Pediatric Tracheotomies in an Asian Population: The Singapore Experience

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Pediatric Tracheotomies in an Asian Population: The Singapore Experience

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OBJECTIVE: Over the past 2 decades, tracheotomy in children and infants has evolved from a primarily emergent procedure for upper airway obstruction into a semielective procedure for airway access in assisted ventilation. We present a 12-year retrospective review of tracheotomies performed in the pediatric population in Singapore.

STUDY DESIGN AND SETTING: We reviewed all tracheotomies performed in children below the age of 16 years in 2 tertiary pediatric medical centers in Singapore from January 1991 to December 2003. Indications for surgery are reviewed, and outcomes in terms of morbidity rate, mortality rate, postoperative rehabilitation, and duration of decannulation process were analyzed.

RESULTS: Tracheotomies were performed in 48 children during the study period. The mean age of patients was 3.24 years, with ages ranging from 16 days to 14 years. Sixty-three percent of tracheotomies were done within the 1st year of life. The chief indication was airway access for assisted ventilation. The overall complication rate was 31%. There were 13 attempts at decannulation, with 9 successes. No tracheotomy-related deaths occurred.

CONCLUSION: Tracheotomy is a relatively safe procedure in children and infants. Lower decannulation rates and the evolving role of tracheotomy for early access in assisted ventilation permits earlier discharge with tracheotomy in situ.

Tracheotomy is the surgical creation of an opening into the trachea. Described as early as 100 BC by Asclepiades,[1] the 1st successful pediatric tracheotomy was performed in the early part of the 1600s.[2] Historically a procedure for urgent relief of acute upper airway obstruction, it has matured to encompass access for assisted ventilation and pulmonary toilet.[3] Tracheotomy in the pediatric patient is fraught with greater difficulties and associated with higher morbidity and mortality compared with those performed in adults.[4] The younger the patient at the time of tracheotomy, the greater the risk.[3,4]

To date, the reported experience of pediatric tracheotomies has come largely from institutions from North America and Europe. We present a descriptive series of all tracheotomies performed on an Asian pediatric population in 2 tertiary pediatric centers in Singapore from 1991 to 2003 and analyze our experience in the wake of the global paradigm shift toward earlier assisted ventilation in this unique group of patients.

METHODS AND MATERIALS

All children below the age of 16 years who underwent tracheotomies over a 12-year period from January 1991 to December 2003 at both the Kandang Kerbau Women's and Children's Hospital and the National University Hospital in Singapore were identified for this study. Their clinical records were reviewed and analyzed for the following parameters: demographic profile of our Asian patients, primary diagnoses and indications mandating tracheotomies, elective versus urgent or semiurgent nature of surgery, techniques of tracheotomy and intraoperative airway control,

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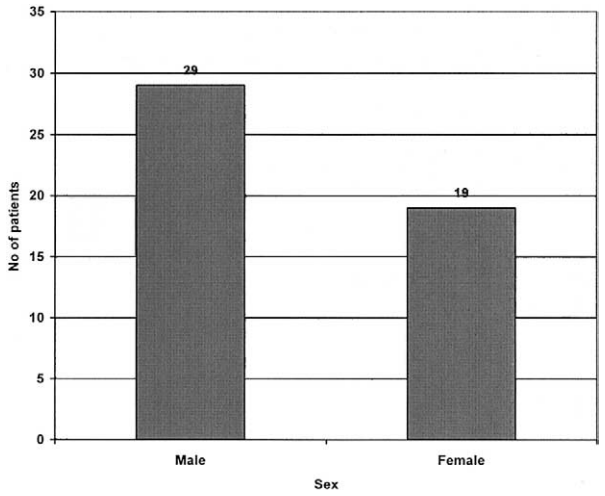

Figure 1 Sex distribution of patients.

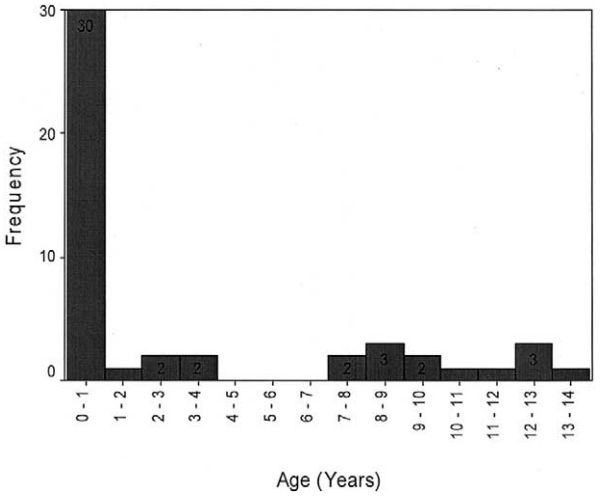

Figure 3 Age histogram of patients.

type of tracheotomy tube and size employed, requirement for and results of subsequent bronchoscopy, duration of tracheotomy, mode of decannulation, and nature of postoperative complications.

RESULTS

Forty-eight pediatric tracheotomies were performed over a 12-year period. There were 29 males and 19 females (Fig 1). They comprised 35 Chinese, 9 Malays, and 4 Indians (Fig 2). Thirty (63%) tracheotomies were done within the 1st year of life (Fig 3). The youngest patient was 16 days old, and the oldest was 14 years old.

Indications for Tracheotomy

The chief indications for tracheotomy were access for assisted ventilation (54%), airway obstruction (40%), and pulmonary toilet (6%); (Fig 4). The primary diagnoses and indications for tracheotomy are presented in Tables 1-3. Six patients had tracheotomies done under semiurgent settings, whereas 42 were elective cases. Of the 6 semiurgent cases, 1 patient was diagnosed with CHARGE (Coloboma, Heart anomalies, Atresia of choanae, Retardatin (mental and growth), Genital anomalies, Ear anomalies) association. He presented with laryngomalacia and bilateral choanal atresia, causing severe acute upper airway obstruction. The 2nd patient suffered from spinal muscular atrophy type I. He presented with acute respiratory failure, necessitating an emergency tracheotomy for ventilatory support. The 3rd patient had Down's syndrome. He developed subglottic stenosis as a complication of prolonged intubation. He presented with worsening stridor after discharge, requiring a semiurgent tracheotomy. The 4th patient had acute airway obstruction due to a congenital laryngeal teratoma. The remaining 2 patients had bilateral vocal cord paralysis secondary to idiopathic congenital hydrocephalus.

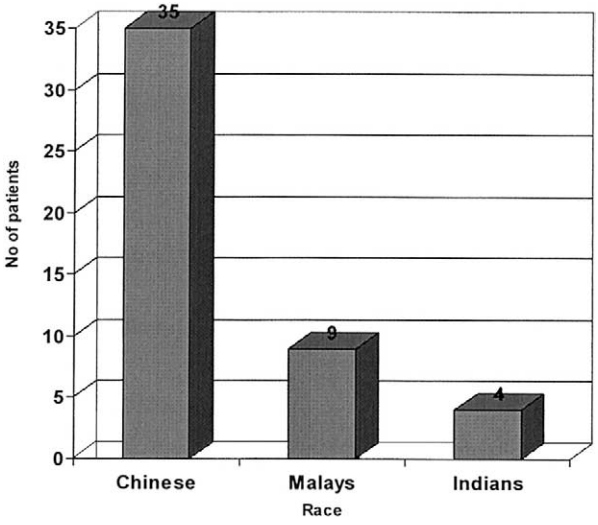

Figure 2 Race distribution of patients.

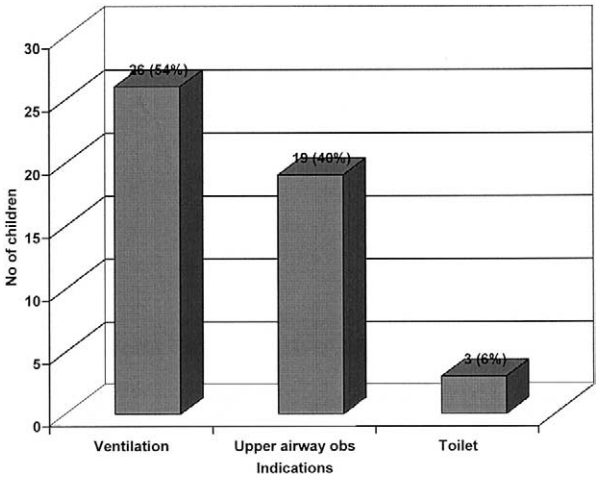

Figure 4 Indications for tracheotomy.

Table 1
Diagnoses for patients with indication of upper airway obstruction

Primary diagnoses	Number of patients
Congenital	
Craniofacial abnormalities	
Treacher Collins syndrome	1
Freeman Sheldon syndrome	1
Pfeiffer syndrome	1
Pierre Robin syndrome	1
Airway abnormalities	
Tracheal stenosis	1
Laryngeal web	1
Macroglossia secondary to mucopolysaccharidosis	1
Tracheobronchomalacia	2
Teratoma of larynx	1
Cardiac malformation causing airway obstruction	
Coarctation of aorta	1
TGA, ASD, PS	1
Congenital bilateral vocal cord palsy	4
Acquired	
Neoplasm	
Tongue lymphangioma	1
Tracheal epithelioma	1
Trauma	
Tracheal stricture secondary to chemical burns	1
Total	19

TGA, transposition of great arteries; ASD, artrial septal defect; PS, pulmonary stenosis

Table 2
Diagnoses for patients with indication of access for assisted ventilation

Primary diagnoses	Number of patients
Neurological disorders	
Congenital/perinatal	
Cerebral palsy	2
Spinal muscular atrophy	1
Olivopontine degeneration	1
Craniosynostosis	1
Congenital hydrocephalus	2
Neuroleptic syndrome	1
Infection	
Meningoencephalitis	2
Neoplasm	
Medulloblastoma	2
Cerebellar astrocytoma	1
Trauma	
C1C2 cord compression	1
Intracranial hemorrhage	
Arteriovenous malformation	4
Prematurity with bronchopulmonary dysplasia	5
Sepsis with respiratory distress	3
Total	26

Surgical Method

All tracheotomies were performed by otolaryngologists. Each patient received general anesthesia in an operating theatre with a controlled airway (eg, an endotracheal tube in situ). After a horizontal skin crease incision midway between the sternal notch and the cricoid cartilage, the subcutaneous fat was removed to facilitate access to the trachea. Midline division of strap muscles and thyroid isthmus was performed with hemostasis secured via monopolar diathermy or ligature. A vertical incision was made through the tracheal wall through the 2nd, 3rd, and 4th or 3rd, 4th, and 5th tracheal rings, followed by insertion of an appropriately sized tracheotomy tube. Withdrawal of the endotracheal tube followed successful ventilation via the newly fashioned tracheotomy. The tracheotomy tube was secured with circumferential cotton tapes around the neck in a flexed position. Routine postprocedural monitoring in the pediatric intensive care or high-dependency unit ensured patient stability before transfer to nursing care in a general ward.

Decannulation Method

Predecannulation assessment of suitability comprised both clinical and endoscopic examination. Microlaryngoscopy and bronchoscopy afforded assessment of airway patency and the presence of tracheal lesions (eg, suprastomal granulomas). Granulomas potentially liable to cause airway compromise were excised before decannulation. Tolerance of a speaking valve without dyspnea often heralded successful decannulation. Inpatient monitoring (vital signs and oxygen saturation) of patients was mandatory during decannulation. Successful progressive downsizing of tracheotomy tube over a 48-hour period culminated in complete occlusion of the tube. The tube is removed after successful occlusion for 24 hours without evidence of respiratory distress. Further 24-hour monitoring of airway competency was undertaken before discharge from hospital.

Complications

The incidence of complications in our series was 23% (11 of 48 patients). The overall complication rate was 31% (15

Table 3
Diagnoses for patients with indication of toilet

Primary diagnoses	Number of patients
Sepsis	1
Neurological disorders	
Spinal muscular atrophy	1
Mitochondrial atrophy	1
Total	3

Table 4
Complications of tracheotomies

Type of complications	Number of episodes
Early	
Bleeding from tracheostome	2
Tracheal wound infection	2
Blocked tube with desaturation	1
Pneumothorax	1
Late	
Suprastomal granulations, requiring surgery	3
Tracheocutaneous fistulae	5
Tracheomalacia	1
Total	15

episodes of complication arising from 48 tracheotomies performed). Of these, 6 patients (12%) had early postoperative complications, defined as complications occuring within one week of surgery. Nine patients (18%) had late postoperative complications (Table 4). No intraoperative complications were encountered. Twelve patients (25%) had at least 1 episode of pneumonia after tracheotomy; the majority of these were attributable to primary disease, immunosuppression (3 patients), and underlying neurological disorders with resultant poor respiratory effort and immobility (18 patients). Eleven patients (22%) developed suprastomal granulations, 3 of whom required surgical excision. One patient had recurrent bleeding, whereas the other 2 patients had airway compromise. Subglottic stenosis was reported in 3 patients who had prolonged intubation. Of these, 1 underwent cricotracheal resection, whereas the other 2 were successfully managed conservatively. Tracheocutaneous fistula occurred in 5 patients (10%), 4 of whom required surgical closure. Eight patients (17%) died eventually as a result of their primary disease conditions. There were no tracheotomy-related deaths. Thirteen patients (27%) underwent decannulation with 9 successful outcomes. The remaining 31 of 40 surviving patients (78%) required continual dependence on tracheotomy.

DISCUSSION

Primarily performed for relief of upper airway obstruction from acute infections such as epiglottitis or laryngotracheobronchitis in seminal pediatric series, the demise of these scourges in the last quarter-century with effective antimicrobial therapy and global vaccination programs has led to evolving indications for tracheotomy. Semielective airway access for prolonged assisted ventilation now dominates the scenario in contemporary pediatric practice.[2-10] Our experience supports this paradigm shift, with the majority of tracheotomies being performed for airway access (54%). Interestingly, there is a low incidence of acute epiglottitis in the Singapore pediatric population despite suboptimal rates of *Haemophilus influenzae b (Hib)* vaccination.[11] Less than 0.1% of our population has been given Haemophilus influenzae b vaccination.[12] Despite this, the reported incidence of acute epiglottitis in Singaporean children is remarkably low. Stanley and Liong[13] reported the 1st series of 42 cases of acute epiglottitis from Singapore General Hospital, over a 4-year period. There were no pediatric patients in their series. In a study reported by Chan et al,[14] there was only 1 case of acute epiglottitis in a pediatric patient during a 7-year period at National University Hospital.

In our series, almost two thirds (63%) were performed in children younger than 1 year of age. Our demographic profile appears similar to that reported by Donnelly et al[5] (48%), Shinkwin and Gibbin[6] (70%), and Carron et al[8] (55%). Tracheotomies in children younger than 1 year of age are more challenging and technically difficult.[5,6]

In this era of advanced pediatric intensive and community care, children with congenital disorders are now living longer and surviving in the community with a tracheotomy in situ. In our series, 31 of 40 surviving children (78%) demonstrated continued dependence on long-term tracheotomy. Programs designed to train patients and their caregivers on optimal tracheotomy care in the community have become an increasingly integral part of holistic rehabilitation of this subgroup of patients requiring long-term tracheotomy. In our center, techniques of caring for a tracheotomy (eg, suctioning, change of tracheotomy tube, etc.) and handling of crisis situations are taught to the primary caregivers of the child by a specialized tracheotomy nursing team before discharge. Support groups of experienced caregivers of children with similar problems are another valuable resource in helping these patients transit successfully into the community after discharge. Materials, such as instruction manuals on caring for tracheotomies, are made available to caregivers. A home care team, comprising a respiratory physician and nurse, patients in their homes every 3 months to monitor their tracheotomy care and review their ventilator needs. Round-the-clock direct telephone access to the pediatric intensive care units in both tertiary centers also is made available to patients and their caregivers.

Our complication rate of 31% compares favorably with that of other reported series, the latter being reported from 35% to 44%.[3,5-10] Of these, early complication rates of 9%-22.5%[3,9] and late complication rates of 23%-35% have surfaced in recent years.[3,9] Also, our experience with suprastomal granulations (22%) mirrors that seen in other centers.[3,5,6,8,9] These lesions generally are not considered complications unless they pose problems with decannulation.[3,5,6,8,9]

Recent interest has arisen in the use of percutaneous dilatational tracheotomy (PDT) as an alternative to open tracheotomy in adults.[15] To date, there has been only 1 series of PDT in the pediatric population, and its long-

term safety profile remains to be seen.[15,16] We have no experience with PDT in our Asian pediatric population to date.

CONCLUSION

Tracheotomy in our Asian pediatric population has been established as a safe procedure, its predominant role being access for assisted ventilation. With the twin thrusts of pediatricians moving toward earlier tracheotomy for these patients requiring prolonged ventilatory support, as well as improvements in decannulation and community rehabilitation, better outcomes are being achieved with pediatric tracheotomy despite its technical difficulties. The challenges in this arena will be to find answers for successfully weaning patients off continued dependence on their tracheotomies and making breakthroughs in treatment regimes of those primary diseases necessitating its use.

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