Key words: TNO, transnasal oesophagoscopy, transnasal esophagoscopy dysphagia, head and neck cancer, balloon dilatation, EAT-10, post-radiation oesophageal strictures

Key points

- Transnasal Oesophagoscopy (TNO) is an approach to inspect the upper aerodigestive tract, especially in the head and neck cancer (HNCA) population that present with dysphagia.
- Twenty-five (25) office-based TNO procedures were performed, with a same-day discharge rate of 96% (24/25) and no reported complications.
- This case series is the first to compare preoperative and postoperative outcomes (EAT-10) following stricture dilatation using TNO in the UK. Our results show a statistically significant improvement in symptom severity (EAT-10 scores) (n=11, P=0.001). In the majority of these patients, strictures were due to post-radiation complications. Biopsy in 4/5 cases was sufficient for diagnosis/ruling out disease. Of these patients, 80% had a previous HNCA.
- This study identifies the remit for a new 'one-stop' TNO service for suspected cancer referrals, of which a large proportion are patients with a previous HNCA. Surveillance, therapeutics and diagnostics can be achieved in a single visit.
- Earlier staging or treatment may be achieved due to a fast turnover in clinic

Introduction

Transnasal oesophagoscopy (TNO) is an office-based procedure that allows superior visualisation and management of conditions affecting the upper aerodigestive tract (UADT), without the need for sedation. It has recently been used in the UK as a tool for investigating dysphagia, globus and reflux in the outpatient setting.[1]2. TNO can also be used for biopsy, stricture dilatation (Figure 1b-d), secondary tracheoesophageal puncture and surveillance of head and neck cancers.3 There is a good evidence base for TNO regarding its favourable safety profile and tolerability, and numerous studies have demonstrated results comparable to those of standard esophagoscopy.[3,4] Given its many advantages, ranging from a short procedure time, avoidance of general anaesthesia (GA) and reduced delays in diagnosis, TNO offers an acceptable alternative to theatre-based oesophagoscopy.

A common indication for TNO is dysphagia, which is a common primary symptom in patients with new or historic head and neck cancer (HNCA). In the latter instance, underlying causes include recurrence and anastomotic/radiation-induced strictures.[5,6] This creates a large scope for utilising TNO in a 'one-stop' service for patients presenting with dysphagia. Our aim was to investigate the safety, efficacy and applicability of TNO in patients presenting with dysphagia, and surveillance of those with a previous HNCA. This includes a costs/savings analysis, and discussion of COVID-19 safety adaptations.

Methods

Participants

We conducted a retrospective case series of 20 patients that underwent office-based TNO between 20th August 2019 and 15 September 2020 in a tertiary centre. This period includes a four-month gap to account for the first COVID-19 pandemic.

Main outcome measures

Primary outcome measures included patient-reported pain scores (nose and throat) using a visual analogue scale (0-10), procedures abandoned and complication rate (%). In balloon dilatation cases, further primary outcome measures were preoperative/postoperative Eating Assessment Tool-10 (EAT-10, 0-40) scores and number undergoing repeat dilatation (during the study period). EAT-10 scores ≥3 are abnormal. For TNO-plus-biopsy, whether biopsy was sufficient for diagnosis was recorded.

Design

TNO cases were extracted from our outpatient procedure database, including details on patient demographics, indications, intervention (biopsy/balloon), pain scores and EAT-10 scores. For balloon procedures, postoperative EAT-10 scores were recorded from follow-up clinic notes, and histopathology reports were obtained from patient records. A paired t-test was applied to pre- and

postoperative EAT-10 scores, with P<0.05 considered statistically significant (Microsoft Excel). This study follows CARE reporting guidelines.

TNO procedure

All procedures were performed in-office using the Pentax EG16-K10 video-gastroscope and Videostack system. Equipment for balloon dilatation includes the Cook Medical® balloon and accompanying pump syringe, used to inflate and monitor balloon pressure (Figure 1a).[2] Before the procedure, the nasal cavity and oropharynx are anesthetised using co-phenylcaine (5%-lidocaine/0.5%-phenylephrine) and 10%-xylocaine, respectively, with lidocaine gel applied to the scope as a lubricant. The scope is passed through the nasal cavity, nasopharynx, and pharynx. The patient is then asked to swallow, allowing the scope to enter the oesophagus.

Balloon dilatation

A guidewire is passed through the working channel until the tip emerges distally. The scope is retracted, with the guidewire maintained below the level of the stricture. The scope is then re-inserted under endoscopic vision, and the balloon is passed over the guidewire. The balloon is maximally inflated and held in place for one-minute, and is then deflated and removed along with the guidewire.[2]

Safety Adaptations to COVID-19

Flexible endoscopy is widely regarded as a high-risk aerosol generating procedure, along with guidance from ENTUK stating secretions can become aerosolised by unexpected coughing/sneezing during the procedure.7 Given that TNO requires close proximity and can induce coughing in patients7, this increases risk. Adapting to this, ENTUK have published recommendations to reduce infection risk.7

Results

Indications

Twenty patients (12 females, 8 males) with a median age of 69 (55-78) underwent 25 TNO procedures. The most common indication for TNO was dysphagia in 88% (22/25). Two patients had previously identified masses and one patient had suspected retrograde cricopharyngeus dysfunction (Figure 2a). In patients with dysphagia, 35% (7/20) had developed strictures secondary to radiotherapy and underwent balloon dilatation.

Positive findings

Positive findings (Figure 2b) were either picked-up intraoperatively or consistent with previous imaging. Strictures (36%) and lesions (24%) were most common.

Safety and tolerability

TNO was well-tolerated with median nose and throat pain scores of 0 (n=22) (Table 1). No complications were reported. Following surgery, 96% (24/25) had a same-day discharge (SDD). One patient had been admitted prior to undergoing TNO and therefore was not discharged the same day but was well post-operatively. In two instances the procedure was abandoned prematurely. The first was due to a tight cricopharyngeus stricture and persistent intraoperative hypertension. However, this patient underwent successful repeat TNO two-weeks later, with no postoperative complications. A second case was abandoned due to dilatation not being tolerated, giving a completion rate of 92% (23/25).

Balloon dilatation

55% (11/20) of patients underwent balloon dilatation of strictures caused by oesophageal webs, cricopharyngeal muscle dysfunction or neopharynx stenosis. Only two patients underwent repeat dilatation during the study period. Preoperative and postoperative EAT-10 scores from eleven procedures were available to evaluate if dilatation improved dysphagia symptoms. There was a statistically significant improvement in EAT-10 scores postoperatively ($p = 0.000979$) (Table 2). One patient from this cohort underwent repeat dilatation twice during the specified period.

Biopsy

Five patients underwent biopsy of lesions in the tongue base, soft palate, epiglottis, hypopharynx and GOJ. Of these, 80% had a previous HNCA. Biopsy was sufficient for diagnosis/progression of care in 4/5 patients. This included two confirmed malignancies, and two negative histology results. One patient underwent repeat biopsy via TNO, with the second sample being sufficient for diagnosis. In

one patient, biopsy was insufficient in grading dysplasia, however a sample taken via subsequent gastroscopy mirrored this result.

Comparison

For two cases, standard panendoscopy was requested following TNO. In both instances, clinical and histological findings were consistent with TNO.

Costs

Five procedures, which had tariffs attached, were used to calculate an average tariff. Based on this, total tariff revenue from 25 TNO procedures is £16,375. The actual value is expected to be significantly higher. Specific for balloon procedures, the average tariff (n=4) was £693 and costs were £644/procedure. For the 11 balloon dilatation procedures carried out, this gives the Trust a net income of £539. Given that TNO can reduce the need for additional investigations such as barium swallow (± £150), follow-up clinics (±£80), and free up both theatre-time and beds (£222 per bed/day)[18], the actual cost savings are expected to be much greater compared to standard panendoscopy.6

Discussion

Synopsis of key findings

In this case series, we demonstrate office-based TNO to be a well-tolerated and safe procedure, with no complications reported. TNO led to a statistically significant improvement in dysphagia symptoms in patients undergoing stricture dilatation(n=11) (Table 2). Biopsy in 4/5 cases was sufficient for diagnosis/ruling out malignancy. Our results suggest that TNO (for investigation and biopsy) generates comparable outcomes to theatre-based panendoscopy. This is supported by Postma *et al.* where 12 patients underwent biopsy via both TNO and panendoscopy, and in each case results were congruent.[3] This suggests TNO could supersede panendoscopy as a diagnostic investigation for HNCA and upper GI malignancy. A key advantage is the avoidance of GA, with nearly all (24/25) patients discharged the same-day and returning to work/home straight away. This makes office-based TNO an attractive option in patients with significant comorbidities and attendant GA risk [6], and those requiring repeated dilatations, as did two patients in this study.

Clinical applicability of the study

Given the considerable risk of primary recurrence[9] and post-radiation strictures in HNCA patients, TNO provides a 3-in-1 solution, allowing the clinician to comprehensively inspect the UADT, remedy strictures and biopsy suspicious, lesions in a single visit. Almost half (40%) of patients undergoing TNO in this study had a previous HNCA. In a large study (n=100) evaluating post-treatment HNCA patients, Farwell *et al.* demonstrated that only 13% had a normal oesophageal examination.10 Given its favourable safety profile, high diagnostic-yield, ability to reduce theatre utilisation, and time to diagnosis, there is a clear rationale for adopting a TNO service in both the urgent suspected HNCA, and surveillance pathways.

Existing literature on tolerability and safety of TNO supports our findings.[1349] Aviv *et al.* in a similar case series (n=14) reported no complications.9 Pain scores were also consistent with scores from other studies using a similar 10-point scale.9

Limitations

The authors recognise a number of limitations in this study. First, this was a small (n=20) retrospective case series limited in part by a four-month gap in cases due to the COVID-19 pandemic. Secondly, not all postoperative EAT-10 scores were recorded, giving only eleven cases for statistical analysis. Although there was a statistically significant improvement ($P<0.001$), a larger prospective study is recommended to corroborate our findings. Finally, whilst our data demonstrates TNO to be cost-effective in relation to standard theatre-based pathways, a stand-alone cost-benefit analysis would be beneficial to quantify this in detail.

Conclusion

Office-based TNO has shown to be a safe, efficient and cost-effective alternative to standard procedures, without compromising patient care/outcomes. Therapeutic procedures in selected patients significantly reduce symptom severity, and diagnostic procedures are efficacious in identifying malignant lesions. There is a strong case for introducing a TNO ‘one-stop’ clinic within the NHS-2WW HNCA pathway to screen and manage patients with new-onset dysphagia and those post-treatment.

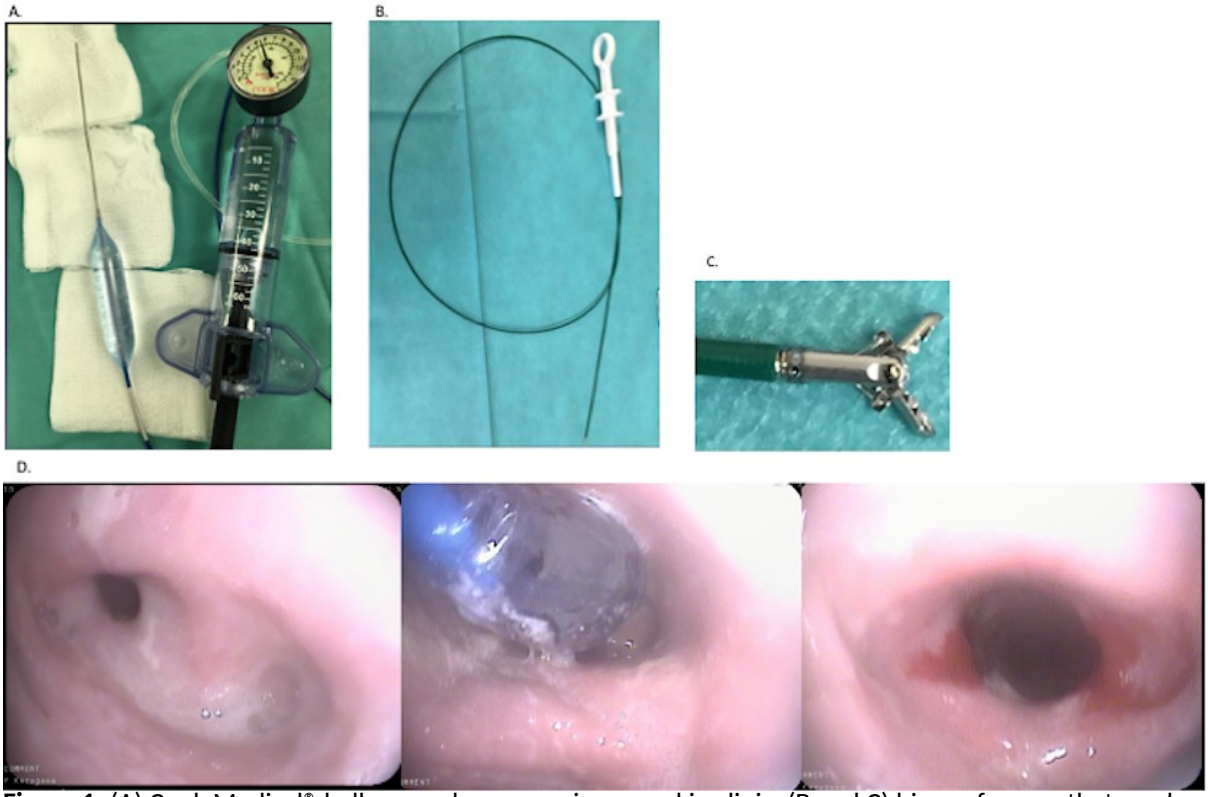


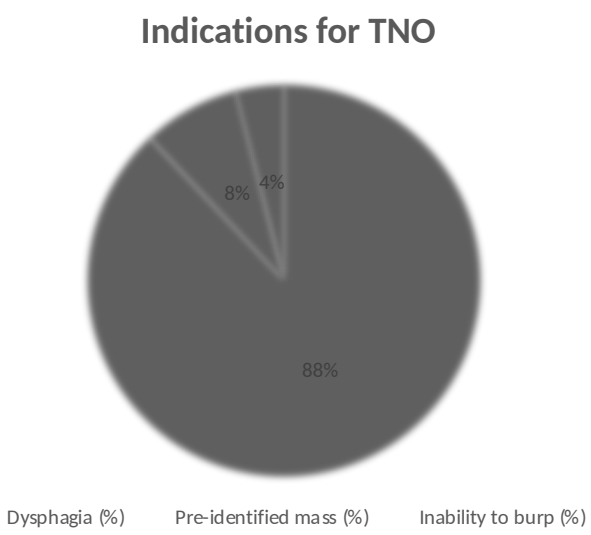
Figure 1. (A) Cook Medical® balloon and pump-syringe used in clinic. (B and C) biopsy forceps that can be passed through the working channel. (D) oesophageal stricture before(left), during(middle) and after(right) balloon dilatation.

Table 1: Patient demographics, indications and pain scores

Number of patients	20
Age	69(55-78)
Gender (F:M)	12:8
Number of cases	25
Nose pain score (0-10), n= 22	0(0-5)
Throat pain score (0-10), n= 22	0(0-1.5)
Same day discharge (SDD) (%)	96%
Complications %	0%
Procedures abandoned	2/25
Indications for TNO, n = 25	
Dysphagia (%)	88
Pre-identified mass (%)	8
Inability to burp (%)	4

Abbreviations: F, female; M, male; TNO, transnasal oesophagoscopy.
Values are median (interquartile range)

A.



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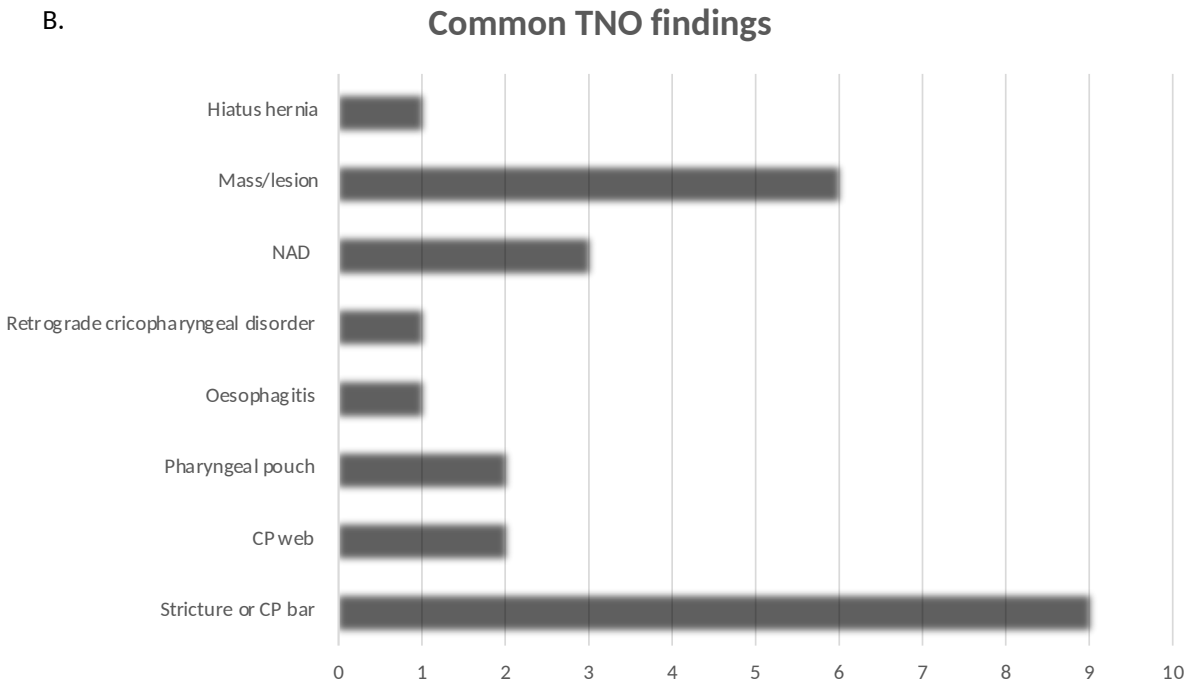

Figure 2. (A) Chart summarising indications for TNO. (B) positive intraoperative findings in this cohort
(Abbreviations: NAD, no abnormality detected; CP, cricopharyngeal)

Table 2: Balloon dilatation outcomes using preoperative and postoperative EAT-10 scores

	Preoperative score	Postoperative score	P value
Balloon dilatation, n=11	21 (16-32)	8 (1-13)	0.000979

Abbreviations: EAT-10, Eating assessment tool 10.
Values are median (interquartile range).

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Figure legends

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