Rigid bronchoscopic dilatation of postintubation tracheal stenosis

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Summary

Background: **Postintubation tracheal stenosis (PITS) occurs due to excessive pressure on the trachea by the cuff of the endotracheal tube which leads to local ischaemic necrosis of the tracheal cartilage and excessive growth of granulation tissue. The recognition of its aetiology and modifications in the design and management of endotracheal tubes have led to a diminished incidence of PITS. The management modalities that have been employed for the management of PITS include stenting, surgical resection and reconstruction, percutaneous dilatation, rigid bronchoscopic dilatation, fibreoptic assisted balloon dilatation and Nd:YAG (neodymium: yttritium-aluminum garnet) laser therapy with or without stenting.**

Methods: **Three female patients with a history of varying periods of endotracheal intubation after a period of acute respiratory failure who developed symptoms of tracheal stenosis 1-2 weeks post-extubation are presented. The mean age was 24 ± 12.49 years (range = 14 -38 years).**

Results: **All the three patients were successfully managed by frequent, rigid bronchoscopy and gradual dilatation until the resolution of the tracheal stenosis and the return of pulmonary function tests (PFT) to normal.**

Conclusions: **Rigid bronchoscopic dilation in patients with PITS provides safe, effective tracheal dilatation and improved pulmonary function in the medium term.**

Key -words: ***Tracheal intubation, Postintubation tracheal stenosis, tracheal dilatation, rigid bronchoscopy.***

Résumé

Introduction: **Sténose de la trachée postinutubation (PITS) arrive à cause de la pression excessive sue la trachée par le revers de la paroi endotrachée aboutissant à la nécrose ishémique du cartilage de la trachée ut une croissance excessive du tissu de la granulation. L'identification de son étiologie et de modifications apportées au dessin et à la prise en charge des parois endotrachées à abouti a l'incidence diminuée de PITS. Les modalités de la prise en charge qu'on avait utilisé pour la prise en charge de PITS sont les suivantes; stenting, résection chirurgicale et la chirurgie réparatrice, dilatation percutanée, dilatation bronchospique rigide, dilatation de la technologie des fibres optiques de la bulle et Nd;YAG (neodymium yttritium - aluminium garnet) la thérapie laser avec ou sans le stenting.**

Méthodes: **Trois malade du sexe féminins avec une histoire des périodes diverses d'intubation endotrachée apres une durée d'insuffisance respiratoire aigue qui avaient manifesté des symptôms de sténose de la trachée de 1 - 2 semaines post-extubation se sont presentées. L'age moyen était 24 ± 12,49ans (tranche = 14 - 38ans).**

Résultats: **Toutes les trios malades ont été traitées avec succés à travers la bronchoscopie rigide et dilatation graduelle, fréquente jusqu' à la resolution de la sténose trachée et le retour du pulmonary function test (PFT) jusqu' à la moyenne.**

Conclusion: **La dilatation bronchoscopique rigide chez des malades atteints de PITS est sans danger, et elle donne une dilatation trachée efficace, et une fonction amaliorée pulmonaire à terme moyen.**

Introduction

Postintubation tracheal stenosis (PITS) occurs due to excessive pressure on the trachea by the cuff of the endotracheal tube which leads to local ischaemic necrosis of the tracheal cartilage and excessive growth of granulation tissue[1-4]. The recognition of its aetiology and modifications in the design and management of endotracheal tubes have led to a diminished incidence of PITS[1]. The management modalities that have been employed for the management of PITS include endoluminal stenting[5], surgical resection and reconstruction[1,6,7,9], percutaneous dilatation; rigid bronchoscopic dilatation[3], fibreoptic bronchoscopic balloon dilatation[8], dilatation with an intra-aortic balloon pump[10] and Nd:YAG (neodymium: yttritium-aluminum garnet) laser therapy with or without stenting[3,2].

Materials and methods

Three patients referred to the Cardiothoracic Unit of the King Fahad General Hospital, Jeddah, form the basis of this report (Table 1). All the patients were females. The ages of the patients were 14, 20 and 38 years respectively (mean age =24 ± 12.49 years). Each of the three cases developed tracheal stenosis following varying periods of endotracheal intubations. The mean duration of intubation was 17.33 ±13.43 days (range = 2-27 days).

The indications for endotracheal intubation included respiratory failure due to Guilan-Bare syndrome in case 1, scorpion bite and anaphylactic shock in case #2 and Systemic Lups Erythomatosus (SLE), severe pneumonia and respitratory failure in case #3.

Investigations carried out in each case included base line Chest X-Ray, CT Scan of the neck and chest, pulmonary function tests (PFT) pre- and post-dialtation, which consisted of the measurements of Vital capacity (VC), Forced vital capacity (FVC), Forced expiratory volume in one second (FEV_1) and $FEV_1/VC\%$.

The stenosed trachea was then dilated under general anaesthesia using various sizes of rigid bronchoscopes. Dilatations were carried out monthly until follow-up PFT and tracheal size adjudged from repeat CT Scans of the neck and chest had returned to normal and the patients became asymptomatic. Case no 3 did not give consent for post-dilatation CT scan but was asymptomatic.

Correspondence

Results

The clinical data on the three patients are shown in Table 1. The durations of monthly dilatations were 7, 8 and 12 months in the three patients respectively (mean = 9 ± 2.65 months). The mean percentage changes in VC, FVC, FEV_1 and FEV_1/VC% in the three patients were 59.22± 56.57% (range= -5.65-98.3%), 41.36±34.71 % (range= 8.16-77.42%), 323.50± 191.60 % (range= 147.0-527.27%) and 174.84±53.80% (range= 143.13-236.96%) respectively (Table 2).

Tracheal size as demonstrated by CT scans of the neck and chest (Figs. 1-3) returned to normal in all the patients and all were asymptomatic following the last dilatations at 8, 7, and

Table 1 Clinical data on three patients with post-endotracheal intubation tracheal stenosis

Case Number	Age (Years)	Sex	Clinical diagnosis	Duration of endotracheal intubation	Level of tracheal stenosis	Frequency of tracheal dilatations	Duration of tracheal Dilatations	Outcome
1	38	F	Respiratory failure due to Guillain-Barre syndrome	27	2.5cm above the carina	Monthly	8	Normal tracheal diameter, Normal PFT
2	14	F	Scorpion sting/ Anaphylactic shock	2	2.5cm above the carina	Monthly	7	Normal tracheal diameter, Normal PFT
3	20	F	SLE, Renal failure, severe pneumonia, respiratory failure	23	4.0 cm above the carina	Monthly	12	Normal tracheael diameter; Normal PFT.

PFT: Pulmonary function tests; SLE: Systemic lupus erythomatosus

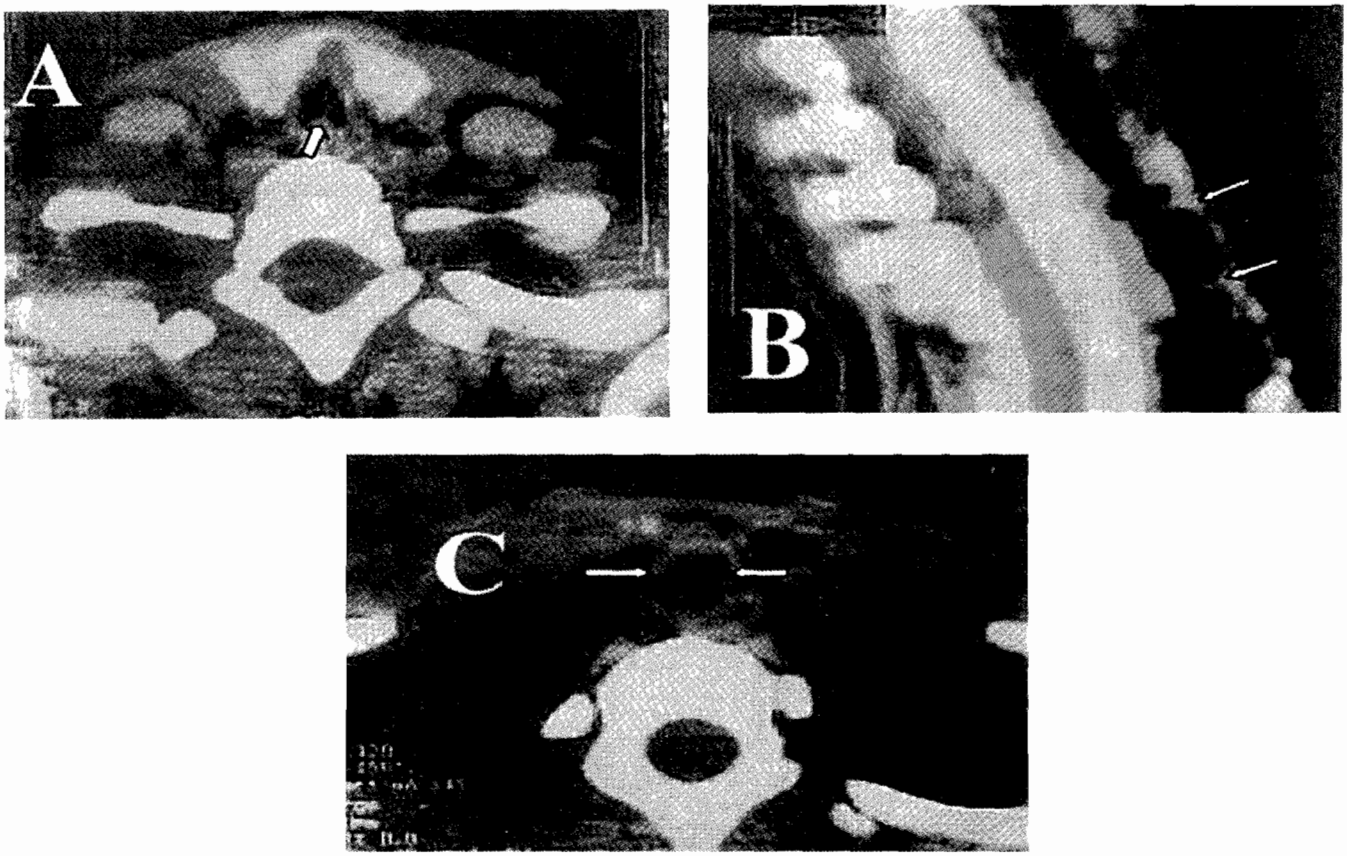

Fig. 1 *A. Plain CT scan of the neck in a 38-year old female with acquired tracheal stenosis (Case # 1) due to the development of granulation tissue (white arrow) in the tracheal. B. Reformatted CT Scan of the neck and upper chest in the same patient showing multiple tracheal stenosis due to granulation tissue (Arrow). C. Plain CT Scan of the neck in the same patient after 8 months of repeated rigid bronchoscopic dilatation of the tracheal. The tracheal size is normal (White arrows).*

Table 2 Pulmonary function test results before and after rigid bronchoscopic dilatations in 3 patients with post-endotracheal intubation tracheal stenosis

Case No	VC (L)			FVC(L)			FEV_1 (L)			FEV_1/VC%		
	Pre dilatation	Post dilatation	% change	Pre dilatation	Post dilatation	% change	Pre dilatation	Post dilatation	% change	Pre dilatation	Post dilatation	% change
1	1.2	2.22	85.0	1.24	2.20	77.42	0.33	2.07	527.27	27.6	93	236.96
2.	1.15	2.28	98.3	1.87	2.59	38.50	0.53	2.10	296.23	32.0	77.8	143.13
3	2.48	2.34	-5.65	2.45	2.7	8.16	0.91	2.38	147.0	36	88.0	144.44

VC: Vital capacity (Litres); FVC: Forced vital capacity (Litres). FEV_1: Forced vital capacity in 1 second.

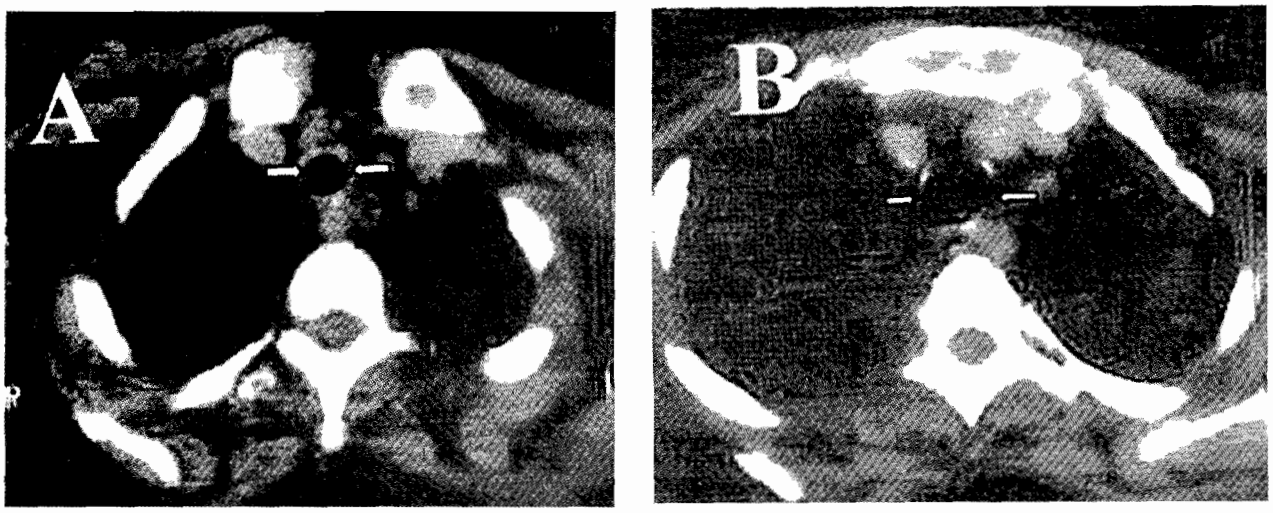

Fig. 2 *A. Plain CT scan of the neck in a 14-year old female with acquired tracheal stenosis (white arrows) (Case # 2). B. Plain CT scan of the same patient after 7 months of repeated rigid bronchoscopic dilatation of the trachea. The tracheal size is normal (White arrows).*

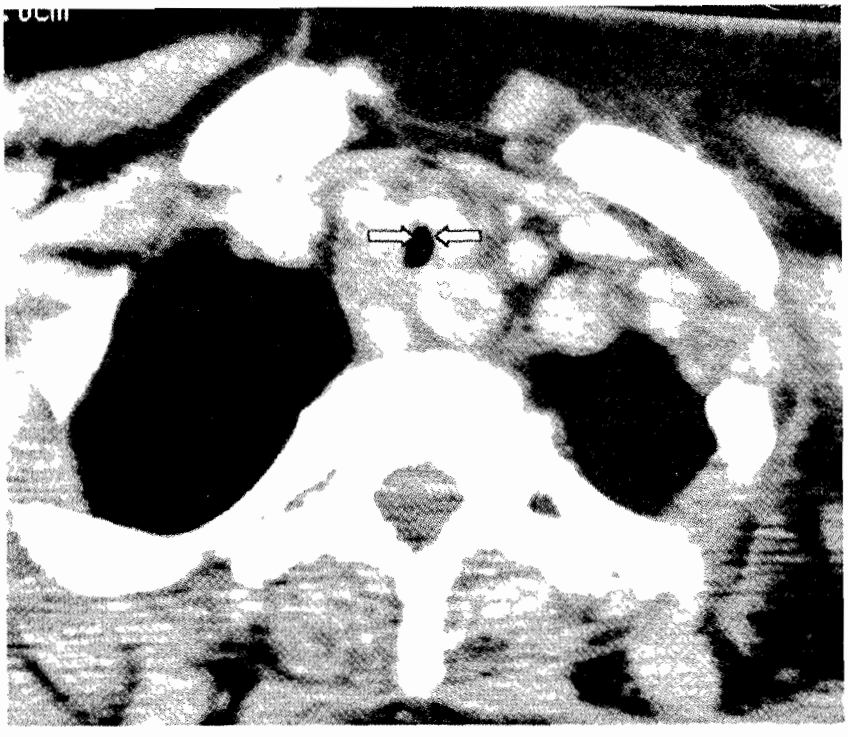

Fig. 3 *Plain CT scan of the neck in a 20-year old female with acquired tracheal stenosis (Case # 3) due to the development of granulation tissue (white arrow) in the trachea.*

12 months respectively in the three cases. The mean follow-up period was 18.5 months.

Discussion

The aetiology of PITS has been identified to be due to excessive pressure on the trachea by the cuff of the endotracheal tube which leads to local ischaemic necrosis of the tracheal cartilage and excessive growth of granulation tissue[1-4]. Granulation tissue was demonstrated radiologically and was seen during bronchoscopy in our patients (Fig. 1). All the three patients that have been presented developed PITS following endotracheal intubation for mechanical ventilation. The duration of endotracheal intubation that predisposes to PITS appear to be very variable. In one of our patients, endotracheal intubation lasted for only two days (Case2). Polderman, et al., [11] reported the development of tracheal haematoma and swelling of the posterior wall of the trachea leading to intermittent tracheal obstruction within 2 to 21 days in patients who had percutaneous dilatational tracheostomy. The periodic obstruction was due to intermittent pressure and chaffing on the posterior tracheal wall. Although the recognition of the aetiology of PITS and modifications in the design and management of endotracheal tubes have led to a diminished incidence of PITS[1] several cases continue to be reported world wide[5, 6, 8, 10-12]. PITS has been reported in both the paediatric and adult age groups[6, 10, 12-14]. The arithmetic mean age in our patients was 24 ± 12.49 years.

The modalities that have been employed for the management of PITS include endoluminal stenting[5], surgical resection and reconstruction[1,6,7,9], percutaneous dilatation, rigid bronchoscopic dilatation[3], fibreoptic bronchoscopic balloon dilatation[8], dilatation with an intra-aortic balloon pump[10] and Nd:YAG (neodymium: yttritium-aluminum garnet) laser therapy with or without stenting[3,2]. With the multiplicity of available methods of management, it is clear that the use of any of the treatment options has to be tailored to the patient's individual needs and the available local resources[5, 6, 8 12, 13, 15]. The desired outcome measure in all cases is the elimination of tracheal stenosis and the satisfactory improvement in the patients' ventilatory parameters[13, 16].

In each of the three patients presented, rigid bronchoscopic dilatation produced statistically significant improvements in their ventilatory parameters. The mean percentage changes (pre-dilatation versus post-dilatation) in VC, FVC, FEV_1 and FEV_1/VC% in the three patients were 59.22± 56.57% (range= -5.65-98.3%), 41.36 ±34.71 % (range= 8.16-77.42%), 323.50± 191.60 % (range= 147.0-527.27%) and 174.84 ± 53.80% (range= 143.13-236.96%) respectively (Table 2). The percentage change between pre- and post-dilatation values of FEV1/VC% was significant (p =0.002, 95% Confidence Interval = -1.9324 to -1.2542). Significant improvements in respiratory function were also reported by Manduor, et al., [15] following endoscopic dilatation of PITS. Management by tracheal resection did not provide a higher improvement in respiratory function[13].

The mean follow-up period reported by Manduor, et al., [15] for their patients with PITS treated by laser endoscopically was 12.58 months while the mean follow-up in our patients was 18.5 months. In the follow-up period, none of our patients developed re-stenosis of the trachea. In 11 patients with PITS who were treated by surgical resection over a 6-year period and reported by Vaamonde, et al., [12] complete cure was seen in 44% while 33% had partial improvement.

Conclusion

Rigid bronchoscopic dilation in patients with PITS provides safe, effective tracheal dilatation and improved pulmonary function in the medium term.

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