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Percutaneous Tracheostomy Via Grigg's Technique in Children: Does Age and Size Matter?

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Objectives: Percutaneous tracheostomy is rarely performed in children, especially in infants. In the present study, we aimed to evaluate the complications and outcomes of PT via the Griggs technique according to the age and size of pediatric patients.

Methods: This study included 110 PICU patients who underwent PT using the Griggs technique between 2012 and 2020. The patients were divided into six groups according to their age, demographic data, primary disease, mean duration of intubation before PT, mean duration of PICU and hospitalization after PT, complications, and decannulation outcomes were compared between these groups.

Results: The mean age and mean weight of the patients were 43.6 ± 58.9 months (1 month–207 months) and 14.6 ± 14.9 kg (2.6–65 kg), respectively. Mean intubation times before the procedures were 64.6 ± 40 days and 38.6 ± 37.9. Thirty-seven (33.6%) infants were under 6 months of age(Group 1). There were no intraoperative complications. Tracheostomy site stenosis was significantly greater in Group 1 than in the other age groups ($p = 0.032$). Granuloma formation and dermatitis incidence were similar in all age groups.

Conclusion: PT is a safe and feasible procedure even in small infants. The accidental decannulation risk is lower than standard tracheostomy. Interacting with rigid bronchoscopy guidance is essential to perform a safer procedure. The first tracheostomy change after PT in small infants under 6 months of age, the possibility of tracheostomy site (stoma) stenosis should be considered.

Key Words: bronchoscopy, children, intensive care unit, tracheostomy.

Level of Evidence: Level III

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INTRODUCTION

Tracheostomy is a frequent procedure that provides stable and easy access to the lower airway in critically ill patients.[1,2] Medical advances have resulted in an increasing number of children surviving critical illness and living with respiratory sequelae that require long-term ventilation.[2–4] Although tracheostomy needs in the pediatric population have increased dramatically over the last decade, tracheostomy is still less frequently performed after a more extended intubation period in children than in adults.[2–4]

In adults, percutaneous tracheostomy (PT) is currently the standard technique because it is a safe and easy bedside procedure that does not damage the tracheal cartilage and has similar complication rates to open tracheostomy.[5–8] On the other hand, PT is rarely performed in children, especially in infants, although infants comprise more than 50% of children who undergo tracheostomy procedures.[3,9,10] PT has been considered a dangerous and contraindicated procedure especially in infants with smaller and pliable airways.[6,11]

We previously reported the prospective data of 45 consecutive children who underwent PT via the Griggs technique under rigid bronchoscopic guidance, revealing that it is a safe and feasible procedure in children, even in small infants.[1] Initially, we started with the Ciaglia technique, which involves serial dilatations over a guidewire under flexible bronchoscopic guidance in the first six PT. After the occurrence of a significant complication, esophageal perforation, which is recognized during the procedure and repaired immediately in the sixth patient, we changed our technique to the Griggs technique, in which a separating forceps advanced over a guidewire, and we converted to rigid bronchoscopic guidance.[1] Since then, we have applied the Griggs technique under rigid bronchoscopic guidance in all patients who underwent PT.

Early and late complications of surgical tracheostomy in children are well described in the literature.[12–14]

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Accidental decannulation and obstruction of the tube by mucous plugs are two of the most common early complications of tracheostomy and may result in cardiopulmonary arrest and death.[12] The other complications of the procedure are subglottic stenosis, suprastomal collapse, tracheostomy site dermatitis, granuloma, and tracheostomy site stenosis.[12] Given that PT is rare in children, there is a lack of data on its complications and outcomes in the literature.

Until our previous report of 51 PT procedures in children,[1] only a small series of PT procedures in children older than 10 years of age had been reported.[15,16] This previous study uncovered intraoperative and perioperative complications and short-term outcomes for children who underwent PT.[1] In the present study, we aimed to evaluate the complications and outcomes of PT via the Griggs technique according to the age and size of pediatric patients.

MATERIALS AND METHODS

The study was performed in compliance with the Declaration of Helsinki. The legal guardians of each child signed written informed consent. Ethical approval was obtained from the local ethics committee (Approval number: i1-68-21). PT was performed on 116 consecutive PICU patients between 2012 and 2020. The outcomes of the initial 51 children were presented in 2016.[1] Initially, six PTs were performed via the Ciaglia technique under flexible bronchoscopic guidance. We used hydrophilic-coated pediatric percutaneous nephrostomy dilators because pediatric-sized PT dilators were unavailable. After a significant complication (esophageal perforation) occurred, we converted our technique to the Griggs technique under rigid bronchoscopic guidance in 110 consecutive patients.

This study included 110 PICU patients who underwent PT using the Griggs technique with rigid bronchoscopy guidance. Patients who have congenital upper airway anomaly, congenital or acquired upper airway obstruction, or congenital facial anomalies such as craniosynostosis and Robin sequence were excluded from the study. The presence of unfavorable neck anatomy, congenital or acquired upper airway obstruction, a narrow upper airway, and craniofacial anomaly preventing the insertion of size-matched rigid bronchoscopy for guidance were the absolute contraindications for PT.

Demographic data, primary disease, duration of intubation before PT, intraoperative complications, postoperative early and late complications, pediatric intensive care unit (PICU) stay after PT, duration of hospitalization after PT, home ventilation status, permanent decannulation, and death were reviewed. The patients were divided into six groups according to their age: under 6 months of age (Group 1), 6–24 months of age (Group 2), 25–60 months of age (Group 3), 61–120 months of age (Group 4), 121–180 months of age (Group 5), and over 180 months of age (Group 6). Demographic data, primary disease, mean duration of intubation before PT, mean duration of PICU and hospitalization after PT, complications, and decannulation outcomes were compared between these groups.

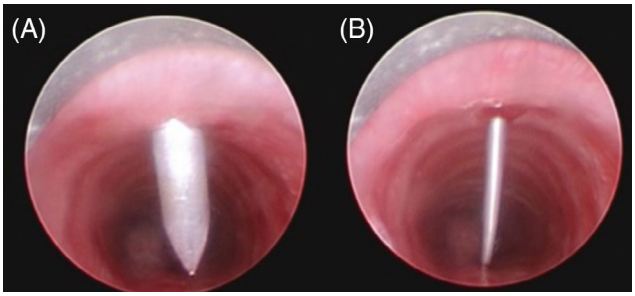


Fig. 1. (A) The needle was inserted into the trachea. (B) Guidewire in the tracheal lumen. [Color figure can be viewed in the online issue, which is available at www.laryngoscope.com.]

Anesthesia Management

All procedures were performed in the operating room (OR) under general anesthesia. Patients were ventilated through a rigid bronchoscope with 100% oxygen. During the procedure, vital signs were monitored by pulse oximetry, electrocardiography, and noninvasive blood pressure measurements.

Surgical Procedure

The patient was supine with a shoulder roll under the scapula, providing neck extension. A rigid bronchoscope (Karl Storz Endoscopy, Tuttlingen, Germany) with a 30-degree telescope (Karl Storz Endoscopy, Tuttlingen, Germany) was inserted into the trachea after the removal of the translaryngeal intubation tube. The cricoid cartilage, the thyroid notch, and the sternal notch were marked, and the surgical field was prepped in a standard sterile fashion. The entire procedure was visualized by a bronchoscopic telescope connected to a video monitor. The bronchoscope was kept in the midline and upper positions just below the vocal cords for adequate visualization of the tracheostomy site. Under bronchoscopic vision, the trachea was punctured with an 18–20-gauge catheter introducer needle between the first and second cartilage rings, and a J-type guidewire was introduced through the needle (Fig. 1). The needle was removed, leaving the guidewire in the trachea. A transverse incision matching the tracheostomy tube size was made, leaving the guidewire in the middle of the incision. Subcutaneous tissue and paratracheal strep muscles were bluntly dissected to the tracheal cartilages. Sharp-tipped separating forceps with a guidewire channel (Bahadir Company, catalog no: G72301, Samsun, Turkey) were placed into trachea over the guidewire, which was subsequently separated to enlarge the tracheal opening (Fig. 2). Then, an appropriate-size cuffed tracheostomy tube (Whisper, Fuzhou, China) was inserted over the guidewire. When adequate ventilation through the tracheostomy tube was assured via bilateral lung auscultation and accurate capnography, the tracheostomy tube was secured in a standard fashion.

Follow-Up

All patients were followed in PICU, postoperatively. Posterior–anterior chest x-ray is taken in all patients, and the location of the tracheostomy tube and complications such as pneumomediastinum and pneumothorax were evaluated. After the PICU stay, the children who underwent tracheostomy were referred to a pediatric pulmonology clinic for tracheostomy care education. Patients who were discharged with home ventilators were examined once a month in the outpatient clinic to determine long-term complications. If the patients had not experienced any clinical problems or ventilation issues, routine laryngoscopy and bronchoscopy were not performed to evaluate suprastomal collapse, tracheal granuloma, or subglottic stenosis. However, we started routine follow-up flexible laryngoscopy and bronchoscopy at 6-month intervals in all patients who underwent PT beginning in January 2022.

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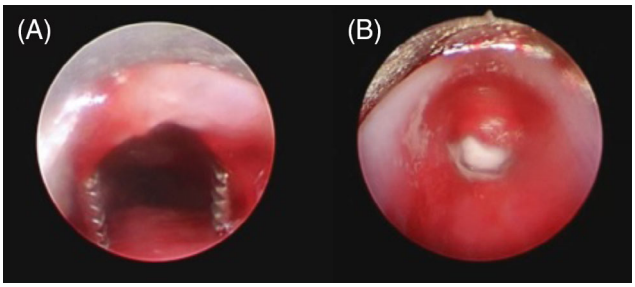


Fig. 2. (A) Dilatation of the orifice on the trachea over the guidewire. (B) Inserting the tracheostomy tube into the trachea over the guidewire. [Color figure can be viewed in the online issue, which is available at www.laryngoscope.com.]

All the patients with the decannulation plans underwent flexible laryngoscopy and bronchoscopy before decannulation to visualize a patent airway.

Complications

Perioperative and early postoperative complications of tracheostomy, including death, pneumomediastinum, pneumothorax, bleeding, wound infection, tracheoesophageal fistula, and misplacement and obstruction of the cannula, and late complications of tracheostomy, including tube obstruction, tracheostomy site dermatitis and granuloma, tracheostomy site stenosis (narrowing of the stoma), suprastomal collapse, tracheal granuloma, and subglottic stenosis and tracheocutaneous fistula were recorded and compared among age groups.

Statistical Analysis

Continuous data were presented as mean ± standard deviation (SD). The chi-square test and the Fisher exact test were used to analyze group differences for categorical variables. For comparisons between more than two groups, one-way ANOVA was used for normally distributed data, and the Kruskal–Wallis test was used for not normally distributed data. To observe differences between groups and to account for multiple testing after one-way ANOVA, a multiple-comparison, post hoc Bonferroni correction was used. A p-value of <0.05 was considered statistically significant. Statistical analysis was performed using SPSS v 26.0 (IBM Corp, Armonk, NY, USA).

RESULTS

The mean age and mean weight of the patients were 43.6 ± 58.9 months (1 month–207 months) and 14.6 ± 14.9 kg (2.6–65 kg), respectively. Sixty-seven (60.9%) of the patients were male, and 43 (39.1%) were female. Fifty-nine (53.6%) of the 110 children were under 12 months of age. There were 37 (33.6%) infants in Group 1 (under 6 months of age), 33 (30%) in Group 2 (6–24 months of age), 16 (14.5%) in Group 3 (25–60 months of age), 6 (5.5%) in Group 4 (61–120 months of age), 13 (11.8%) in Group 5 (121–180 months of age), and 5 (4.5%) in Group 6 (over 180 months of age). The demographics of the patients according to group are presented in Table I.

The most common primary disease was chronic neurological disease (59.1%), followed by neuromuscular conditions (12.7%), metabolic diseases (11.8%), complex cardiopulmonary anomalies (8.2%), and chronic lung conditions (8.2%). Chronic neurological diseases include hypoxic–ischemic encephalopathy, perinatal asphyxia, cerebral palsy, hydrocephaly, pilocytic astrocytoma, medulloblastoma, Sandoff syndrome, ependymoma, Rubinstein–Taybi syndrome, and Wolf Hirschhorn syndrome, whereas neuromuscular conditions include congenital myotonic dystrophy, hypotonic infant, infantile spasm, spinal muscular atrophy, and mitochondrial disease. Complex cardiopulmonary anomalies and chronic lung conditions include bronchopulmonary dysplasia, pulmonary hypoplasia, and pulmonary hypertension. No patient had congenital upper airway anomaly, upper airway obstruction, or craniofacial anomaly. The mean duration of intubation before PT was 55.6 ± 42.6 days (11–240 days). No significant correlation existed between intubation time before PT and primary disease or age group (Table I, Figure 3).

There were no intraoperative complications. Accidental decannulation, pneumomediastinum, and pneumothorax were not observed in any patient during the early postoperative period. The mean duration of PICU stay after the procedure, the mean duration of hospitalization after PT, the duration of hospitalization, in the hospital, and the follow-up death data according to groups are presented in Table I. The mean follow-up was 34.9 ± 184 months. Eighty-nine (80.9%) children were discharged with a home ventilator. Twenty-one (19.1%) and 38 (33.6%) children died in the hospital and during the follow-up period, respectively, due to complications of their primary condition. The occurrence of in-hospital or later death did not differ among the groups (Table I).

Tracheostomy site (stoma) stenosis was observed in 14 (12.7%) children. The stenosis was resolved in 13 children by simple dilation, and one child required reoperation. Granuloma, which was treated with silver nitrate sticks, was observed in 10 (9.1%) children. Tracheostomy site dermatitis occurred in 5 (4.5%) children (Table II). Tracheostomy site stenosis was significantly greater in Group 1 (patients under 6 months of age) than in Groups 2–6 ($p = 0.032$). Granuloma formation and dermatitis incidence were similar in all the groups (Table II).

Permanent decannulation was attempted in 10 patients. Permanent decannulation was successful in eight (7.3%) children without a need for surgical intervention. Twelve children underwent flexible laryngoscopy and bronchoscopy to evaluate ventilation issues or to check the airway before decannulation. We did not observe any tracheal granulomas, subglottic stenosis, or suprastomal collapse in these children. Accidental decannulation of tracheostomy, tube obstruction, and tracheostomy-related death did not occur in any patient.

DISCUSSION

To the best of our knowledge, this is the largest PT series reported in children, with 53.6% younger than 12 months of age. In this series, intraoperative complications were not observed, and life-threatening complications did not occur during the follow-up period.

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TABLE I.
Demographics and Outcomes According to Group.

			Groups						
			Group 1	Group 2	Group 3	Group 4	Group 5	Group 6	
		Total	<6 months	6–24 months	24–60 months	60–120 months	120–180 months	>180 months	*p*-value
Number of the patients (%)		110	37 (33.6%)	33 (30.0%)	16 (14.5%)	6 (5.5%)	13 (11.8%)	5 (4.5%)	
Age (months)		43.6 ± 58.9	3.3 ± 1.64	14.1 ± 5.9	44 ± 5.9	91 ± 13.1	149.6 ± 15.5	201 ± 7.4	0.000
Weight (kg)		14.6 ± 14.9	4.4 ± 1.3	8.6 ± 3.8	15.8 ± 7.2	26.1 ± 12.6	39.8 ± 12.9	46.4 ± 15.4	0.000
Sex									
Male		67 (60.9%)	19	20	13	6	6	3	0.100
Female		43 (39.1%)	18	13	3	0	7	2	
Primary disease	Chronic neurologic disease	65 (59.1%)	22 (59.5%)	15 (45.5)	15 (93.8%)	3 (50.0%)	7 (53.8%)	3 (60.0%)	
	Neuromuscular conditions	14 (12.7%)	8 (21.6%)	5 (15.2%)	0	1 (16.7%)	0	0	
	Metabolic diseases	13 (11.8%)	1 (2.7%)	8 (24.2%)	0	0	3 (23.1%)	1 (20.0%)	
	Complex cardiopulmonary anomalies	9 (8.2%)	4 (10.8%)	1 (3.0%)	0	2 (33.3%)	1 (7.7%)	1 (20.0%)	
	Chronic lung conditions	9 (8.2%)	2 (5.4%)	4 (12.1%)	1 (6.3%)	0	2 (15.4%)	0	
The mean duration of intubation before PT (day)		55.6 ± 42.6	66.5 ± 29.4	60.5 ± 51.9	37.6 ± 21.1	51.1 ± 55.4	47.9 ± 60	26.6 ± 8.8	0.129
PICU stay after PT (day)		33.6 ± 50	49.2 ± 73.9	28.8 ± 32.4	10.6 ± 8.3	28.5 ± 23	25 ± 13.9	52.2 ± 62	0.132
Mean duration of hospitalization after PT (day)		56.2 ± 56.8	62.8 ± 72.2	44.1 ± 72.2	35.2 ± 18.7	74.6 ± 97.5	71.2 ± 54.2	93.2 ± 71.3	0.166
Discharging with a home ventilator (*n*, %)		89 (80.9%)	31 (83.8%)	27 (81.8%)	13 (81.3%)	4 (66.7%)	11 (84.6%)	3 (60.0%)	0.771
In-hospital death (*n*, %)		21 (19.1%)	6 (16.2%)	6 (18.2%)	3 (18.8%)	2 (33.3%)	2 (15.4%)	2 (40.0%)	0.566
Death during the follow-up (*n*, %)		38 (34.2%)	15 (40.6%)	11 (39.4%)	4 (25%)	0	5 (38.4%)	1 (20%)	0.841

PICU = pediatric intensive care unit; PT = percutaneous tracheostomy.

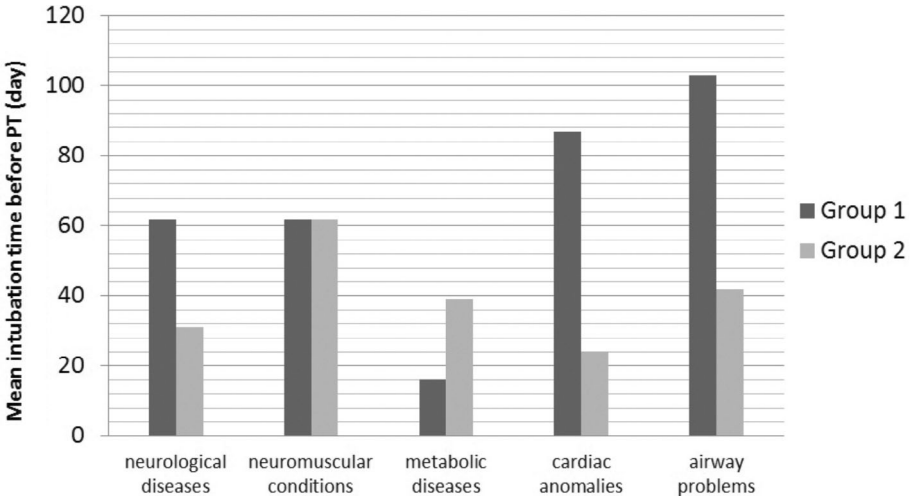


Fig. 3. The mean duration of intubation before PT according to primary diseases.

Tracheostomy complications have been reported to be more common in infants than in children older than 1 year.[17,18] The incidence of overall tracheostomy-related death ranges from 0.8% to 6% in the literature.[12,19–22] Watters et al. reported that children under 1 year of age have a sevenfold greater risk of death than do children older than 1 year.[23] In this series, although 53.6% of the children who underwent PT were younger than 12 months of age, tracheostomy-related death was not observed in any patient. Our data show that PT via the Griggs technique under rigid bronchoscopic guidance can be performed safely and successfully in infants and children given that no intraoperative and early postoperative complications occurred. Midwinter et al. reported that the overall complication rate of tracheostomy was 41% in their series and 63% in infants.[18] Corbett also reported a greater complication rate, particularly late complications, in infants than in older children.[17] The overall

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TABLE II.
Complications of PT According to Group.

Complications	Total *n* (%)	Groups						*p*-value
		Group 1	Group 2	Group 3	Group 4	Group 5	Group 6	
		<6 months	6–24 months	24–60 months	60–120 months	120–180 months	>180 m	
Number of the patients	110	37	3	16	6	13	5	
Tracheostomy site (stoma) stenosis	14 (12.7%)	10 (27.0%)	3 (9.1%)	0	1 (16.7%)	0	0	0.032
Granuloma	10 (9.1%)	3 (8.1%)	3 (9.1%)	2 (12.5%)	0	0	2 (40.0%)	0.159
Dermatitis	5 (4.5%)	1 (2.7%)	1 (3.0%)	2 (12.5%)	0	1 (7.7%)	0	0.606

PT = percutaneous tracheostomy.

complication rates of PT, reported in this study (26.3%) are lower than that previously reported and include less significant complications. However, the tracheostomy site stenosis rate was significantly greater in children younger than 12 months ($p = 0.042$).

In this study, 12.7% of children developed tracheostomy site stenosis, which was greater in small infants under 6 months of age ($p = 0.032$). However, 93% of the stomal stenosis was managed by simple dilatation. Neto et al. reported 0.02% stomal stenosis in children who underwent surgical tracheostomy in a systematic review of 49 studies.[12] The high rate of stomal stenosis after PT, especially in infants, might be due to the creation of a small tracheal opening in a child's growing trachea. PT opening is even smaller in infants, given that smaller tracheostomy tubes are used. In small children, a tracheal opening may not accommodate the infant's growing trachea, resulting in tracheostomy site stenosis. Creating a smaller opening on the trachea during PT prevents accidental decannulation, which can be catastrophic for patients. However, tracheostomy site stenosis may be a late postoperative complication of tracheostomy. Stoma stenosis, which can be relieved by simple dilatation, is a minor complication compared to accidental decannulation, which may lead to death.

After experiencing a greater incidence of tracheostomy site stenosis in this age group, we started performing the first tracheostomy change in the OR in small infants under 12 months of age and, weighing less than 5 kg. Although we took these infants to the OR for initial tracheostomy changes, we only performed the procedure under general anesthesia if there was a narrowing of the tracheostomy site and dilatation requirement. We prefer to have an OR setting and anesthesia ready if the patient has a narrowing of the stoma and needs dilatation of the stoma during tracheostomy change. In our setting, it is easy and safe to perform the first tracheostomy change in the OR in small infants, given that the PICU and OR are on the same block in our children's hospital, and it takes two or three floors by elevator to take these patients to the OR accompanied by intensive care unit staff. We usually have available ORs. Therefore, a first tracheostomy tube change in a limited number of infants does not increase our resource utilization.

Depending on each hospital setting and resource utilization, the first tracheostomy change after PT in small infants can also be performed in the PICU or emergency room (ER), where the emergency intubation and ventilation of the patient can safely be performed if the stoma site is narrow and a tracheostomy tube cannot be inserted.

Tracheocutaneous fistula, subglottic stenosis, and suprastomal collapse are other late complications of tracheostomy.[12,24] Tracheocutaneous fistula is the epithelization of the tracheostomy tract, preventing spontaneous tracheostomy closure following decannulation.[12] In this study, only eight children underwent permanent decannulation, and tracheocutaneous fistula did not occur. Suprastomal collapse and subglottic stenosis are believed to result from fibrosis of the damaged tracheal cartilage and mucosa during the procedure.[12] These complications do not become symptomatic before decannulation and can only be diagnosed by endoscopic evaluation.[25] Twelve children underwent flexible laryngoscopy and bronchoscopy; no case of suprastomal collapse or subglottic stenosis was encountered in this study. As bronchoscopic evaluation was not performed for most of the patients in the study group, it was impossible to determine the actual incidence of suprasternal collapse and subglottic stenosis. However, PT may be advantageous over surgical tracheostomy, given that PT requires minimal dissection and might cause less damage to the tracheal cartilage than surgical tracheostomy.

The rate of minor complications, such as peristomal dermatitis and granuloma, was 13.6% which is in accordance with the reported incidence. Roberts et al. reported an overall late complication rate of 40% in 153 children.[20] In a meta-analysis, Neto et al. recently investigated tracheostomy complications in children.[12] According to their study, the percentages of skin lesions and granulomas were 23.7% and 20.4%, respectively.

The complications of PT and surgical tracheostomy have been compared in adult patients. PT was associated with a lower wound infection rate and unfavorable scar tissue.[5,26] A significant difference was not observed in terms of a false passage, major or minor bleeding, death, or overall complications.[5] To the best of our knowledge, the complications of surgical tracheostomy and PT have not been compared in children. In this study, we did not observe major intraoperative or postoperative complications or accidental decannulation. PT seems reasonable in children, considering the surgical tracheostomy

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complications reported in the literature.[12,17,18] According to our experience, proper anesthetic management, rigid bronchoscopic guidance, appropriate equipment, and surgical experience are the main components of a safe PT in children.

In adults, tracheostomy is frequently performed when there is a need for mechanical ventilation support for more than 5–7 days.[3,9] In contrast to adult practice, the timing of the decision to proceed with tracheostomy is highly variable in children, and this decision is based on patient-specific situations.[2,3] However, some recent studies have reported a shorter duration of intubation before tracheostomy in children.[20,27] Roberts et al. and Wakeham et al. reported that the mean durations of intubation before tracheostomy were 13 and 14.4 days, respectively.[20,27] In this study, the mean duration of intubation before tracheostomy was 50.7 days, which was significantly longer than that reported in recent studies, especially in children younger than 12 months of age. This longer duration is related to the approach of our PICU team, which is more conservative in making tracheostomy decisions. The lack of a consensus on tracheostomy timing and concerns about tracheostomy complications, particularly in infants, may cause hesitations in the decision of tracheostomy, leading to a prolonged intubation period. Furthermore, most parents need a long time to accept their child's condition and want to wait before consenting to the tracheostomy decision in our country.

Roberts et al. reported 172 children who underwent tracheostomy within 13 days of the mean intubation time before tracheostomy, for a 44.4% decannulation rate.[20] Schweiger et al. reported a 22.5% decannulation rate in children who underwent tracheostomy, and they found neurological and pulmonary diseases to be negative predictive factors for decannulation.[19]

The major drawback of this study is the lower permanent decannulation rate of 7.3% compared to that in the recent literature. The low rate of decannulation is related to the consideration of PT in children, mostly those with chronic conditions such as neurological or neuromuscular disease, who are candidates for long-term or life-long mechanical ventilation. The other limitation of this study is that routine follow-up endoscopic evaluations were only performed if the patients had experienced ventilation issues or had a decannulation plan. Although we did not observe suprastomal collapse, tracheal granuloma, or subglottic stenosis in any of our patients, the actual incidence of these long-term complications could be greater than that in the current study. We started to perform routine follow-up flexible laryngoscopy and bronchoscopy at 6-month intervals in all patients who underwent PT beginning in January 2022. In future studies, we will be able to assess the actual incidence of long-term complications.

PT via the Griggs technique under rigid bronchoscopic guidance can be performed safely and successfully in infants and children. It is a less invasive alternative to conventional surgical tracheostomy even in small infants less than 12 months old. The main advantage is the decreased risk of accidental decannulation in the early period. We strongly recommend PT done by Griggs technique in children. It is of utmost importance that it should be done in an operating room setting and under rigid bronchoscopic visualization of every step to prevent complications in pediatric patients.

The presence of unfavorable neck anatomy, congenital or acquired upper airway obstruction, a narrow upper airway, or craniofacial anomaly preventing the insertion of size-matched rigid bronchoscopy for guidance are the absolute contraindications for PT. Surgical tracheostomy should be the procedure of choice when these conditions exist in pediatric patients. During the first tracheostomy change after PT in small infants under 6 months of age, the possibility of tracheostomy site (stoma) stenosis should be considered. Therefore, the procedure should be performed in the PICU, ER, or OR, where emergency intubation and ventilation of the patient can be performed safely if a tracheostomy tube cannot be inserted due to the narrowing of the stoma, depending on the hospital's settings and resources.

CONCLUSION

PT via the Griggs technique under rigid bronchoscopic guidance can be performed safely and successfully in infants and children. It is a less invasive alternative to conventional surgical tracheostomy even in small infants less than 12 months old. The main advantage is the decreased risk of accidental decannulation in the early period. In this study, 12.7% of children developed tracheostomy site stenosis, which was greater in small infants under 6 months of age. The first tracheostomy change after PT in small infants can also be performed in the PICU or emergency room (ER), where the emergency intubation and ventilation of the patient can safely be performed if the stoma site is narrow and a tracheostomy tube cannot be inserted.

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