Research Article

Is Intensive Care a necessary postoperative destination for all patients following elective balloon dilatation for subglottic stenosis?

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Background: Admission to the Intensive Care Unit (ICU) for airway monitoring after endoscopic balloon dilatation for subglottic stenosis (SGS) is common practice at our institution. This practice appears to occur as a matter of routine and without consideration of individual patient risk profile. Whether ICU admission is necessary, appropriately utilises resources or is in the best interests of these patients remains to be proven.

Methods: This retrospective review examines 20 years (n=38 dilatations) of data from a total of 18 adult patients undergoing elective endoscopic balloon dilatation for SGS to examine the practice of routine postoperative ICU admission and to determine the rate and nature of postoperative complications. Data from admissions for elective balloon dilatation for SGS was collected. Data was collected for admissions between 1998 and 2017 at a tertiary hospital in Perth, Western Australia and analysed for patient demographics, operative details and for evidence of postoperative complications. The study was approved by the Health Service Research Ethics and governance unit in accordance with hospital protocol.

Results: Thirty-one of the 38 cases were admitted to ICU postoperatively. Of the remaining 7 cases 2 were cared for in the high dependency unit (HDU) and 5 went from theatre recovery directly to the ward. No postoperative complications were recorded. No patients required a return to theatre within the perioperative period.

Conclusions: No complications were encountered in our cohort. The practice of routine admission to ICU following elective dilatation for SGS warrants scrutiny as to whether it upholds best practice. There is no national or international consensus for ICU admission criteria for surgical (or medical) patients. There is a lack of studies focusing specifically on immediate postoperative care of SGS dilatation patients. Further research would shed light on best practice and if ICU is not deemed routinely necessary this could reduce resource use and result in better postoperative care.

Keywords: Subglottic stenosis (SGS); Intensive Care Unit (ICU); postoperative care; balloon dilatation

Received: 06 August 2019; Accepted: 15 February 2020; Published: 15 June 2020.

doi: 10.21037/ajo.2020.04.01

View this article at: http://dx.doi.org/10.21037/ajo.2020.04.01

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Introduction

Endoscopic balloon dilatation is a procedure performed by Ear, Nose and Throat (ENT) Surgeons to treat subglottic stenosis (SGS) and it is common practice at our institution to admit these patients to the Intensive Care Unit (ICU) for monitoring postoperatively. The lack of evidence guiding ICU admission criteria is well recognised (1-3). Given this, it is unsurprising that there is a lack of consensus, accepted guidelines or consistent practice between hospitals or even within hospital departments regarding this decision-making. ICU is an expensive and overburdened resource already in Australia and overseas (4,5) and these issues are likely to worsen with a predicted 4% annual rise in utilisation (6). Despite the high cost and demand-supply mismatch, at present we are unable to reliably predict which patient would benefit from or require ICU postoperatively (2).

Inappropriate use of ICU represents significant resource waste and has the potential to preclude access by patients genuinely in need of acute care. The ICU setting presents potential risks to patients, which are well documented and may be life-threatening. These include higher infection rates and more frequent staff errors (4,5,7,8). The necessity of an ICU admission warrants scrutiny to ensure best practice.

This article examines the immediate postoperative outcomes of a 20 year case series (n=38 dilatations, 18 patients) of SGS patients following endoscopic balloon dilatation and seeks to identify whether ward-based care may be more appropriate than ICU postoperatively.

Common causes of SGS are well documented and include; intubation injury, granulomatosis with polyangiitis, airway burns and irradiation. By contrast the pathogenesis remains only partially understood which impairs the advancement of prevention and treatment (9-11). As in decision-making related to any other disease entity, approaches to the treatment of SGS are dependent upon the nature and severity of symptoms, patient factors and surgeon preference and experience.

SGS treatments include medical and surgical options, often in combination. Approaches range from watchful waiting in cases of mild asymptomatic disease to open neck surgery and resection of the affected segment with end-to-end anastomosis for severe cases. The most common treatment approach for symptomatic SGS however is endoscopic dilatation using a rigid laryngoscope and mechanical dilatation of the stenosed segment with an inflatable balloon (10). While endoscopic balloon dilatation often provides effective symptom relief, re-stenosis is common (40–70%) and repeat procedures often required, particularly for patients with severe stenosis, that is, grade III or IV, longer stenotic segment (>1 cm), circumferential scarring and loss of cartilage framework (9,10,12). Rigid dilatation of the stenosis using a bougie or barrel of the rigid endoscope is also a treatment option, however this has declined in use due to higher complication rates. Adjunctive and alternative treatments during endoscopy include radial mucosal incisions (with sickle knife, scissors, Coblator or CO_2 laser) of the affected area, topical Mitomycin, injected and systemic steroids. Despite progress in certain aspects of SGS management there is no gold standard and treatment is highly individualised (10,13-15) for this condition which is often challenging to treat.

Methods

The study received approval from the East Metropolitan Health Service of Western Australia Research Ethics and Governance (REGS) unit (approval number: GEKO 23832) in accordance with hospital regulations. Participant consent was not required due to the retrospective nature of the review.

A retrospective chart review was performed of all SGS balloon dilatations at our institution, an adult tertiary hospital, during the 20 year study period (1998–2017). Cases were identified using a prospective hospital theatre database through the search terms ‘subglottic stenosis’ and ‘endoscopic balloon dilatation’. Exclusion criteria included; cases in which there was tracheostomy present or performed, tracheal dilatations which did not include a dilatation of the subglottis and cases performed as emergency dilatations. Eighteen patients who underwent a collective 38 dilatations during the study period were identified and demographics collected including; stenosis grading, operation details from the surgical and anaesthetic documents , perioperative complications, postoperative destination, length of stay and unplanned readmission/ return to theatre. Where available, preoperative ENT and anaesthetic notes were examined for documented decision-making around postoperative destination. Collected data was de-identified and stored on a password protected hospital computer.

Results

Patient demographics

The average age at time of surgery was 48.3 years. The most common cause of SGS as outlined in *Table 1* was

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Table 1 Aetiology of subglottic stenosis (n=18 patients)

Aetiology of subglottic stenosis	Value
Idiopathic	11 (laryngopharyngeal reflux noted as a possible aetiology in n=3)
Intubation/trauma	3
Granulomatosis with polyangiitis	2
Post-operative	2

Table 2 Relevant co-morbidities

Relevant co-morbidities	Value
GORD	6
Obesity	2
Hypertension	2
Tracheomalacia	1
DMII	1
Alcohol abuse	2
OSA	1
None identified	9

idiopathic (n=11), of which laryngopharyngeal reflux (LPR) was identified as a contributing cause in 3 patients. Two patients had confirmed granulomatosis with polyangiitis (formerly Wegner's granulomatosis). Three patients had a history of prolonged intubation or suspected intubation trauma resulting in SGS, one of which had an associated unilateral vocal cord palsy from childhood cardiac surgery. Medical comorbidities relevant to SGS (*Table 2*) included GORD (n=6), obesity (n=2) and hypertension (n=2). Most patients had 2 or more relevant comorbidities. Common within the 18-patient cohort was a lack of any identifiable risk factor (n=9) known to be associated with SGS.

Of the 38 cases most (79%) were graded Cotton-Meyer I (n=19, 50% of cases, *Table 3*) or II (n=11, 29% of cases) stenosis (16). In contrast to the consistent documentation of stenosis grading on the operation report, further details of the stenosis including length and nature (membranous, cartilaginous, fibrous, circumferential) were poorly documented (no mention of nature of stenosis in 26 cases). Five operation reports noted a circumferential stenosis, 4 noted it to be membranous while 1 noted a fibrotic nature. One report commented on a 'mature' stenosis (grade II) and 1 operation report commented on a pachydermal appearance consistent with LPR.

Previous balloon dilatations had been performed in at least 66% (n=25) of cases, with most of these patients having had multiple dilatations (n=16). Unclear or conflicting documentation regarding prior balloon dilatation was common (n=4). The majority of cases (84%) scored 2 or 3 on American Society of Anesthesiology Physical Status Score (ASA). Two cases received an ASA of 4, 1 of these cases was admitted to the ward postoperatively, the other to ICU. Patient characteristics at the time of dilatation (n=38) are summarised in *Table 3*.

Surgical technique

All cases were performed under general anaesthetic with patients positioned supine. Following induction, ventilation was achieved via either transnasal humidified rapid-insufflation ventilatory exchange (THRIVE) (n=8, 1 of which required intermittent microlaryngoscopy tube placement due to desaturation), intermittent microlaryngoscopy tube (n=6), 5 used this alone, 1 in combination with THRIVE as noted), 15 used supraglottic jet ventilation (n=13 jet alone, 2 required ETT placement). Anaesthetic documentation for 9 cases was insufficient to comment. A rigid 0° Hopkin's rod telescope was used to visualise the airway and to assess the stenosis.

Balloon catheters were inserted using either telescopic guidance or direct visualisation. The type of balloon was documented in 25 cases. Boston Scientific CRE Pulmonary balloons in sizes; 12/13.5/15 mm, 15/16.5/18 mm and 18/19/20 mm were used in 21 cases. An angioplasty catheter was used in 4 cases (12, 14, 16, 16 mm). The number of balloon passes/dilatations was recorded in 29 of 38 cases and ranged from 1–5. Two to three passes per patient was common (n=10 and n=9 respectively) however 4 patients underwent 1 pass only, 5 underwent 4 passes and 1 patient underwent 5 passes. Rationale for number of passes was not made clear in the operation notes. Documentation regarding number of passes in 8 cases was absent. Degree of dilatation was variable in documentation, 29 cases had millimetres of dilatation recorded (12–20 mm) while 11 cases had pressure documented (3–8 atmospheres). Duration of dilatation was documented in 19 cases and varied between 30 seconds (n=3) and 2 minutes (n=5) per pass. The most common duration of dilatation was 1 minute (n=10).

Surgical variables (adjuvant treatments) are outlined in *Table 4*. Eighteen of 38 cases underwent balloon dilatation alone. Seven cases underwent biopsy of the

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Table 3 Characteristics of cases at time of dilatation (n=38)

Characteristic	Value
Age in years at time of surgery: mean [range]	48.3 [27–67]
Stenosis Grading (I–IV)	
1	19
2	11
3	7
4	0
Not documented	1
Number of previous endoscopic balloon dilatations	
0	9
1	9
2	6
3	3
≥4	7
Indeterminate	4
ASA	
1	1
2	14
3	18
4	2
5	0
6	0
Not documented	3

Table 4 Surgical variables (n=38)

Variables	n
Balloon dilatation alone	18
Biopsy of subglottis	7
Intralesional triamcinolone (0.8–2 mLs: 40 mg/mL)	9
Topical mitomycin C (5 mg/mL)	1
Radial incisions	
Sickle knife	2
CO_2 laser	3
Coblation	3

subglottic tissue to investigate the cause of stenosis. Nine cases underwent adjuvant intralesional injection of Triamcinolone (steroid) of consistent concentration (40 mg/mL) but variable volume (0.8–2 mL). Topical Mitomycin C (5 mg/mL) was used in one case. Mucosal radial incisions were used in 8 cases (sickle knife: 2, CO_2 laser: 3 and coblation: 3).

Four cases underwent combination adjuvant treatment. This included: (I) biopsy, triamcinolone and coblation incision; (II) biopsy and knife incision; (III) laser and Mitomycin C and (IV) biopsy and triamcinolone.

Intraoperative administration of intravenous dexamethasone was common (n=31) and ranged between 4–12 mg with the majority of these cases receiving 8 mg.

The use of adrenaline soaked pledgets for haemostasis following the procedure(s) was common but not ubiquitous practice.

Postoperative care

Minimal postoperative analgesia was utilised with paracetamol commonly prescribed but minimally used in the case of 'as required' prescribing (n=28 cases). The use of strong analgesia was uncommon, limited to few and low doses—Oxycodone (n=7), Tramadol (n=5), Fentanyl (n=1) and Hydromorphone (n=1).

Postoperative care included humidified air/oxygen for 7 cases. The rationale for this appeared to be surgeon preference as opposed to case severity or complexity as 4 of these 7 cases were grade I stenosis and the remaining 3 classified as grade 2. Six of these 7 cases were cared for in ICU, with 1 cared for on the ward. The use of postoperative oxygen supplementation was common (n=18) and ranged from 2 litres/minute via nasal prongs to 6 litres/minute via a Hudson Mask. Patient oxygen saturation levels ranged from 94% or higher and for patients who received supplemental oxygen therapy—no rationale for use was able to be deduced from the patient file apart from that required for humidification.

Postoperative use of steroid was common (n=26). Ten cases did not receive any steroid following the procedure while in 2 cases documentation could not be verified. Six patients received steroid during both admission and on discharge, 16 only while an inpatient and 4 on discharge only. Steroid dosing ranged from 4 to 8 mg of dexamethasone (PO and IV) daily to three times daily and on discharge

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prednisolone 40–60 mg daily for 5 days was a typical regime.

The immediate postoperative destinations for the 38 cases were as follows; 31 to ICU, 2 to the HDU and 5 to the ward. Explicit documentation of decision-making around postoperative destination was not evident. The rationale for ward-based care of 5 of these patients was not clear from review of documentation around patient medical history and disposition. These patients had ASA scores ranging from 2–4 while 4 had grade 1 stenoses and 1 had grade 3. Intraoperatively—2 had a balloon dilatation only, 2 had Triamcinolone and 1 had laser and Mitomycin C.

The two patients cared for in HDU were planned for this preoperatively, although the rationale was not made explicit. The degree of stenoses of these 2 patients were graded 1 and 2 and both were ASA 2. Both patients underwent biopsies, 1 in the glottis and subglottis, the other in the nasal septum. One of these patients developed a cough which required 1 day additional stay.

Outcomes

Of the 38 cases, 30 were discharged day 1 postoperatively. Of the remaining 8 patients, all were discharged the following day. The reasons for delayed discharge included mobilisation concerns unrelated to the operative site (n=1), 4 cases appeared to have delayed discharge due to the patient being from a rural location although this was not explicitly documented, 1 patient with long-standing unilateral vocal cord palsy was placed on a postoperative diet restriction and the gradual return to normal diet appeared to be the rationale for remaining in hospital. One patient developed a postoperative cough (in HDU) for which Continuous Positive Airway Pressure (CPAP) was briefly trialled. This patient had no recorded desaturations or other respiratory symptoms and CPAP was ceased due to ineffectiveness, the cough self-resolved and the patient was discharged day 2 postoperatively. Of the 8 patients discharged day 2 this HDU patient was the only one not admitted to ICU. The other 7 patients were stepped down to the ward from ICU day 1 postoperatively.

Of the 38 cases there were no postoperative complications recorded. No documented desaturations, bleeding, new vocal cord palsy, pneumothorax, airway oedema or respiratory distress. No patients required return to theatre during the perioperative period. One patient was re-admitted following discharge day 1 postoperatively with anxiety in which no surgical complication was identified, and was discharged within 24 hours of readmission. No other patients were readmitted within the perioperative period.

Discussion

In this series, there was no evidence that routine postoperative ICU admission influenced patient outcomes. Thirty-one out of 38 patients went to ICU. There were no documented postoperative complications in our 20 year, 38 case cohort. Our data set did not obviously suggest any patient benefited from ICU admission. It is possible that complications were prevented due to the patient being situated in ICU, however there was no evidence found which indicated this.

Reported perioperative complication rates associated with endoscopic balloon dilatation of SGS are very low and no recorded deaths or permanent disability were found in a review of the literature (9,10,17,18). A 2019, 603 patient cohort study of endoscopic dilatation (which included rigid dilatation) reported all complications which comprised; temporary tongue paraesthesia (13.9%), dental injury (5.6%) and transient postoperative emphysema (0.5%) (10). Potential complications include postoperative oedema, aspiration pneumonia, vocal cord injury and damage to adjacent structures (for example lips and airway mucosa).

In contrast to the tendency at our centre to admit SGS patients to ICU following endoscopic balloon dilatation, other centres are increasingly discharging these patients from hospital on the day of operation after a period of observation (19,20). A 2014 study of 223 cases of endoscopic airway surgery for laryngotracheal stenosis found this to be a safe alternative to hospital admission and had only 1 patient in the outpatient arm to have a complication—moderate airway oedema, which was able to be medically managed with humidification and steroids, followed by discharge day 1 postoperatively (21). Outcomes comparable to this are reflected in similar studies, none of which report major complications following endoscopic balloon dilatation (19).

The move in other centres to treat select SGS as same-day discharges following endoscopic balloon dilatation prompts analysis of the rationale driving our own practice. Review of patient notes included; preoperative, intraoperative and inpatient documentation from ENT and critical care teams and yet decision-making regarding postoperative destination was not found to be explicit or consistent. Another 2 tertiary adult public hospitals in the same city perform this procedure with the same techniques in comparable patient cohorts and, anecdotally, also routinely admit postoperatively to ICU. It appears surgeon preference and established culture are the

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main determinants behind this practice.

Several ENT operations routinely admit to the ICU, including uvulopalatoplasty and major head and neck procedures. Similar to balloon dilatation for SGS, the primary reasons for this use of ICU relate to the desire for close nursing observations postoperatively as opposed to the provision of intensive treatment (22-24). Close monitoring in the specialist ENT ward with a clear nursing protocol may result in an improved care pathway. While there may be a reluctance on the part of clinicians to reduce the acuity of postoperative care, there is a growing body of evidence to support a shift in practice, based on large, multicentre studies (24,25).

Explicit documentation of expected postoperative disposition of SGS patients could lead to more conscious decision-make regarding the appropriate postoperative destination for these patients (26,27). Critical care pathways are increasingly recognised as effective in rationalising resource use, particularly for expensive, highly limited resources such as the ICU. The creation of a postoperative clinical care pathway by a multidisciplinary team has been shown to reduce admission length and readmission rates without causing higher postoperative complications and would ideally be considered for all operations, to ensure best practice (28-32).

Overuse of ICU occurs across specialties and a broad examination of ICU utilisation indicated that in up to 32% of admissions the degree of patient care provided is equivalent to that able to be provided by a less intensive environment (25).

Decision making around postoperative ICU admission lacks evidence and there is a growing body of literature which suggests the ICU environment itself poses a risk. Deciding whether a patient warrants ICU admission is a complex decision and requires a multidisciplinary approach. Guidelines to determine which patients should be admitted to ICU have been proposed however consensus building remains in progress and recommendations are commonly vague—'If [the] patient is at risk of developing a severe complication' (33). More recent systematic reviews have failed to provide a definitive, adequate triage system for ICU admission criteria, and reiterate that clinical judgement is vital (34,35). There is no evidence which suggests admitting patients to ICU 'for monitoring' improves postoperative outcomes (2). A study of medical admissions to ICU found that a restriction of admissions solely for monitoring purposes (due to a shortage of medical ICU beds) had no effect on mortality (36). No similar study involving surgical patients has been performed.

Several studies have suggested that patient factors as opposed to surgical factors are better predictors of postoperative complications (37). While further research is required, particularly research which focuses specifically on SGS, these 'patient factors' could help in the creation of an algorithm for deciding which SGS patients should be cared for postoperatively in ICU.

Mandatory ICU admission leads to overuse of intensive care for post-surgical patients, and there has been an international shift away from this practice (2). Viable alternatives for postoperative SGS patients could include HDU or a 'high-visibility' bed on an ENT ward.

Examples from other surgical specialties include a 14-year study of postoperative care of patients undergoing major vascular surgery in which there was a change in approach from mandatory ICU admission of all patients to more than two-thirds being postoperatively admitted to HDU or ward without a demonstrated increase in morbidity and mortality (38). An 8-year observational study examined the effects of diverting postoperative patients (n=915, abdominal aortic reconstruction or lung resection for cancer) from ICU to a Post-Anaesthesia Care Unit (PACU), deemed 'intermediary care' (39). The study found that admission to PACU (in comparison to ICU) did not compromise patient outcomes—and that there were comparable perioperative complications (for example respiratory compromise) and mortality rates. The study did note that patients with congestive heart failure, chronic obstructive pulmonary disease, or renal insufficiency were more likely to be admitted to the ICU than the PACU in the first instance.

These studies illustrate the possibility of caring for high-risk postoperative patients in locations other than the ICU and highlight the need for procedure-specific criteria for postoperative ICU admission. Further research to develop a risk stratification system for SGS patients would be helpful. Certain patient groups may be appropriate for mandatory ICU admission following SGS dilatation for example; patients with significant co-morbidities, pregnant patients, paediatrics and patients undergoing emergency dilatation. Currently there is inadequate evidence to guide decision-making regarding postoperative care of patients with SGS undergoing endoscopic balloon dilatation.

Conclusions

This retrospective study showed no postoperative complications from 38 endoscopic balloon dilatation cases of patients with SGS. The study contributes to the literature in that there have been no other published studies dedicated to examining the use of ICU following balloon dilatation of SGS.

Further research is required specifically on postoperative

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care of SGS dilatation patients and ideally would result in the development of an algorithm to assist this decision-making.

This dilemma is not unique to SGS patients and highlights a broader issue—that surgical patients continue to be make up a significant proportion of ICU care, yet an adequate system of triage remains elusive. Providing high-quality, cost-effective care requires a careful balance between underuse and overuse of critical care resources.

The development of a clinical care pathway outlining specific criteria for postoperative ICU admission would be beneficial. This would require consensus between Intensivists, Anaesthetists, ENT surgeons, ENT nurses and hospital management to effectively and safely implement.

Acknowledgments

Funding: None.

Footnote

Conflicts of Interest: All authors have completed the ICMJE uniform disclosure form (available at http://dx.doi.org/10.21037/ajo.2020.04.01).The authors have no conflicts of interest to declare.

Ethical Statement: The authors are accountable for all aspects of the work in ensuring that questions related to the accuracy or integrity of any part of the work are appropriately investigated and resolved. The study was conducted in accordance with the Declaration of Helsinki (as revised in 2013). The study received approval from the East Metropolitan Health Service of Western Australia Research Ethics and Governance (REGS) unit (approval number: GEKO 23832) in accordance with hospital regulations. Participant consent was not required due to the retrospective nature of the review.

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doi: 10.21037/ajo.2020.04.01
Cite this article as: Reid A, Pollaers K, Wormald R. Is Intensive Care a necessary postoperative destination for all patients following elective balloon dilatation for subglottic stenosis? Aust J Otolaryngol 2020;3:23.

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