# The use of Balloon dilation in Pediatric Subglottic Stenosis, Experience at Queen Rania Al-Abdullah hospital for children

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## ABSTRACT

**Objective:** To evaluate the outcomes of balloon dilation and Mitomycein-C application in the endoscopic management of pediatric patients with subglottic stenosis (SGS).

**Methods:** A total number of 32 children 18 boys, 14 girls, age 1-7 years. 20 children (12 boys, 8 girls) had primary acute subglottic stenosis after intubation for 1-6 days (group (1). 12children (6 boys, 6 girls) had recurrent subglottic stenosis post intubation group (2). All children in this group had been treated multiple times previously with bronchoscopic dilation without response. 22 children (13 boys, 9 girls) had moderate to severe SGS.10 children (5 girls, 5 boys) had mild to moderate SGS. All children (groups (1) + (2) were treated with appropriate width cardiac vessel Balloon dilators endoscopically using apnoic technique without intubation. Mitomycin-C was applied in all patients post dilation.

**Results:** Group (1) who had primary balloon dilation with Mitomycin-C application, 14 children (70%) had successful balloon dilation and they did not necessitate further sessions of dilation and their SGS was cured, 4 children (20%) necessitate two sessions of dilation with 3&5 weeks interval. Two children (10%) necessitates 3 sessions of dilation, 2 weeks and 8 weeks after the first dilation to get their SGS nearly cured. In all sessions we used Mitomycin-C application after dilation. Group (2) who had been treated previously with bronchoscopic dilation. 12 of 12(100%) had at least 4 sessions of balloon dilations and Mitomycin-C application, with 3-4 weeks intervals and all of them after 2 years of follow up still have a some degree of SGS that is not severely symptomatic.

**Conclusion**: Balloon dilation and Mitomycin-C application is safe and effective in the primary management of pediatric SGS. This technique reduces the degree and severity of SGS which was previously treated with bronchoscopic dilation.

**Key words:** Balloon dilation, SGS, Mitomycin-C.

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## Introduction:

The Subglottis is defined as the airway directly below the level of the vocal folds and encased in the cricoid cartilage. Subglottic stenosis(SGS) are chronic inflammatory processes that may lead to narrowing of the subglottic airway. In children subglottic stenosis is considered a rare congenital disorder if there is no acquired reason for it is formation. In the late 1960s through the 1970s, prolonged endotracheal intubation started to be an important role in the treatment of premature infants, with the result of being a major risk factor for developing acquired SGS in children. [(1)] Myer Cotton grading system [(2)] describe the

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degree of subglottic stenosis bases on endoscopic findings. This classifies subglottic stenosis into 4 grades.: grade 1 included all the lesions with less than 50%obstruction,grade 2 obstruction vary from51% to 70%stenosis,grade 3 from 71%to 99%,and finally grade 4 describe lesions with almost complete obstruction. The incidence of SGS is accounting for approximately 1% to 2% of intubated neonates [3] .For every 5 days intubation the risk of developing SGS increases to almost 50%. [4] The risk of developing stenosis due to intubation increase with the relatively large size tube, duration of endotracheal intubation and recurrent intubation. Other factors include anemia, systemic disease and hypoxia. [5] Management of subglottic stenosis in children is considered to be a major challenge for otorhinolaryngologists. However the endoscopic techniques have the advantage of being a none invasive procedure with no external scars. Balloon laryngoplasty (BLP) is the endoscopic techniques which were described in the literature for the first time in 1984[6] for the treatment of upper airways stenosis. Balloon laryngoplasty was used, since that time for the management of stenosis secondary to prolonged intubation and re-stenosis after laryngotracheal reconstructions with favorable results. [7-8] Dilatation can be done with laryngoscopy under direct visualization or by fluoroscopic control or bronchoscopy [9]. Endoscopic management of subglottic stenosis usually includes radial incisions of the stenotic airway segment, dilation, and finally treatment with Mitomycin C or steroids [10-12]. Mitomycin-C (MMC), derived from the streptomyces caespitosus bacteria, can modify wound healing at the molecular level. Mitomycin-C first applied topically for the treatment of superficial bladder tumors. Later, ophthalmologists pioneered its use in preventing scar tissue after surgery. It was first reported in the ENT literature for the treatment of tracheal scarring after tracheal reconstruction in a small case series [13] .Application of Mitomycin C into the mucosa immediately following dilatation will reduce re-stenosis by decreasing the production of fibroblasts and scar tissue [14]. For mild SGS, studies have reported success with serial endoscopic dilation, with or without steroid injections [15], whereas endoscopic balloon dilation has been reserved, only for severe SGS [16]. Open procedures such as tracheotomy, tracheal resection, or laryngotracheoplasty have been traditionally offered. Endoscopic treatment with the introduction of the carbon dioxide laser was used in the 1970s [17-18]. Although controversial (no good placebo-controlled studies have been performed to back up results). Mitomycin-C has been reportedly used after carbon dioxide lasering of a mature SGS with presumed improved results over lasering alone, with or without the use of oral steroids. In this paper, we discuss our experience in the management of patients with SGS at Queen Rania Pediatric Hospital with balloon dilatation and Mitomycin-C application.

## Methods

A retrospective analysis was done for all children who had balloon dilation for subglottic stenosis in Queen Rania Pediatric Hospital in Amman-Jordan from the period April 2011 to October 2016.The medical charts of all children were reviewed. Demographic and clinical data, including age, sex, history and physical examination were recorded .The aetiology of subglottic stenosis, grade of stenosis, number of dilations, and complications were all reviewed. Average follow up time was 18 months. The total number of patients on whom balloon dilation was performed was 45 patients and the number of patients whom included in the study was 32. We choose all the symptomatic patients and the only exclusion criteria was patients with follow up less than 6 months and patients with associated congenital abnormalities. Informed consent was obtained from the parent of each child before each procedure. The same surgeon performed all operations. Subglottic stenosis was evaluated primarily with dynamic Fibrooptic Nasolaryngoscope. Patients were sedated and remained in spontaneous ventilation during this procedure .The diagnosis and the severity of stenosis then confirmed by direct laryngoscopy using

the zero degree 4 mm Telescope under general anesthesia using apneic technique with the patient breathing spontaneously and without the insertion of an endotreacheal tube. Severity of subglottic stenosis was classified according to the Myer–Cotton grading system described earlier. Balloon dilation was performed through the laryngoscope, under direct view. We used a cardiac vessels dilation balloon (Low ProfilePTA Balloon Dilation Catheter. MEDICAL COOK .USA).It is used with it is special pump to be inflated and only saline can be used to inflate the balloon by the special pump. Balloon was placed in the subglottic area and inflated with saline solution. The balloon then remained inflated for 60 seconds if the patient oxygen saturation permit and afterwards it was emptied and removed from the airway. The dilation was repeated according to the result at the same session. Topical Mitomycin- C (Kyowa Hakko UK Ltd, Slough, UK; 1mg/ml ) was put in a neurupatty and the Patty was put in the stenosic part 3-4 minutes after being dilated. Then the subglottic area was re-assessed in order to see the immediate result .In most cases, patients were not intubated after dilation and were observed in the pediatric intensive care unit for about 24 to 48 hours. Patient were given intravenous Dexamethasone (0.5-1 mg/kg/d) during hospitalization as well as proton pump inhibitors for a period of 1-3 months, until complete disease resolution. Follow-up Fibroptic Nasolaryngoscopy was carried out 7 days after the dilatation procedure, and again whenever the patient presented with symptoms. The average follow up time was 18months.

## Results

A total number of 32 children were included in this study. 18boys, 14 girls, with a mean age of 18 months (range 3-7 years) and a mean weight of 17 kg (range 9 -28 kg) see Table I .20 children (12 boys, 8 girls) had primary acute subglottic stenosis after intubation for 1-6 days (group (1) , Figure1, 12 children (6 boys, 6 girls) had recurrent subglottic stenosis post intubation (group (2). Figure 2 all children in group (2) had been treated multiple times previously with bronchoscopic rigid dilation with quick restenosis. 22 children (13 boys, 9girls) had moderate to severe SGS from both groups. 10 children (5 girls, 5 boys) had mild to moderate SGS. All children were treated with appropriate width cardiac vessel balloon dilators endoscopically using apnoic technique without intubation. A total number of 94 balloon dilation procedures with Mitomycin-C application were performed. In group 1.14 children (70%) had successful balloon dilation done once and they did not necessitate further sessions of dilation and their SGS was cured.4 children (20%) necessitate two sessions of dilation with 3&5 weeks interval. Two children (10%) necessitates 3 sessions of dilation, 2 weeks and 8 weeks after the first dilation to get their SGS cured completely. In all sessions Mitomycin-C was applied topically after dilation. In group 2, 12 out of 12 (100%) had at least 4 sessions of balloon dilations and Mitomycin-C application, with 3-4 weeks intervals and almost all of them after 2 years of follow up still have a some degree of SGS that is not severely symptomatic except in three patients.

**Table I**: Demographic Data .

| **Age Range** | N | mean weight | Age Range | % |
|---|---|---|---|---|
| **<24 months** | 9 | 14kg | <24 months | 28.1 |
| **24-72 months** | 13 | 18kg | 24-72 months | 40.6 |
| **>72 months** | 10 | 24kg | >72 months | 31.25 |

**Fig 1**:Percentage of patients with primary acute subglottic stenosis according to the number of balloon dilation sessions

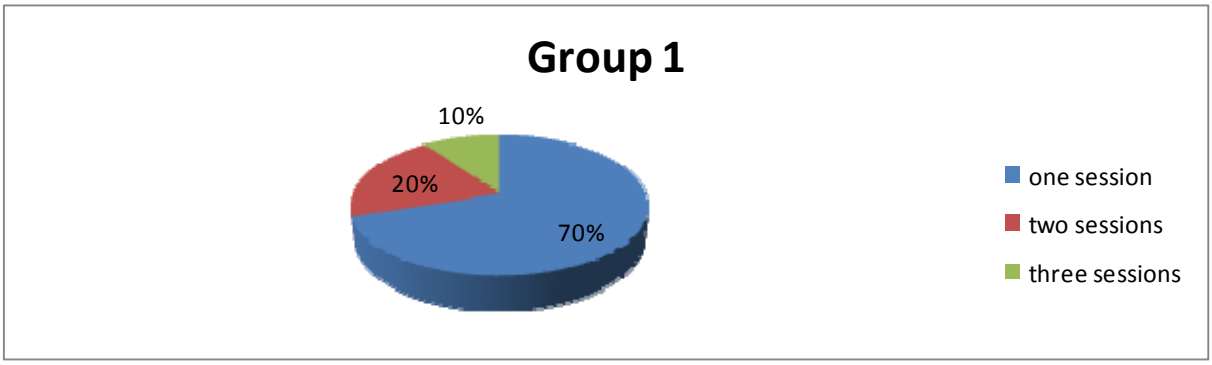
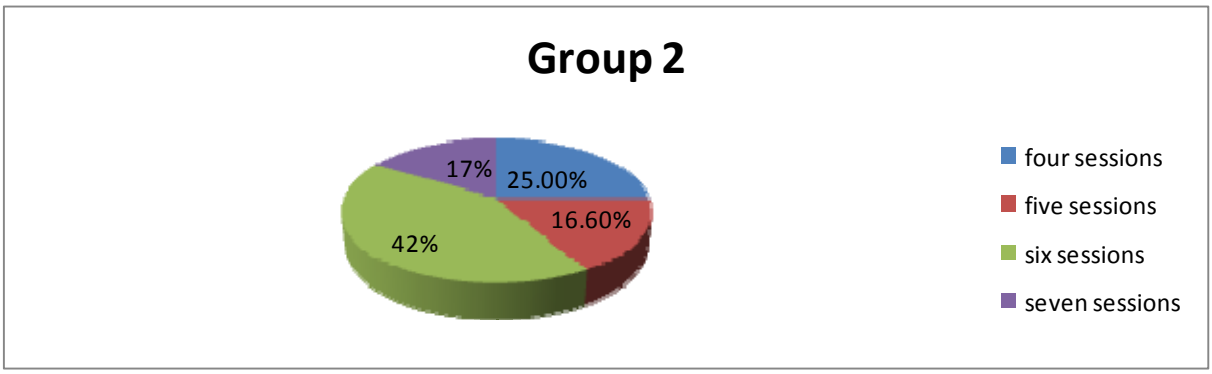



**Fig 2:** Percentage of patients with recurrent subglottic stenosis according to the number of balloon dilation sessions.




## Discussion

Management of SGS in pediatric patients still continues to be a challenge for the otolaryngologist. Variable surgical procedures have been proposed for the management of subglottic stenosis in children. . Since 1980s, open surgery with laryngeal expansion has been the standard option for SSG management [(20-21)]. In 1985 Axon et al [(22)] reported the first case in the literature for a 4 years old child with grade 2 subglottic stenosis managed with balloon dilation technique. Balloon tracheoplasty, as a non invasive technique became a management option in 1991 by Hebra et al [(23)] with variable success rates. Balloon laryngoplasty was found to be more effective than the other methods of dilatation. Balloon dilatation may need to be repeated several times to reach the optimal outcome [(24-25)]. Durden & Sobol in 2007 described 10 children with SGS, all patients treated with Balloon dilatation [(26)] the authors came to the conclusion that balloon dilatation is an effective method of management for patients with severe SGS without complications, with successful rate of 70% which is comparable to those of laryngeal reconstruction. They also showed that BLP is not effective in children with congenital SGS. According to our study, regardless the frequency of balloon dilation, successful rate was 90.6 %, and we believe that the higher rate of success may be explained by the use of Mitomycin-C application in all of our patients. None of our congenital subglotic stenosis, but only one glottic congenital stenosis (Laryngeal Web) which responded well to recurrent balloon dilations when accompanied with Mitomycin-C application. Mirabile et al [(27)] reported a success rate of 75% in 8 pediatric patients with congenital stenosis who underwent balloon dilations combined with endoscopic cricoids splits. Despite the well proved fact of the efficacy of using the balloon dilations in the vascular stenosis with several advantages and less complications, still some otolaryngologists are resistant to use these techniques in the management of SGS [(28)]. Some relatively new studies [(29)]

showed no general agreement regarding the specific indications for laryngeal balloon dilations versus open surgery for SGS in pediatric patients. Our experience in the use of balloon dilation with Mitomycin-C application in pediatric SGS, has led to use this method as the standard method of treatment in acquired SGS. Previously in our institution, patients with SGS were treated with direct laryngoscopy and/or tracheostomy and end up later with laryngotracheal reconstructive surgery in severe cases. Fortunately now we avoid almost all these invasive techniques and their related complications by using balloon dilation management as first choice therapy for pediatric patients with subglottic stenosis. Due to the relatively small sample and limited number of patients included in our study, future prospective studies are needed to support our conclusions.

## Conclusion

Balloon dilation and Mitomycin-C application has a higher success rate in the treatment of primary pediatric SGS when compared to bronchoscopic dilation that was previously used in our institution.

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