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Arytenoidopexy for bilateral vocal fold paralysis in young children

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Abstract

The purpose of this retrospective study was to describe and evaluate the results of arytenoidopexy performed by the external laterocervical approach in 15 consecutive children presenting bilateral vocal fold paralysis causing life-threatening airway compromise. Mean age at the time of surgery was 20 months and mean follow-up was 42 months. At the end of follow-up all patients were in good health and did not need special care for breathing. No abduction movement has been observed on the opposite vocal fold since arytenoidopexy. One failure subsequently required arytenoidectomy. The findings of this study suggest that arytenoidopexy is an effective surgical treatment for life-threatening bilateral vocal fold paralysis in young children.

Key words: Vocal fold paralysis; Arytenoid cartilage, surgery; Child

Introduction

Bilateral vocal fold paralysis is an uncommon but often disabling problem in young children. It may be acquired or congenital and is generally present before the end of the first month (De Gaudemar *et al.*, 1996). The most common aetiologies include injury (e.g. surgical or obstetrical), idiopathic paralysis, and neurological disorders (e.g. hypotonia, hypoxic encephalopathy, cerebral palsy, Arnold-Chiari malformation with associated meningomyelocele and hydrocepalus) (Holinger *et al.*, 1976). Whenever possible, the cause must be promptly determined so that proper management decisions can be made. Laryngeal obstruction usually causes various degrees of stridor and dyspnoea. If symptoms are not life-threatening and there is a reasonable chance of recovery, a watchful attitude may be advocated. However, in more severe cases with little chance for recovery, intervention is indicated. Several ways to ensure an adequate airway have been proposed including endotracheal intubation, tracheotomy, laryngeal reinnervation (Tucker, 1989), and lateralisation of the vocal fold. Methods of lateralisation include endoscopic laser arytenoidectomy (Lim, 1985), endoscopic vocal fold laterofixation (Ejnell *et al.*, 1984), anterior laryngofissure (Scheer, 1953), and the external laterocervical approach (Kelly, 1941; Woodmann, 1946; King, 1949). This retrospective report describes and evaluates the results of arytenoidopexy by the laterocervical approach in children with life-threatening bilateral vocal fold paralysis.

Patients and methods

Of 34 children presenting evidence of bilateral vocal fold paralysis between October 1988 and January 1995 at La Timone Children's Hospital in Marseille, France, 15 underwent arytenoidopexy (Table I). In all cases direct endoscopic examination of the larynx was performed using a flexible fiberscope (ENFP2 and ENFP3 Olympus) which ensures safe and complete evaluation of the upper airway. Further endoscopic inspection of the larynx

TABLE I
OUTCOME OF BILATERAL VOCAL FOLD PARLYSIS ACCORDING TO AETIOLOGY (N = 34)

Aetiology		Recovery		No recovery		
		Complete	Partial	Tracheotomy	Arytenoidopexy	Lost to follow-up
Idiopathic	(n = 16)	4	1	3	5	3
Neurological	(n = 11)	2	3	—	6	—
Surgery	(n = 6)	—	1	1	4	—
Obstetrical	(n = 1)	1	—	—	—	—
Total	(n = 34)	7	5	4	15	3

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TABLE II
SUMMARY OF SURGICAL CASES ($n = 15$)

Case no.	Sex	Cause of paralysis	Onset	Associated anomaly	Pre-op. treatment	Age at time of arytenoidopexy	Decannulation	Follow-up
1	F	Neurological	Birth	Encephalopathy	T	3 years	No	Arytenoidectomy/Died
2	M	Neurological	1 m	ACM (VPS-)	T	4 months	Yes	6 years
3	F	Idiopathic	Birth	—	T	1 month	Yes	6 years
4	F	Neurological	Birth	Microcephaly	T	7 months	Yes	5 years
5	M	Idiopathic	Birth	—	ETT	2 months*	Yes	2 years
6	F	Thyroid surgery	8 years	—	T	9 years	Yes	3 years
7	F	Neurological	Birth	Muscular hypotonia	ETT	3 months	Yes	4.6 years
8	M	Idiopathic	Birth	—	T	6 months	Yes	5 years
9	M	Oesophageal surgery	12 days	Oesophageal atresia	None	2 months	Yes	3 years
10	M	Idiopathic (patient 14's sister)	Birth	Microcephaly	ETT	3 months	Yes	4.6 years
11	F	Neurological	Birth	Microcephaly	ETT	1 month*	Yes	4 years
12	M	Neurological	Birth	Hirschprung Oesophageal atresia Pierre Robin	T	3 years	Yes	2 years
13	F	Oesophageal and cardiac surgery	5 years	—	T	6 years	Yes	2 years
14	F	Idiopathic	Birth	—	None	1 month*	Yes	2 years
15	M	Oesophageal surgery	2 years	—	None	2.6 years*	Yes	1 year

Abbrevations: F: female; M: male; ACM: Arnold-Chiari malformation; VPS-: no resolution after ventroperitoneal shunt; T: tracheotomy; ETT: endotracheal tube; *surgery with endotracheal tube.

and tracheobronchial tree was performed under general anaesthesia to rule out compression or underlying obstruction. To avoid false positive diagnosis, the vocal folds were observed to detect movement while the patient was awakening from anaesthesia and breathing spontaneously. During observation, care was taken not to distort the larynx with the laryngoscope and the arytenoid cartilages were palpated to rule out vocal fold fixation. In all cases both vocal folds were paralysed in the midline position with no abduction movement. In a few cases there was intermittent abduction movement. The files of the 15 surgical cases were retrospectively analysed for aetiological factors, associated lesions, symptoms, age at the time of the surgery, details of each therapeutic intervention, outcome, and follow-up (Table II).

Surgical technique

Arytenoidopexy was performed under general anaesthesia. Patients were ventilated via either a tracheotomy (eight cases) or Portex® endotracheal tube (seven cases). The procedure was right-sided in 12 cases and left-sided in three. After a lateral horizontal skin incision at the level of the cricoid cartilage and elevation of the platysmal flaps, the sternocleidomastoid muscle was retracted posteriorly to discover the lateral border of the thyroid cartilage. The inferior constrictor muscle was identified, coagulated, and divided vertically. Next the thyroid and cricoid cartilages were gently rotated away from the surgeon using a hook, and the pharyngeal mucosa was exposed. The piriform sinus located at the internal side of the thyroid cartilage was elevated superiorly out of the surgical field. Care was taken to avoid perforation of airway mucosa. It was not necessary to cut the inferior cornu of the thyroid cartilage since identification of the cricoarytenoid joint and arytenoid cartilage is generally easy and, if not, the surgeon can follow the superior edge of the cricoid cartilage posteriorly. After division of the ipsilateral posterior cricoarytenoid muscle and interarytenoid muscle, the arytenoid cartilage was quite mobile and easily retracted laterally. Gentle anterior dissection permitted location of the insertion of the vocal fold. Two lateralisation sutures, usually a 2–0 or 3–0 prolene, are introduced. The first suture is passed around the vocal fold at the level of the vocal process. The second suture is placed around the body of the arytenoid cartilage. The two sutures are then passed through the thyroid cartilage near its posterior border and tied, thus fixing the arytenoid in outward rotation. The inferior constrictor muscle is repaired, and the wound is closed without suction drain. Typically procedure time was less than 45 minutes. All patients were maintained on broad spectrum antibiotics for six days and corticosteroids for two days.

Results

The mean age of the 15 children in this study (eight boys and seven girls) was 20 months at the time of the procedure (range: one month to nine years). Seven patients were younger than three months, three between three and 12 months, and five older than 12 months. The underlying cause of bilateral vocal fold paralysis was considered as surgical in four cases, neurological in six cases, and idiopathic in five cases. All patients presented life-threatening airway obstruction. In eight patients endotracheal intubation and tracheotomy had been unsuccessful prior to arytenoidopexy with a mean delay of 13 months (range: one to 36 months). In four patients endotracheal intubation was repeatedly attempted prior to arytenoidopexy with a mean delay of 39 days (range: 20 to 60 days). In the last three patients, neither endotracheal intubation nor

tracheotomy had been attempted prior to arytenoidopexy.

Fourteen of 15 patients were successfully decannulated following arytenoidopexy. In the eight patients with pre-operative tracheotomies, the average time from the procedure to decannulation was 38 days (range: 10 to 42 days). In the four patients with pre-operative endotracheal tubes, the average time from the procedure to decannulation was six days (range: two to 19 days). The last case remained tracheotomy-dependent and arytenoidectomy was performed via laryngofissure 10 months later. This patient tolerated plugging of her tracheotomy during the day only, but died because of encephalopathy.

At the end of follow-up, all fourteen patients who were decannulated were in good health. Mean follow-up was 3.5 years (range: one to six years). Five patients were followed for less than two years, three for two to four years, and six for more than four years. Parents were generally satisfied with the quality of breathing, feeding, and voice. Breathiness was noted in three patients, but no child required special care for dyspnoea. Repeat flexible endoscopy examinations have not demonstrated spontaneous recovery of the contralateral vocal.

Comment

Several procedures have been proposed for the treatment of bilateral vocal fold paralysis: King (1939) described the first arytenoidopexy involving fixation of the arytenoid cartilage in outward rotation and transposition of the omohyoid muscle. Subsequent review of results showed that it was fixation of the arytenoid cartilage and not the transposed omohyoid muscle that achieved airway enlargement (Holinger *et al.*, 1976). Clerf (1950) modified the technique by separating the arytenoid cartilage from the cricoid at the joint space and fixing the former in a lateral position along the posterior margin of the thyroid cartilage.

In this series, the technique proposed for adult patients was modified for the paediatric population (Garcin *et al.*, 1970). The inferior cornu of the thyroid cartilage was not cut or dislocated at the level of the thyrocricoid joint which serves as the only lateral point of stabilisation of the thyroid ala after knotting the arytenoid cartilage around the lateral border of the thyroid cartilage. The cricoarytenoid joint must be left intact and dissection along the medial surface of the arytenoid cartilage must be avoided. Sharp division of the posterior cricoarytenoid and interarytenoid muscles was always sufficient to mobilize the arytenoid cartilage. Physiologically, it is the outward rotation of the arytenoid cartilage, rather than the outward displacement, which produces an adequate airway (King, 1949). By allowing external lateralisation of the arytenoid cartilage, intubation of the larynx during the operation facilitates identification of the arytenoid cartilage without risk of perforating airway mucosa. Post-operative intubation for a few days (mean duration: six days in this series) reduces suture stretching and minimises postsurgical oedema.

Arytenoidopexy is considered as successful if an adequate airway and voice are achieved, and long-term tracheotomy is avoided. Few paediatric series have been reported in the literature. Narcy *et al.* (1990) advocated use of arytenoidopexy based on a series of 22 paediatric cases in which all patients were decannulated without a second procedure on the vocal folds. In our series, 93 per cent of children had improvement in breathing, feeding, and speech performance.

Management of bilateral vocal fold paralysis is controversial. Indications for surgical management must be selected according to aetiology, type and severity of symptoms, and chance of recovery. Surveillance without tracheotomy is possible in eight to 35 per cent of paediatric cases (Cohen *et al.*, 1982; Gentille *et al.*, 1986; Rosin *et al.*, 1990). The incidence of spontaneous recovery ranges from 16 to 66 per cent (Gentille *et al.*, 1986; Swift and Rogers, 1987; Rosin *et al.*, 1990; Bower *et al.*, 1994) with variable delays up to several years. According to De Gaudemar *et al.* (1996) patients with idiopathic and neurological paralysis recover spontaneously in 52 per cent within an average of five months. Because recovery is possible, authors have empirically advocated different waiting periods: six to nine months for Narcy *et al.* (1990), one year for Bower *et al.* (1994), and two to three years for Cohen (1973). However, it should be emphasised that the longer vocal fold paralysis lasts, the greater is the extent of cricoarytenoid joint fixation and laryngeal muscle atrophy (Tucker, 1983). Woodson and Miller (1991) have postulated that return of movement may be seen without functional improvement.

Although arytenoidopexy is not reversible in case of spontaneous recovery of the vocal fold paralysis, it may be a safer and more functional approach to laterofixation in bilateral vocal fold paralysis than endotracheal intubation or tracheotomy. By allowing rapid decannulation, arytenoidopexy avoids multiple intubation and long-term tracheotomy which is associated with well-known potentials for morbidity and mortality in young children under one year of age. With regard to tracheotomy, Line *et al.* (1986) and Wetmore *et al.* (1982) reported complications in 12 and 62 per cent respectively and deaths in two to 20 per cent respectively. Thus when the chance of recovery is low as in patients with idiopathic or neurological bilateral vocal fold paralysis, a rapid and resolute decision to perform arytenoidopexy may be better than tracheotomy with little chance of recovery. In case of failure, arytenoidopexy does not rule out a more complicated procedure. This is illustrated by the one case of our series in which adequate laterofixation of the arytenoid cartilage was not achieved and arytenoidectomy was subsequently required. Arytenoidectomy has been frequently advocated in children (Cohen *et al.*, 1982; Bower *et al.*, 1994).

In our experience with paediatric bilateral vocal fold paralysis, the decision to perform arytenoidopexy was taken in 15 of 34 patients in whom careful pre-operative examination demonstrated bilateral abductor paralysis. Since post-operative follow-up in these patients has not demonstrated abduction movement of the controlateral vocal fold and since Swift and Rogers (1987) postulated that in cases of bilateral paralysis recovery occurs in both folds, we feel reasonably certain that without arytenoidopexy all patients in this series would still be tracheotomized at this time.

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