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Aspiration of Fractured Tracheostomy Tube in a Prone Positioned COVID-19 Patient: A Case Report and Review of the Literature

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Abstract

A 61-year-old male patient diagnosed with Coronavirus disease 2019 (COVID-19) acute respiratory distress syndrome (ARDS) was managed with tracheostomy and intermittent prone positioning in the intensive care unit. After a sudden deterioration, examination of tracheostomy tube (TT) and X-ray of the chest revealed that he had aspirated the fractured TT. The fractured tube was removed through the tracheostomy stoma using a rigid ventilating bronchoscope and forceps. Prone positioning is a beneficial postural therapy capable of improving patient oxygenation. However, it has some complications, like unplanned extubation and facial tissue injury. Percutaneous tracheostomy is also a valuable and safe procedure and has been increasingly performed in critical care patients, including those who suffer from COVID-19 ARDS. Fractures and aspiration of a tracheostomy tube can occur anytime after tracheostomy. We think prone positioning may contribute to the rupture and aspiration of the tracheostomy tube in this study.

Keywords: Adverse events, critical care, mechanical complications, tracheostomy tube

Main Points

- Percutaneous tracheostomy is usually a beneficial and safe procedure.
- Fractures and aspiration of the tracheostomy tubes are rare but possible complications.
- Tubes can be manufactured as single rather than two connected pieces.
- Mechanical stress associated with prone positioning may have facilitated the fracture of tracheostomy tubes.

Introduction

Tracheostomy is a standard, reasonable surgical procedure for critically ill patients who require long-term mechanical ventilation.[1] Due to the increase in demand for critical care arising from the global Coronavirus disease 2019 (COVID-19) pandemic, the number of tracheostomized patients has also generally increased.[2]

Prone positioning is an adjuvant therapy for treating COVID-19-induced acute respiratory distress syndrome (ARDS).[3] Tracheostomy and prone positioning may reduce morbidity and mortality among mechanically ventilated patients by different mechanisms. Prone positioning relieves external compression forces, recruits the most atelectatic regions of the lungs, and thus recovers ventilation-perfusion ratio mismatching without subjecting the lungs to high airway pressures.[4] On the other side, tracheostomy improves patient comfort, safety, and communication ability. Better oral and airway care is possible with tracheostomy. At the same time, prone positioning has some airway complications like swelling of the tongue, accidental extubation, and obstruction of the ventilating tube by

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secretions.[5-8] Aspiration of a fractured tracheostomy tube is a rare complication, even in supine-positioned patients.

We present the case of a tracheostomized patient with COVID-19 whose fractured tracheostomy tube dislodged into the left main bronchus.

Case Presentation

A 61-year-old male patient with no comorbidities was referred to our emergency department for a persistent cough complaint for 6 days. He was positive for COVID-19 (diagnosed using polymerase chain reaction) and was admitted to the intensive care unit (ICU) because of respiratory failure. With worsening respiratory status, he was intubated on the third day of ICU admission without any complications. Due to persistent hypoxemia despite full ventilator support, he was prone at 16 h and supine for 8 h on the following 10 days. Percutaneous tracheostomy using the Griggs forceps-dilational technique was performed on the 14-day of ICU admission. The procedure was uneventful, and a tracheostomy tube (Easyflow; Boen Healthcare Co., Ltd, Jiangsu, China) was inserted easily. Intermittent prone positioning was carried out to optimize oxygenation. There were no acute complications following the procedure.

However, the patient deteriorated in the prone position five days after the tracheostomy. He developed sudden hypoxia and hypotension and was turned to the prone position. Examination of the tracheostomy tube showed that the flanges were securely tied around the neck while the stem was missing (Figure 1). The patient was orotracheally intubated, and a chest X-ray was performed. It revealed a foreign body in his left main bronchus (RMB) (Figure 2). He was transferred to the operating room for bronchoscopic removal under general anaesthesia. Using a rigid ventilating bronchoscope and forceps, the tube was removed through the tracheostomy stoma (Figure 3). After the procedure, with no complications, he was retransferred to the ICU as orotracheally intubated. The patient died on the 23rd hospital day of multiorgan failure related to septic shock.

Figure 1. The outer part of the tracheostomy tube.

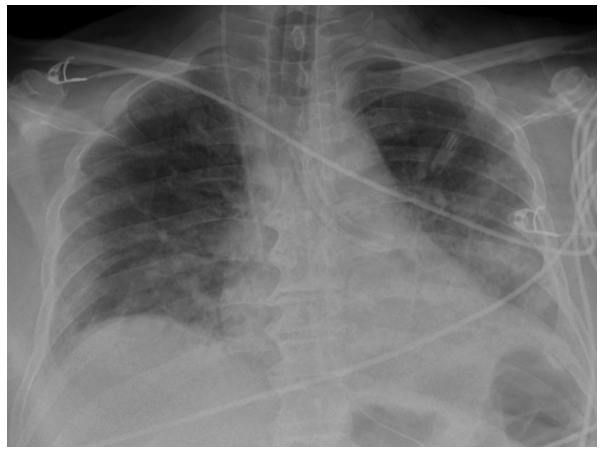

Figure 2. Chest radiograph showing the fractured tracheostomy tube in left main bronchus.

Figure 3. Inner part of the tracheostomy tube removed with bronchoscopy.

Discussion

Prone positioning of ventilated patients was first used in the 1970s and has been reported as a tool to improve respiratory function in patients with ARDS.[9] Increased incidence of pressure ulcers, obstruction of endotracheal or tracheostomy tubes, unplanned removals of arterial or venous catheters, unplanned extubation, accidental loss of thoracic or abdominal drains, facial edema, conjunctival hemorrhage, kinking of tubes and catheters, displacement of nasogastric tube and vomiting are some of the complications that have been associated with the use of prone positioning.[10]

Tracheostomy is another ICU practice used for patients requiring an extended mechanical ventilation period. Patients with tracheostomy can be managed in the prone position. Still, since the airway cannot be visualized in this position, the risk of displacement of the tracheostomy tube may be increased.[5,10] Fracture of the tracheostomy tube with migration into the tracheobronchial tree is a rare complication, even in supine-positioned patients. It is the first report of a fractured tracheostomy tube in a prone-positioned patient.

The first case report of a fractured tracheostomy tube was reported by Howarth[11] in 1913, although Bassoe and Boe[12] are known as the first. Since then, this complication has been published in the literature occasionally. Occasionally cases are reported in 65 articles after an extensive literature review.[11-75] Material and fracture sites of the tubes, possible causes and timing of the events, dislodgement sites, and treatment modalities are some of the topics worth discussing. The fracture of tracheostomy tube can occur from the first minutes of its placement and 22 years later.[53] Early breakage is usually considered a manufacturing defect.[14] Fractures after prolonged usage may be due to mechanical (repeated cleaning/boiling or sterilization, suctioning, removal, and reinsertion) or chemical (alkaline bronchial secretions, corrosive cleaning agents) stress.[14,26,28-30,35,36,42,56] Our review of 92 cases revealed that; 66 (71%) of fractures appeared to be associated with prolonged use (repeated boiling, corrosion, and cracking), 13 (14%) appeared to be associated with manufacturing defect and 2 (2%) were attributed to mechanical stress. There are no available data about the rest.

Tracheostomy tubes are made of metal, polyvinyl chloride (PVC), or silicone. Metallic tracheostomy tubes have two main types: Fuller and Jackson. Initially, metallic tubes were thought to allow for prolonged wear due to their physical properties. Silver, steel, copper, or zinc were the materials for manufacturing these tubes, all with poor corrosion resistance to alkaline pH. As a result, they have been corrodible by tracheal secretions and repeated boiling.[12,52,64] Fractures occur less frequently in PVC and silicone tubes than in metallic tubes.[48] In this study, the PVC tracheostomy tube was used only for five days before fracturing. Although it is plausible to consider a manufacturing defect that might have contributed to the fracture with its short time use, we believe that prone positioning might also contribute to the mechanical stress created by kinking of the tube. Therefore, this case appears to be an unusual complication of prone positioning.

Most fractures occur at the junction of the cannula and neck plates. As Table 1 reflects the author's own words, the term "flange" has been used instead of "neck plate" in some reports. On the other hand, the Fuller metallic tubes have flanges at the distal end of the main cannulas and sometimes get fractured at the junction of these flanges.[53] There are 31 reports about fractured PVC tubes in the literature; two have no data about the fracture sites, and only one siliconized PVC tube was fractured from the mid-shaft. In our case, the tracheostomy tube fracture occurred at the junction of the cannula and neck plate, similar to the other reported cases of fractured PVC tracheostomy tubes. The manufacturers of PVC tubes should be warned about strengthening the connection between the two components of the tubes. Li et al.[42] and friends mentioned that they filed a Medical Device Alert form, and the tube was returned to the supplier in their report. Hence, the supplier redesigned to incorporate a new shaft-to-head base assembly method to strengthen the connection.

RMB is more exposed to the lodgment of foreign bodies since it is mostly vertically positioned and has a larger diameter than the left main bronchus.[75] It was also the most common dislodgement site for fractured tubes (37 cases).

Clinical presentation depends on factors such as patient status, dislodgement style, and site of the fractured tube. Patients tracheostomized for chronic respiratory disorders can present with mild respiratory distress, cough, wheezing, recurrent pneumonia, and difficulty suctioning or reinserting the inner tube.[64,74] Some cases even remain asymptomatic in which the fractured part acts like a stent in the trachea or main bronchus.[36,62] Death may also occur, especially in pediatric patients, probably due to the small airway caliber.[28,54] Our patients suffered from acute and severe ARDS, and disconnection of the two parts of the tube resulted in inadequate mechanical ventilation. He needed urgent orotracheal intubation because of sudden hypoxia.

Large foreign bodies in the tracheobronchial tree are usually removed by rigid bronchoscopy. It is also recommended for the removal of fractured tracheostomy tubes in the literature. A bronchoscope is usually inserted through the tracheostomy stoma to avoid vocal cords and oral cavity from mechanical injury caused by a fractured tube during removal.[64] Flexible bronchoscopy, local exploration of the tracheostome, and removal with forceps, nasal endoscope, or Desjardin's forceps under C-arm guidance through the tracheostome, thoracotomy, and bronchotomy are some other treatment approaches.[33,40,61,63,65]

Conclusion

Fracture and aspiration of the tracheostomy tube is a rare complication that can occur anytime after tracheostomy. Regular care and replacement of worn-out tracheostomy tubes are essential to avoid this complication in patients with chronic tracheostomy. We also recommend checking

Table 1. Summary of the previous case reports

Year	Author (S)	Lodging site	Sex	Age	Possible cause	The duration of the wearing the same tracheostomy tube	Material	Fracture site	Treatment
1913	Howarth[11]	RMB	M	NAD	NAD	NAD	NAD	NAD	NAD
1960	Bassoe and Boe[12]	RMB	F	35 y	Prolonged use ("season cracking", long continued high internal stress in the surface)	6 m	Metallic (silver and nickel)	Distal end of cannula	Bronchoscopy
1972	Kemper et al.[13]	T and RMB	M	48 y	NAD	NAD	Metallic	Inner tracheostomy tube	NAD
1972	Kakar and Saharia[14]	T and LMB	M	40 y	Prolonged use	2 y	Metallic (copper and zinc)	Junction between tube and neck plate	Bronchoscopy
1973	Sood[15]	T	M	60 y	Prolonged use (repeated boiling)	5 y	PVC	Junction between tube and flange	NAD
1978	Maru et al.[16]	T and LMB (2 pieces)	M	50 y	Prolonged use	6 m	Metallic	Junction between tube and neck plate/midshaft	One of the pieces removed from widening tracheostome, other removed by bronchoscopy
1981	Gupta and Chhangani[17]	RMB	M	10 y	Prolonged use ("season cracking", long continued high internal stress in the surface)	4 y	Metal (silver and nickel)	Flange	Bronchoscopy
1981	Gupta and Chhangani[17]	LMB	M	15 y	Prolonged use ("season cracking", long continued high internal stress in the surface)	2 y	Metal (silver and nickel)	Flange	Bronchoscopy (through tracheostome)
1983	Okafor[19]	T and RMB	M	40 y	Prolonged use	8 y	Metal (silver and zinc)	Junction between tube and neck plate	Bronchoscopy (through the enlarged tracheostome)
1983	Bhalla et al.[18]	LMB	F	50 y	Prolonged use	2 y	NAD	Midshaft of outer tube	Bronchoscopy (through tracheostome)
1984	Myatt and Willatts[20]	T and RMB	M	76 y	Prolonged use	12 y	Metallic (silver)	Junction between tube and neck plates (Outer cannula)	Rigid bronchoscopy (through tracheostome)
1985	Bowdler and Emery[21]	T and RMB	M	3 y	Prolonged use	6 w	Metallic (silver)	Junction between tube and neck plates (outer cannula)	Bronchoscopy (through tracheostome)
1985	Bowdler and Emery[21]	C and RMB	M	76 y	Prolonged use	7 y	Metallic (silver)	Junction between tube and neck plates (outer cannula)	Bronchoscopy (through the enlarged tracheostome)
1985	Otto and Davis[22]	T and RMB	NAD	3 y	Manufacturing defect	6 m	Metallic (stainless steel)	Junction of the tube and flange	Bronchoscopy

Table 1. Continued

Year	Author (S)	Lodging site	Sex	Age	Possible cause	The duration of the wearing the same tracheostomy tube	Material	Fracture site	Treatment
1987	Gupta[23]	C	M	30-70 ys	Repeated boiling/Prolonged use/Erosion by secretions/Manufacturig defect (Reported with a "case series", no specific data)	NAD	Metallic (Fuller)	Flange	Bronchoscopy (through tracheostome)
1987	Gupta[23]	T	M	13 y	Repeated boiling/Prolonged use/Erosion by secretions/Manufacturig defect (Reported with a "case series", no specific data)	NAD	PVC	Junction	Bronchoscopy (through tracheostome)
1987	Gupta[23]	T	M	30-70 ys	Repeated boiling/Prolonged use/Erosion by secretions/Manufacturig defect (Reported with a "case series", no specific data)	NAD	PVC	Junction	Bronchoscopy (through tracheostome)
1987	Gupta[23]	RMB	M	30-70 ys	Repeated boiling/Prolonged use/Erosion by secretions/Manufacturig defect (Reported with a "case series", no specific data)	NAD	Metallic (Fuller)	Flange	Bronchoscopy (through tracheostome)
1987	Gupta[23]	RMB	M	30-70 ys	Repeated boiling/Prolonged use/Erosion by secretions/Manufacturig defect (Reported with a "case series", no specific data)	NAD	Metallic (Fuller)	Flange	Bronchoscopy (through tracheostome)
1987	Gupta[23]	RMB	M	30-70	Repeated boiling/Prolonged use/Erosion by secretions/Manufacturig defect (Reported with a "case series", no specific data)	NAD	Metallic (Fuller)	Flange	Bronchoscopy (through tracheostome)
1987	Gupta[23]	RMB	M	30-70	Repeated boiling/Prolonged use/Erosion by secretions/Manufacturig defect (Reported with a "case series", no specific data)	NAD	Metallic (Fuller)	Flange	Bronchoscopy (through tracheostome)
1987	Gupta[23]	LMB	M	30-70 ys	Repeated boiling/Prolonged use/Erosion by secretions/Manufacturig defect (Reported with a "case series", no specific data)	NAD	Metallic (Fuller)	Flange	Bronchoscopy (through tracheostome)
1987	Gupta[23]	LMB	M	30-70 ys	Repeated boiling/Prolonged use/Erosion by secretions/Manufacturig defect (Reported with a "case series", no specific data)	NAD	Metallic (Fuller)	Flange	Bronchoscopy (through tracheostome)

Table 1. Continued

Year	Author (S)	Lodging site	Sex	Age	Possible cause	The duration of the wearing the same tracheostomy tube	Material	Fracture site	Treatment
1987	Slotnick et al.[24]	RMB	M	67 y	Prolonged use	2 y	Metallic	The junction of the neck plate and tube (Inner cannula)	Bronchoscopy (through oral cavity, extraction through tracheostome)
1987	Slotnick et al.[24]	LMB	M	55 y	Prolonged use	7 y	Metallic	The junction of the neck plate and tube (Outer cannula)	Fiberoptic bronchoscope (through tracheostome)
1988	Jensen and Pedersen[25]	T	M	8 m	Mechanical stress	3 m	PVC	Junction of the tube and flange	Partly fractured cannula was changed using a suction catheter as a guide
1988	Jensen and Pedersen[25]	T	M	14 m	Mechanical stress	6 m	PVC	Junction of the tube and flange	Rigid bronchoscopy (through tracheostome)
1989	Ming and Ghani[27]	RMB	M	50 y	Manufacturing defect	3 d	Metallic (silver)	Junction between tube and (both inner and outer cannula)	Rigid bronchoscopy (through tracheostome)
1989	Majid[26]	LMB	F	63 y	Prolonged use	1 y	Metallic	Junction between tube and neck plates (outer cannula)	Rigid bronchoscopy (through tracheostome)
1987	Gupta[23]	RMB	M	7 y	Prolonged use	2 y	Metallic (Fuller)	Flange	Exitus
1991	Brockhurst and Feltoe[28]	NAD	F	16 m	Corrosion and cracking	NAD	Metallic(silver)	Junction between tube and neck plate (inner cannula)	Exitus
1992	Bhatia et al.[30]	NAD	M	68 y	Prolonged use	1,5 y	PVC	Junction of the tube and flange	NAD
1992	Bhatia et al.[30]	NAD	M	58 y	Prolonged use	6	PVC	Junction of the tube and flange	NAD
1992	Bhatia et al.[30]	NAD	M	63 y	Prolonged use	12	PVC	Junction of the tube and flange	NAD
1993	Rastogi et al.[31]	NAD	M	65 y	Repeated cleaning and boiling	24 d	PVC	Junction	NAD
1994	Bhattacharjee[32]	NAD	M	60 y	Repeated cleaning and boiling	3 m	PVC	Junction	NAD
1994	Bhattacharjee[32]	NAD	M	40 y	Repeated cleaning and boiling	2 m	PVC	Junction	NAD
1995	Kochhar et al.[33]	T	M	24 y	Manufacturing defect	Few m	PVC	Junction between tube and neck plate	Release with forceps through the tracheostome

Table 1. Continued

Year	Author (S)	Lodging site	Sex	Age	Possible cause	The duration of the wearing the same tracheostomy tube	Material	Fracture site	Treatment
1996	Gupta and Ahluwalia[34]	RMB and left posterior basal segment	M	10 y	Prolonged use	18 m	Metallic	Flange	Bronchoscopy (through tracheostome)
1999	Krempl and Otto[35]	T and RMB	M	48 y	NAD	NAD	NAD	Fenestra	NAD
2000	Gana and Takwoingi[36]	RMB and LMB	M	7 y	NAD	NAD	PVC	NAD	Bronchoscopy (through tracheostome)
2000	Yeh et al.[37]	LMB	M	77	Prolonged use, repeated cleaning and boiling	10 y	Metallic	Junction between tube and neck plate	The fiberoptic bronchoscope
2001	Poorey and Iyer[38]	LMB	M	28 y	Prolonged use	20 y	Metallic (Fuller)	Flange	Bronchoscopy
2003	Fraga et al.[39]	T	F	6 y	NAD	NAD	PVC	NAD	Bronchoscopy (through tracheostome)
2002	Ng et al.[40]	T and LMB	M	3 y	Prolonged use	21	Siliconized PVC	Junction	Flexible bronchoscopy (through tracheostome)
2003	Shivakumar et al.[41]	T	M	20 y	Prolonged use	5 y	Metallic (Fuller's tube)	Junction between tube and neck plates (Inner cannula)	Release through the tracheostomy after an incision
2005	Li et al.[42]	T	M	47 y	Manufacturing defect	28 d	PVC	Junction	Rigid bronchoscopy
2006	Qureshi et al.[43]	LMB	M	6 y	NAD	NAD	NAD	NAD	NAD
2007	Yoo et al.[44]	T	NAD	NAD	NAD	NAD	NAD	NAD	Flexible bronchoscopy
2007	Wu et al.[45]	T and LMB	F	14 m	Manufacturing defect	7 h	PVC	Junction between tube and neck plate	Bronchoscopy
2009	Radpey et al.[46]	LMB	M	41 y	Prolonged use	2 y	Metallic	Shaft	Rigid bronchoscopy (through tracheostome)
2009	Simtoco et al.[47]	The left upper quadrant of the abdomen	M	4 y	Prolonged use	40 m	PVC	Junction between tube and neck plate	Abdominal surgery
2010	Piromchai et al.[48]	RMB	M	14 y	Prolonged use	4 y	Metallic (stainless steel)	Junction between the inner tube and connector	Rigid bronchoscopy (through tracheostome)
2001	Srirompotong and Kraitrakul.[49]	LMB	M	7	NAD	NAD	NAD	Inner tracheostomy tube	Bronchoscopy (through tracheostome)

Table 1. Continued

Year	Author (S)	Lodging site	Sex	Age	Possible cause	The duration of the wearing the same tracheostomy tube	Material	Fracture site	Treatment
2010	Piromchai et al.[48]	LMB	F	5 y	NAD	NAD	NAD	NAD	Bronchoscopy
2011	Feng et al.[51]	RMB	M	81 y	NAD	NAD	NAD	NAD	NAD
2011	Feng et al.[51]	LMB	F	95 y	Prolonged time with improper care	NAD	NAD	Junction between tube and flange	NAD
2011	Herrag et al.[52]	LMB	M	52 y	Prolonged use	2 y	Metallic (Copper and zinc)	Junction between neck plate and tube	Flexible bronchoscopy (through tracheostome)
2011	Herrag et al.[52]	LMB	M	50 y	Prolonged use	5 y	Metallic (Copper and zinc)	Junction between neck plate and tube	Flexible bronchoscopy (through tracheostome)
2011	Agarwal and Agarwal[53]	LMB	F	35 y	Prolonged use	22 y	Metallic	Midshaft (a flange)	Rigid bronchoscopy (through tracheostome)
2012	Lynrah et al.[54]	T	F	5 y	Manufacturing defect	2 d	PVC	Junction between tube and flange	0^0 nasal endoscope (through tracheostome)
2012	Lynrah et al.[54]	RMB	M	7 y	Manufacturing defect	5 d	PVC	Junction between tube and flange	Bronchoscopy
2012	Lynrah et al.[54]	RMB	F	8 y	Manufacturing defect	NAD	PVC	Junction between tube and flange	Exitus
2014	Poduval et al.[55]	T	M	5 y	Prolonged use	3 y	Metallic	Junction between tube and neck plates (Outer cannula)	Rigid bronchoscopy (through tracheostome)
2014	Parida et al.[56]	T	M	1 y	Prolonged use	3 m	PVC	Junction between tube and neck plate	Local wound exploration and removal under direct vision
2014	Parida et al.[56]	T	F	11 y	Prolonged use	22 m	PVC	Junction between tube and neck plate	Bronchoscopy (through tracheostome)
2014	Parida et al.[56]	RMB	M	8 y	Prolonged use	25 m	Metallic (Jackson tube; copper, zinc, nickel)	Junction between tube and neck plates (inner cannula)	Bronchoscopy (through tracheostome)
2014	Parida et al.[56]	RMB	M	9 y	Prolonged use	2 y	Metallic (Jackson tube; copper, zinc, nickel)	Junction between tube and neck plate	Bronchoscopy (through tracheostome)

Table 1. Continued

Year	Author (S)	Lodging site	Sex	Age	Possible cause	The duration of the wearing the same tracheostomy tube	Material	Fracture site	Treatment
2014	Parida et al.[56]	RMB	F	13 y	Prolonged use	35 m	Metallic (Jackson tube; copper, zinc, nickel)	Junction between tube and neck plates (inner cannula)	Bronchoscopy (through tracheostome)
2014	Parida et al.[56]	RMB	F	15 y	Prolonged use	4 y	Metallic (Fuller tube; copper and zinc)	Junction between tube and flange	Bronchoscopy (through tracheostome)
2014	Parida et al.[56]	T and LMB	F	6 y	Prolonged use	30 m	Metallic (Jackson tube; copper, zinc, nickel)	Junction between tube and neck plates (inner cannula)	Bronchoscopy (through tracheostome)
2014	Parida et al.[56]	RMB	F	7 y	Prolonged use	10 m	PVC	Junction between tube and neck plate	Bronchoscopy (through tracheostome)
2014	Loh et al.[57]	RMB	F	70 y	Prolonged use	2 y	PVC	Midshaft	Flexible bronchoscopy (through tracheostome)
2015	Guggarigoudar[58]	RMB	F	11 y	Prolonged use	1 y	Metallic	Outer tube	Rigid bronchoscopy
2015	Kumar et al.[59]	RMB	M	24 y	Prolonged use	4 y	Metallic	flange	Bronchoscopy (through tracheostome)
2015	Al-Momani et al.[60]	LMB	F	4 y	Manufacturing defect	2 m	PVC	Junction between tube and neck plate	Rigid bronchoscopy (through oral cavity)
2016	Rana et al.[61]	RMB	M	67 y	Prolonged use	4 y	Metallic	Junction between tube and neck plate	Desjardin forceps (through tracheostomy under C-arm guidance)
2016	Viswanathan and Esakkimuthu[62]	RMB	M	4 y	Prolonged use	3 y	Metallic	Junction between tube and neck plate	Rigid bronchoscopy (through tracheostome)
2016	Ranjnan et al.[63]	T, RMB, and IM	M	65 y	Prolonged use	4 m	Synthetic	NAD	Thoracotomy and bronchotomy
2016	So-Ngern and Boonsarngsuk[64]	LMB	M	65 y	Prolonged use	18 m	Metallic	Midshaft of outer tube	Rigid and flexible bronchoscopy
2017	Moideen et al.[65]	LMB	M	42 y	Prolonged use	2 y	Metallic	Junction between neck plate and tube	The nasal endoscope (through tracheostome)
2018	Wongsa[66]	LMB	F	78 y	NAD	NAD	Metallic	Midshaft of inner tube	Rigid bronchoscopy

Table 1. Continued

Year	Author (S)	Lodging site	Sex	Age	Possible cause	The duration of the wearing the same tracheostomy tube	Material	Fracture site	Treatment
2020	Bd and Kothari[67]	T	M	50 y	Manufacturing defect	Few d	PVC	Junction between tube and flange	Holding with forceps through tracheostomy
2019	Akhter et al.[68]	C	F	3 y	Manufacturing defect	Few d	PVC	Junction between tube and neck plate	Rigid bronchoscopy (through tracheostome)
2019	Kumar et al.[69]	LMB	M	50 y	Prolonged use	2 y	Metallic	Junction between tube and neck plate	Rigid bronchoscopy (through tracheostome)
2020	Parida et al.[70]	C	M	14 y	Prolonged use	8 y	Metallic (Jackson's tube; copper, zinc, nickel)	Junction between inner tube and neck plates	Rigid bronchoscopy
2020	Parida et al.[70]	T	M	6 y	Prolonged use	63 m	PVC	Junction between inner tube and neck plates	Rigid bronchoscopy
2020	Parida et al.[70]	RMB	F	12 y	Prolonged use	4 y	Metallic (Fuller's tube; copper and zinc)	Just distal to the junction of two flanges	Rigid bronchoscopy
2020	Kashoob et al.[71]	RMB	M	29 y	Prolonged use	14 y	Metallic (Jackson)	Junction between neck plate and tube(inner parts)	Rigid bronchoscopy
2020	Mohammadi et al.[72]	RMB	M	58 y	Manufacturing defect	14 d	PVC	Junction between neck plate and tube	Rigid bronchoscopy
2021	Chehbouni and Benhoummad[73]	LMB	M	70 y	Prolonged use	3 y	Metallic	Tip of the inner cannula	Bronchoscopy (through tracheostome)
2022	Singhal et al.[74]	LMB	M	7 y	Manufacturing defect	1 d	PVC	Junction between the neck plate and tube	Rigid bronchoscopy (through tracheostome)

RMB, right main bronchus; LMB, left main bronchus; LPBS, left posterior basal segment; T, trachea; C, carina; NAD, no available data; PVC, polyvynylchloride; IM, intermediate bronchus; F, female; M, male; d, day (s); m, month (s); y, year (s); w, week (s) *"possible causes" are usually mentioned with the own words of the authors.

for manufacturing defects before insertion. Tubes can be manufactured as single rather than two connected pieces. On the other hand, we think that mechanical stress associated with prone positioning may have facilitated the fracture of the tracheostomy tube in this study. Tracheostomy tubes should be avoided kinking and mechanical stress during prone positioning.

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