laryngoscopy.

All the selected patients who underwent standard tracheostomy procedure were given intensive care for the first 48 h postoperatively.

Problems encountered during surgery were documented in the operative notes. The immediate post-operative problems were seen in post-operative ward/ICU and were documented in the clinical records. Intermediate post-operative complications were assessed after 48 h. Late post-operative complications were assessed during the follow-up of patients and documented.

In the post-operative ward, tracheostomy care was given by the surgeon and the attending nurse, while the patient's care giver was asked to observe the same. In the ward, tracheostomy care was done once in the morning and again in the evening. In the interval period, patient's care giver was taught the same. If patient was to be discharged with tracheostomy tube in-situ, then the Portex tube was changed to Fuller's tube. Regular follow-up of the patients was done as follows:

- Twice a week for 1st month.
- Once a week for 2nd month.
- Monthly twice in the 3rd month and finally whenever patient has any problems, he/she was asked to come for follow-up.

During follow-up in minor OT, inspection of the tracheostomy tube, cleaning, and dressing was done. Advice was given as required.

Statistical analysis plan

The primary outcome was the study of indications for tracheostomy in the given setup. The other objective was to study the complications

post-tracheostomy. The coded data set was imported into Stata 17.1 version for analysis.

Funding

There was no external funding for this study. Participants were not paid any fee/incentive or given any gift to participate in the present study.

RESULTS

Out of 60 tracheostomies performed, most common indications were laryngo-tracheal trauma (26.7%), organo-phosphorus poisoning (25%), malignancy of larynx (11.67%), post-intubation stenosis (6.7%), B/L abductor paralysis (6.7%), head injury (6.7%), meningitis (5%), acutelaryngo-tracheo-bronchitis (3.33%), hypoxic ischemic encephalopathy (3.33%), cerebro-vascular accidents (1.67%), faucial-diphtheria (1.67%), and guillain-barre syndrome (1.67%).

Out of 60 tracheostomies performed, 18 complications were encountered. The most common complication was granulations of tracheostoma which occurred in 5 cases (8.3%), three cases of tube-occlusion (5%), three cases had difficult decannulation (5%), three cases developed infection of stoma (5%), two cases developed surgical emphysema (3.3%), and one case of tracheostomy scar hypertrophy (1.6%) and one case of tracheal stenosis (1.6%).

The pediatric complication rate was 71.4% and consisted of three cases of difficult decannulation, two cases of tube obstruction. There were no tracheostomy related deaths.

In our study, 31 tracheostomies were performed as an emergency, out of which 12 (38.7%) complications were encountered. Twenty-nine tracheostomies were performed electively, out of which only 6 (20.7%) complications were seen.

Among the 60 cases, one patient died on the same day following tracheostomy and repair of cut-throat injury due to massive aspiration and blood loss. One case each developed supraglottic stenosis and pharyngocutaneous fistula respectively following tracheostomy for repair of cut-throat injury. These three complications were not part of tracheostomy *per se*.

DISCUSSION

Sixty cases of tracheostomy were taken up for the study at Geetanjali Medical College and Hospital, Udaipur, India, during study period from February 2021 to March 2022.

In the present study, indications for tracheostomy included the following (Table 1): 26 cases (43.3%) were for prolonged mechanical ventilation (OP compound poisoning, CVA, HIE, severe head injury, and meningitis) Fig. 1.

Eighteen cases (30%) were for upper airway obstruction (faucial diphtheria, acute laryngo-tracheal bronchitis, malignancy of larynx,

Table 1: Indications of tracheostomy

Diagnosis	No. of male	No. of female
Organo-phosphorus compound poisoning	10	5
Laryngo-tracheal trauma	13	3
Faucial diphtheria	1	-
Malignancy of larynx	3	4
Post intubation stenosis	3	1
B/l abductor paralysis	2	2
Head injury	3	1
GB syndrome	-	1
Acute laryngo-tracheo-bronchitis	2	-
Cerebro-vascular accident	1	-
Hypoxic ischemic encephalopathy	-	2
Meningitis	3	-

neurological affection of larynx, post-thyroidectomy recurrent laryngeal nerve paralysis, and post-intubation laryngeal stenosis). Sixteen cases (26.7%) were for laryngo-tracheal trauma (penetrating neck injury and cutthroat injury).

The study also revealed the age incidence varying from 4 years to 74 years.

Gender incidence of 41 males (68%) and 19 females (32%) was noted. Maximum cases were reported in the age group 25–45 years Figs. 2 and 3.

In a retrospective study of 1130 cases by Goldenberg *et al.* (1996) [38], the most common indication was for long term mechanical ventilation (76%) which is same as our study.

In the studies done by Crysdale [39] in 1976–1985 and Zeitouni and Manoukian [16] in 1993, 319 and 44 cases were taken up, respectively. In Crysdale study, 222 cases (70%) were of Airway obstruction, 65 cases (20%) were of tracheobronchial toilet and 32 cases (10%) were of continued assisted ventilation. In Zeitouni and Manoukian study 25 cases (57%) were of airway obstruction. Crysdale study also revealed more males than females who underwent tracheostomy.

In a retrospective study of hospital records of 43 tracheotomized patients by Aass at Scandinavia (1975) had shown tube occlusion in 2.3% tracheostomies, dislocated tube in 2.3% tracheostomies, bilateral pneumothorax in 2.3% tracheostomies, fatal innominate arterial hemorrhage in 2.3% tracheostomies as early complications, and the late complication seen was tracheal stenosis in 40–60% tracheostomies [40].

A prospective study of the complications of tracheostomy on 21 critically ill adult patients was done by Stauffer *et al.* in 1981. Problems with tracheostomy had included stomal infection (36%), stomal hemorrhage (36%), and subcutaneous emphysema or pneumomediastinum (13%). Follow-up studies revealed a high prevalence of tracheal stenosis in 65% tracheal stenosis [41].

In this study, the indications for tracheostomy were broadly divided into two groups, elective 29 cases (48%) and emergency 31 cases (52%) Fig. 4.

The elective group includes patients who required prolonged mechanical ventilation (OP poisoning, GB syndrome, and neurological disorders). The emergency group includes patient with stridor due to malignancy of larynx/hypopharynx, acute infections of larynx, post intubation stenosis and cut-throat injuries.

During this study the tracheostomies were done both under General and Local Anesthesia (GA-22, LA-38) Fig. 5.

The type of skin incision during tracheostomy was horizontal (55%) and vertical (45%) Fig. 6. In this study, 56 cases (93.4%) were mid tracheostomies, and 4 cases (6.6%) were low tracheostomies.

In our study, there were seven pediatric cases of which 5 (71.4%) developed complications of tracheostomy which consisted of three cases of difficult decannulation and two cases of repeated tube obstruction, which is same as other studies.

Out of 60 cases of tracheostomy performed, 18 complications were encountered (Table 2).

Out of 31 cases of emergency tracheostomies, 12 (38.7%) developed complications (Table 2).

While out of 29 cases of elective tracheostomies, 6 (20.7%) developed complications (Table 2).

Tube obstruction was encountered in three cases. Two cases were due to blood clots and one had thick mucus plug obstructing the lumen

which led to severe asphyxia, but this was promptly recognized and managed. Tube obstruction is common in the immediate post-operative period (i.e., first 24 h), failure of prompt supportive care may lead to severe asphyxia and even death.

Tube obstruction may be eliminated by proper humidification of the inspired air either by HME or wet gauze covering the tracheostoma and regular suctioning.

Subcutaneous surgical emphysema developed in two cases which was limited to the neck and subsided without any sequel within 7 days. Surgical emphysema is common in the immediate post-operative period.

Factors contributing subcutaneous surgical emphysema are: Uncuffed tracheostomy tubes, too tight closure around the tracheostomy wound, and large incision in the trachea.

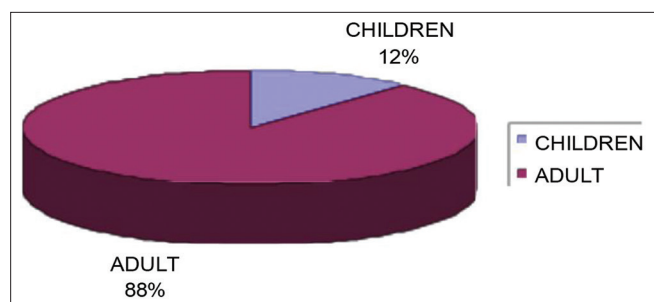


Fig. 1: Indication of tracheostomy

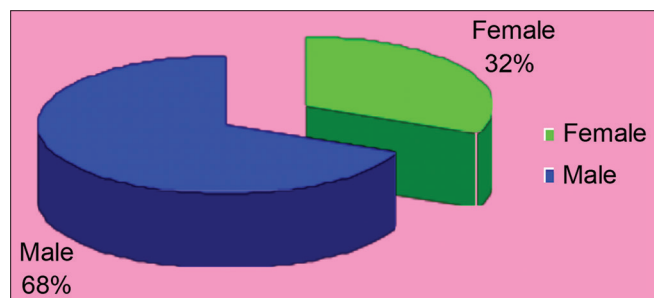


Fig. 2: Age distribution

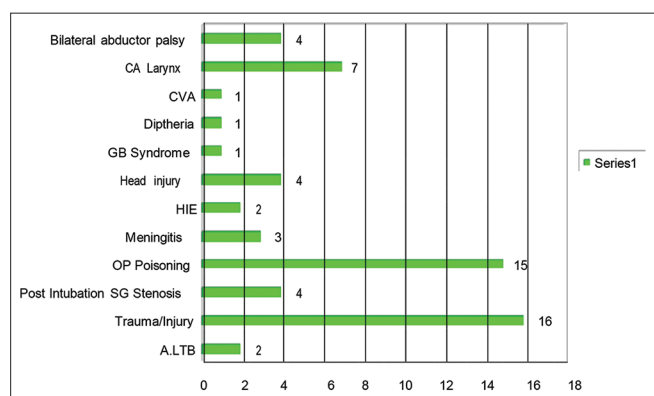


Fig. 3: Percentage distribution by sex

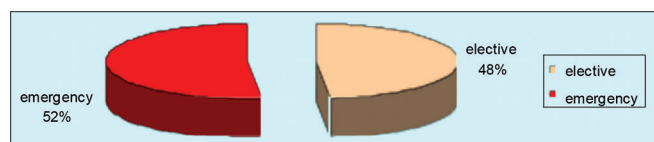


Fig. 4: Types of tracheostomy



Fig. 5: Types of anaesthesia

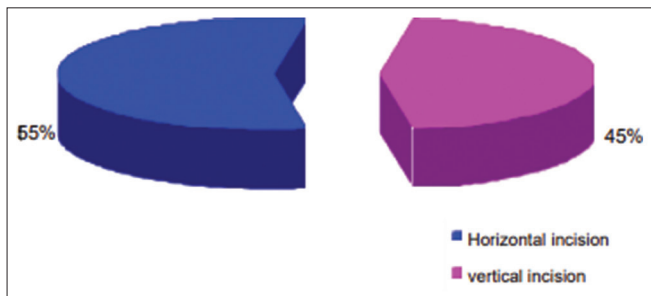


Fig. 6: Types of incision

Usually, emphysema is mild which resolves spontaneously within few days. Occasionally extensive subcutaneous emphysema may develop which requires multiple needle punctures to relieve the trapped air.

Infection of tracheostoma developed in three cases, one case developed bacterial pneumonitis which was treated with appropriate antibiotics. This complication can be avoided by maintaining sterility of the stomal site and neck.

Granulation of tracheostoma developed in five cases. Granulations of stoma are a consequence of the wound being exposed to bacteria and mechanical irritation because of tube motion. Debridement of granulations was done during regular follow-up in the minor-OT. Exuberant granulations were cauterized with silver nitrate or copper sulfate crystals.

Tracheal stenosis developed in one case at the cuff site in the late post-operative period. This was managed by excision of the fibrous stenosis and tracheoplasty and T-tube. This complication can be prevented by performing a mid tracheostomy, minimal removal of tracheal cartilage, use of appropriate size, length, and cuff pressure of the tracheostomy tube.

One case developed tracheostomy scar hypertrophy. Hypertrophied scar of tracheostoma was excised and Z-plasty done.

Use of vertical skin incision sometimes causes the scar formation. The problems of the scar are vertical contracture and widening of the scar, large depression. Treatment is by Z-plasty.

Three children developed problems of decannulation. Decannulation problems in children is quite common. Decannulation in children is done by gradually reducing the size of tube and observing closely. Once the smaller size is tolerated then the tube is occluded intermittently, and child observed very closely. When the child tolerates continuous tube occlusion for more than 24, then tube is removed, and strapping done. If child remains comfortable for more than 48 h, child may be discharged.

If child cannot tolerate weaning of tube or strapping, then it is considered decannulation failure.

Incidence of complications varies in different author's series. In Goldenberg *et al.* study complications occurred in 49 (4.3%) cases,

Table 2: Elective v/s Emergency tracheostomy complication rate

Variables	Emergency tracheostomy	Elective tracheostomy
Total cases	31	29
Total complications	12 (38.7%)	6 (20.7%)

most common was tracheal stenosis (21 cases), hemorrhage (nine cases), trachea-cutaneous fistula (six cases), infection (five cases), and tube obstruction (four cases) [38].

Studies by Crysedale [39] and Zeitouni and Manoukian [16], the incidence of complication was 54% and 27%, respectively.

In a retrospective study of hospital records of 43 tracheostomized patients by Aass AS at Scandinavia (1975) revealed: Early complications of one tube occlusion (2.3%), one dislocated tube (2.3%), one bilateral pneumothorax (2.3%), and one case of fatal innominate arterial hemorrhage (2.3%). Late complications included tracheal stenosis (40–60%) [40].

A prospective study of the complications of tracheostomy on 21 critically ill adult patients was done by Stauffer *et al.* in 1981. Problems with tracheostomy included stomal infection (36%), stomal hemorrhage (36%), and subcutaneous emphysema or pneumomediastinum (13%). Follow-up studies revealed a high prevalence of tracheal stenosis (65%) [41].

A prospective study of complications of tracheostomy by Imperatore *et al.* on 140 patients over 2 years revealed the following. There were a total of 8 (5.71%) complications. Hemorrhage, wound infection, and tracheal stenosis were present in 3 (2.14%), 4 (2.85%), and 1 (0.71%) patient, respectively [25].

Among the 60 cases, one patient died on the same day following tracheostomy and repair of cutthroat injury due to massive aspiration and blood loss.

CONCLUSION

Out of 60 tracheostomies performed, most common indications were laryngotracheal trauma (26.7%), organophosphorus poisoning (25%), malignancy of larynx (11.67%), post-intubation stenosis (6.7%), B/L abductor paralysis (6.7%), head injury (6.7%), meningitis (5%), acute laryngo-tracheo-bronchitis (3.33%), hypoxic ischemic encephalopathy (3.33%), cerebrovascular-accidents (1.67%), faucial diphtheria (1.67%), and GB syndrome (1.67%).

In the present study, most common complication was formation of granulation tissue around tracheostoma (five cases), tube obstruction (three cases), difficult decannulation (three cases), stoma infection (three cases), and surgical emphysema (two cases), one case each of tracheal stenosis and scar hypertrophy. There were no deaths related to tracheostomy. These numbers represent very low rate when compared to the previous studies, that is, first 24 h is important in management of tracheostomized patient during which patient may go for tubal obstruction due to increased secretion and blood clots in tubes and trachea which has to be continuously monitored and prevented by doing frequent suction and cleaning the tube, control hemorrhage, and prevent aspiration.

Thorough anatomical knowledge of trachea and adjacent structures, skill of surgeon, sterile technique, meticulous surgery, use of high-volume low pressure cuffed Portex tracheostomy tubes, and good bedside tracheostomy care results in minimal intraoperative and immediate post-operative complications.

Intermediate and late post-operative complications were minimized because of:

1. Use of Fuller's tube.
2. Good tracheostomy care.
3. Educating the patient as well the patient's care giver about tracheostomy care.

Tracheostomy is the procedure of choice especially in cases where it is needed to provide prolonged positive pressure ventilation and tracheobronchial toilet (as in OP-poisoning and comatose patients) when compared to prolonged endotracheal intubation which causes tracheal/subglottic stenosis, resulting in severe morbidity and treatment of this complication is difficult.

To conclude even today, tracheostomy remains a life-saving procedure and complications of tracheostomy are largely preventable.

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AUTHORS' CONTRIBUTION

All the authors have contributed equally.

CONFLICTS OF INTEREST

The authors declare no conflicts of interest.

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