Outcomes of Endoscopic Balloon Dilatation for acquired laryngotracheal stenosis in Pediatric Patients: UKMMC Early Experience.

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ABSTRACT

Laryngotracheal stenosis is abnormal narrowing of airway which may be congenital or acquire. Laryngotracheal stenosis in children mostly comprised of the acquired form whereby endotracheal intubation is the commonest etiology. The mainstay of treatment remains a challenge to many otorhinolaryngologists. Four pediatric patients aged less than 13 years underwent balloon dilatation for acquired laryngotracheal stenosis in Universiti Kebangsaan Malaysia Medical Centre from 2000 to 2016. Mean follow up duration was 18 months. All patients showed positive early outcomes whereby tracheostomy was successfully decannulated and open surgery was avoided. We conclude that endoscopic balloon dilatation is useful in acquired pediatric laryngotracheal stenosis.

Keywords: Subglottic stenosis, tracheal stenosis, balloon dilatation

INTRODUCTION

Most pediatric laryngotracheal stenosis are acquired comprising 95% of all cases with only 5% are of congenital origin[1]. Intubation is the commonest etiology for acquired pediatric laryngotracheal stenosis (APLTS).[2] The incidence of subglottic stenosis (SGS) in intubated neonates and children of 5 years and below is estimated at 1% to 2% and 11% respectively.[3] The risk of developing SGS increases by 50% for every five days of intubation.[3] Cotton-Myer grading describing the severity of stenosis was proposed by Myer et al in 1994.[4]

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In 1991, balloon dilatation in children with laryngeal stenosis was reported by Hebra *et al* to be less traumatic as compared to bougienage dilation. [5] Since then it has progressively gain its popularity among the surgeons. We report our early experience with four patients who showed promising outcomes after undergoing balloon dilatation.

Case Series

Patient 1

This was a five year girl who was intubated for status epilepticus. Immediately following extubation, patient developed stridor with respiratory distress and was re-intubated twice in two w eeks duration. Tracheostomy was performed and the patient was referred to our centre. Direct laryngotracheoscopy was performed which showed SGS Cotton-Myer

grade 3 with thin, matured and circumferential scar. Vocal cords were mobile and there were no features of laryngotracheomalacia or bronchomalacia. The stenotic segment was incised with CO2 laser and endoscopic balloon dilatation was performed with balloon size 7 (Inspira Air, USA) with the pressure of 12ATM. Intralesional Triamcinolone acetate (10%) was injected at the stenotic segments. Patient was discharged the following day and no postoperative systemic steroids were given.

Second balloon dilatation was performed five weeks later and achieving an improved Cotton-Myer grading of grade 2. The 3rd balloon dilatation was carried out at 30 weeks following the second dilatation and again with a good outcome. Patient's tracheostomy was successfully decannulated five weeks after.

Patient 2

This is a five year girl who was intubated for respiratory distress secondary to bibasal lung abscess. Multiple attempts of extubation failed and a tracheostomy was performed after 23 days. The patient was referred to our centre and she underwent direct laryngotracheoscopy and bougie dilation at two settings. Findings at that time were SGS Cotton-Myer grade 4, with a thick and matured scar.

Four months later, she underwent a third procedure whereby the findings were of SGS Cotton-Myer grade 3, again with a thick and matured scar. This time, balloon dilatation was performed using balloon size 7 (Inspira Air, USA) with pressure of 14 ATM over 1 minute. Mitomycin C 2mg was applied at the raw area. Patient then defaulted follow up.

After a year and half, patient represented and reassessment of airway under general anaesthesia revealed tremendously improved airway, a repeat procedure was unnecessary and patient was successfully decannulated of her tracheostomy.

Patient 3

This was a 23 months old male infant who was admitted with hemolytic uremic syndrome secondary to right lung empyema. Patient was intubated for 22 days and developed respiratory distress following extubation. Direct laryngotracheoscopy was performed and revealed a thin segment tracheal stenosis Cotton-Myer 3. Balloon dilatation was performed using balloon size 7mm (Inspira Air, USA), at 14 ATM pressure for a total of 2 minutes. Intralesional Triamcinolone acetate (10%) was injected at the stenotic segments. Patient was extubated the next day and remained asymptomatic. Repeat laryngotracheoscopy six weeks later revealed no residual stenosis and a repeat procedure was deemed unnecessary.

He was regularly reviewed in the outpatient clinic and at one year post procedure , he was found to be well and free of symptoms.

Patient 4

This was a ten months old premature infant who was intubated for six days for respiratory distress syndrome and was nursed in NICU for two months. One month later, child developed stridor, with breathing difficulty and poor oral intake. Child was intubated and direct laryngotracheoscopy was performed. Subglottic cyst seen on the left posterolateral wall and marupilization was done. Subsequently, patient had multiple admissions with similar presentations requiring intubation. Direct laryngotracheoscopy showed SGS cotton-Myer 3 and patient underwent balloon dilatation using balloon size 5 (Inspira Air, USA), maximum pressure at 18mmH2O for 90 seconds. Intralesional Triamcinolone acetate (10%) was injected at the stenotic segments.

Second balloon dilatation was performed five weeks apart using balloon size 7 (Inspira Air, USA) with pressure at 16mmH2O for 90 seconds. Intralesional Triamcinolone acetate (10%) was injected at the stenotic segments. Findings at that time were SGS Cotton-Myer 2. Patient was nursed postoperatively without the need of intubation.

During clinic follow ups, flexible nasopharyngolaryngoscopy showed no residual SGS at one, two, six and twelve months post procedure.Currently, she has stable airway for 14 months since the last balloon dilatation.

A total of four children ranging from ten months old to five years old had undergone balloon dilatation for laryngotracheal stenosis. Three patients had SGS and one had tracheal stenosis. Intubation being the commonest etiology while one preterm patient had concomitant subglottic cyst. Using Cotton -Myer grading, one patient Cotton-Myer grade 2 and 3 patients with grade 3. Two patients underwent balloon dilatation once, one patient underwent twice, and one patient underwent thrice. Two children had tracheostomy prior to balloon dilatation.

All patients who underwent balloon dilatation in our centre have positive outcomes. There were significant improvements of Cotton-Myer grading in between endoscopic dilations as compared to bouginage dilatation methods. Patients who underwent endoscopic balloon dilatation had shorter stay in the intensive care unit and required lesser duration of post operative endotracheal intubation.

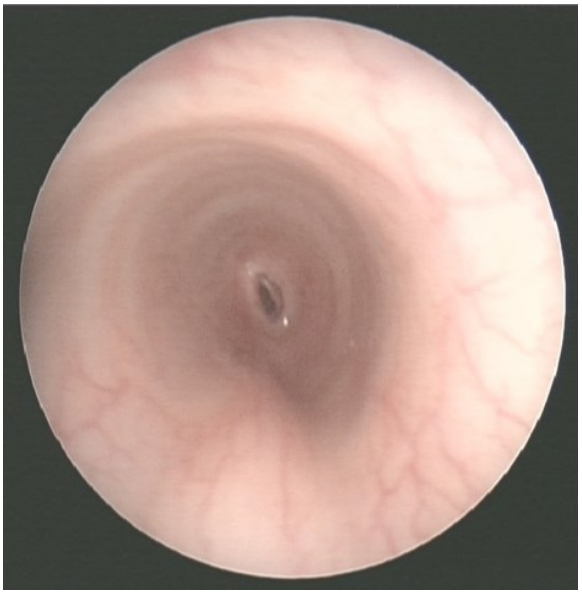

Figure 1: Tracheal stenosis Cotton-Myer Grade 3 before endoscopic balloon laryngotracheoplasty

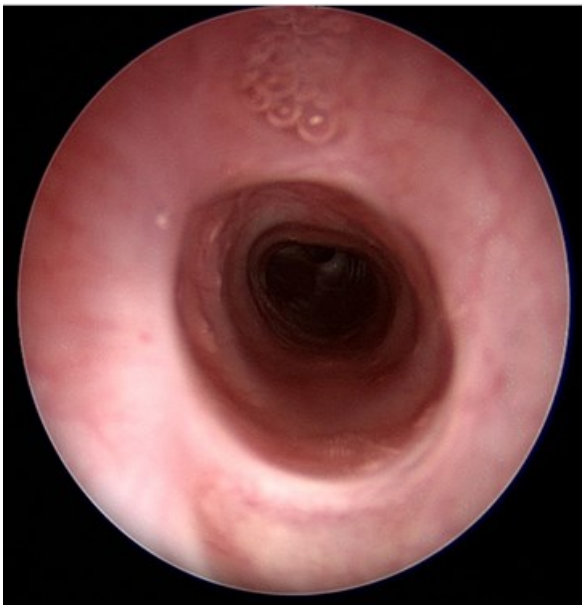

Figure 2: Tracheal stenosis Cotton-Myer Grade 1 post endoscopic balloon laryngotracheoplasty.

Discussion

The management of laryngotracheal stenosis in children remains as a challenge for otorhinolaryngologist. Various management options were popularized, vary from adjuvant therapy with Mitomycin C and intralesional steroids injection, endoscopic cold instrument and laser excision, and also open reconstructive surgery. Currently, with the advantages of balloon dilatation, it has gained popularity among surgeons in managing SGS in the pediatric population.

Table 1: Demographic characteristics and outcome of endoscopic balloon dilation laryngotracheoplasty in pediatric patients.

	Patient 1	Patient 2	Patient 3	Patient 4
Age	5 years 2 months	5 years	1 year 11 months	10 months
Gender	Female	Female	Male	Female
Etiology	Intubation x 3, 7 days (in total)	Intubation x 1, 22 days	Intubation x 1, 22 days	Intubation x 2, 6 days (Subglottic cyst)
Location of Stenotic segment	Subglottis	Subglottis	Trachea	Subglottis
Previous tracheostomy	Yes	Yes	No	No
Type of stenosis and Cotton Myer grading	Grade 3 Mature Thin circumferencial	Grade 3 Mature Thin Anterior part	Grade 3 Inmature Thin circumferencial	Grade 2 Inmature Thin circumferencial
Number of dilation	3	1	1	2
Balloon size (mm)	7	7	7	1st-5/2nd-7
Clinical improvement in 24 hrs	Yes	Yes	Yes	Yes
Success: Avoidance of open surgery/ decannulation	Yes	Yes	Yes	Yes
Follow up duration (months)	17	34	4	19

Endotracheal intubation remains as the major cause of laryngotracheal stenosis as it imposed an insult from the tube cuff leading to fibrosis.[2,6] Balloon dilatation exerts only the radial directed forces on the mucosa as compared to the traumatic shearing forces seen in bougienage dilation which can cause further scarring.[5] The balloon exerts maximal radial pressure to enable a controlled dilation over a small surface area. The bougienage dilation requires multiple insertions of bougie dilators gradually from smaller to larger sizes.[7] Hence balloon dilatation has the advantage of reducing significant mucosal trauma.

Balloon is inserted under direct vision using a telescope whereas bougie dilators are inserted as a blind procedure with a higher risk of trauma to surrounding structures.[8] Moreover, the nature of the balloon being inserted in a risk of trauma to surrounding structures.[8] Moreover, the nature of the balloon being inserted in a deflated manner has the advantage over bougie dilators to be able to pass through the narrow glottis and subglottis in pediatric population with a lesser risk of cricoarytenoid joint dislocation. With these advantages, balloon dilatation is thought to be superior to bougienage dilation.

In the review of Jiovani et al, the recommended balloon size used in treating pediatric acquired airway stenosis should not exceed age-appropriate diameter by 1mm.[9] However, only balloon size 5 and 7 were available at our centre. Successful dilations were achieved without complications despite using balloon out of recommended sizes. Endoscopic balloon dilation is less invasive. Hence, it is better tolerated especially among preterms and critically ill infants as they would not survive a major operation.[7]

In our review, all patients who had undergone balloon dilatation for acquired airway stenosis had good early outcomes. All patients showed significant clinical improvement and better Cotton-Myer gradings. There was no complication following balloon dilation

in all patients.

Conclusion

Endoscopic balloon dilation is an effective and safe treatment modality in relieving airway obstruction from acquired pediatric laryngotracheal stenosis but may require repeat dilatation. It is a less invasive form of surgery and can also help in avoiding potential morbidities of open surgery.

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