Review

Transnasal endoscopy: moving from endoscopy to the clinical outpatient–blue sky thinking in oesophageal testing

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ABSTRACT

Background COVID-19 has severely affected UK endoscopy services with an estimate 86% loss of activity during the first wave. Subsequent delays in diagnostic and surveillance procedures highlight the need for novel solutions to tackle the resultant backlog. Transnasal endoscopy (TNE) provides an attractive option compared with conventional upper gastrointestinal endoscopy given its limited use of space, no sedation and reduced nursing resources.

Our experience We describe piloting and then establishing an outpatient model TNE service in the pandemic era and the implications on resource allocation, training and workforce. We also discuss our experiences and outline ways in which services can evolve to undertake more complex endoscopic diagnostic and therapeutic work. Over 90% of patients describe no discomfort and those who have previously experienced conventional transoral endoscopy preferred the transnasal approach. We describe a low complication rate (0.8%) comprising two episodes of mild epistaxis. The average procedure duration was reasonable (9.9±5.0 min) with full adherence to Joint Advisory Group quality standards. All biopsies assessed were deemed sufficient for diagnosis including those for surveillance procedures.

Discussion TNE can offer a safe, tolerable, high-quality service outside of a conventional endoscopy setting. Expanding procedural capacity without impacting on the current endoscopy footprint has great potential in recovering endoscopy services following the COVID-19 pandemic. Looking forward, TNE has potential to be used both within the endoscopy suite as part of therapeutic procedures, or outside of the endoscopy unit in outpatient clinics, community hospitals, or mobile units and to achieve this in a more sustainable and environmentally friendly way.

Key messages

⇒ Transnasal endoscopy (TNE) uses an ultra-thin endoscope to visualise the upper gastrointestinal tract and is a safe, well-tolerated and resource-efficient alternative to conventional transoral endoscopy that is currently underused.
⇒ As units confront the challenges of COVID-19, the versatility of TNE provides a route to recovery, with potential to enhance existing services and increase productivity.
⇒ Seen through the prism of COVID-19, we highlight our experience of establishing a TNE service in a non-traditional setting and of maintaining key performance indicators throughout the roll-out period while outlining learning points from setting up this service.
⇒ Despite the initial investment, TNE has numerous future benefits for both diagnostic and therapeutic applications, including expansion beyond the footprint of the endoscopy department and the development of novel outpatient services.
⇒ TNE procedures may have other wider reaching advantages including a reduction in plastic use compared with the standard transoral route, and a positive effect in reducing the environmental impact of endoscopy.

BACKGROUND

Conventional oesophagogastroduodenoscopy (c-OGD) is the gold standard for diagnosis and surveillance of upper gastrointestinal (GI) pathology and makes

up approximately 50% of GI endoscopic procedures in the UK. The 2017 Joint Advisory Group (JAG) census reported over 1.2 million OGDs were performed annually[1] with an estimated 6.8% rise in procedures at the subsequent JAG census in 2019.[2]

There is a substantial need to improve GI endoscopy capacity in the UK, with units in the pre-COVID-19 era unable to meet their targets for urgent 2-week cancer wait (26.3%), routine 6-week DM01 (31.3%) and surveillance procedures (36.6%).[2] Further impacts caused by COVID-19 have exposed patients to diagnostic delay for upper GI cancer with an estimated 759 oesophageal and 320 gastric cancers missed during the COVID-19-impacted period in the UK,[3] and modelling studies estimating a 10% increase in oesophageal cancer deaths up to 1 year after the pandemic.[4]

Transnasal endoscopy (TNE) uses an ultra-thin endoscope of less than 6 mm diameter via the nasal route and is typically performed with the patient sitting upright. This offers an elegant solution to several problems facing endoscopy services in the post-COVID-19 era.[5] As an unsedated procedure that bypasses the tongue, palate and uvula, TNE minimises stimulation of the gag reflex[6] and offers excellent patient tolerability while the absence of sedation is cost-saving in terms of equipment, monitoring, and nursing resources during and after the procedure.

TNE has been shown to more than halve aerosol generation compared with c-OGD,[7] in part due to less gagging, and may be further minimised with the wearing of surgical masks during the procedure.[8] The subsequent improvement in patient throughput associated with reduced recovery time would also minimise COVID-19 transmission.

Technological advances in optical performance, channel size and image enhancement now deliver the benefits of visual resolution and diagnostic performance comparable and often superior to c-OGD.

With a current trend towards green endoscopy[9] characterised by waste reduction and sustainable practices, the efficiency of TNE would move departments in the right direction towards minimising consumption of single-use plastics (such as mouthguards, syringes and needles) and other equipment required for c-OGD.

These factors, combined with its excellent safety profile and minimal cardiorespiratory effects,[10] offer flexibility for endoscopy to safely expand beyond the traditional boundaries of the endoscopy unit and into novel outpatient spaces.

Despite these positives, TNE currently remains significantly underused. With only 26 685 procedures performed in 2019 (comprising less than 3% of all OGDs the UK[2]), TNE has considerable potential to scale up and meet the demand of the post-COVID-19 landscape. Indeed, the COVID-19 pandemic may provide the stimulus for redefining the way services are conceived and delivered in novel and interesting ways, such as one-stop outpatient TNE services for upper GI symptoms[11] or community diagnostic hubs coupled with radiology.

Here we describe our experiences of a standalone TNE service at St Thomas' Hospital, reflect on its role in the recovery of endoscopy services in the shadow of COVID-19 and describe how we envisage the role of TNE in the future.

OUR EXPERIENCE

A standalone TNE service operating between 16:00 and 19:00 was initially piloted as a weekly list involving one consultant and one training fellow from October 2019 to March 2020, with support provided by otorhinolaryngology (ENT) colleagues and the opportunity for trainees in TNE to attend ENT clinics. Full roll-out of the service occurred in September 2020, comprising three six-patient lists per week covered by nine endoscopists (four consultants, three fellows and two nurse endoscopists) all of whom were already independent in c-OGD and had attended a TNE training course. While no formal accreditation currently exists, we found that endoscopists training in TNE achieved procedural independence after approximately 10–15 observed procedures.

Lists were constructed the same as c-OGD, with one point per TNE procedure. The lists operated within pre-existing job plans for doctors and nurses and, by using an unused clinical space, did not impact on other endoscopy activities.

Funding for the service was secured from a business case submitted to remedy 6-week wait targets, and the service was incorporated within our department's standard operating procedure.

All patients referred for OGD were screened by a senior endoscopy nurse and offered an unsedated TNE within the inclusion and exclusion criteria (table 1). As TNE was carried out on an ambulatory pathway running out-of-hours, it was felt that high-risk patients would be excluded initially. Patient demographics and indications for procedures are highlighted in online supplemental appendix 1.

On the day of the procedure, patients were preassessed by endoscopy nurses and given 50 mL of a mucolytic drink to enhance mucosal visualisation (consisting of 40 mL N-acetylcysteine (1:25 dilution) and 30 drops of Infacol made up to 1000 mL with water). Standard consent was obtained, and patients were given nasal preparation with 5% lidocaine/0.5% phenylephrine topical solution 5–10 min before the procedure.[6]

Procedures were carried out in an unused bowel preparation room located within the endoscopy unit which, at 14.6 air changes per hour, had the same ventilation as standard endoscopy rooms.

Procedures were performed by one endoscopist assisted by one nurse (band 5 level) and one healthcare assistant. All patients were scoped in a seated position but transferred to the left lateral position if

Table 1 Summary of inclusion and exclusion criteria for commencing a standalone outpatient transnasal service

Inclusion criteria	Exclusion criteria
1. Any patient ASA grade II or less who requires standard diagnostic gastroscopy (including 2-week wait patients) 2. Barrett's oesophagus short segment (<3 cm) 3. Eosinophilic oesophagitis assessment and biopsies 4. Gastric intestinal metaplasia surveillance 5. Post-HALO radiofrequency ablation surveillance (>2 years from procedure)	1. ASA grade III and IV 2. Unable to stop aspirin/clopidogrel* 3. Current use of DOAC* 4. Check ulcer healing† 5. Barrett's oesophagus surveillance >3 cm 6. Any intervention required/expected 7. *Helicobacter pylori* culture 8. Duodenal biopsies for coeliac assessment (type 1/2 refractory) 9. Nasal surgery/fractures/septal deviation/recurrent epistaxis (unless cleared by ENT) 10. 12 months following endoscopic eradication therapy for Barrett's (either RFA or EMR)

*Continuing antiplatelet and anticoagulant therapy as per BSG/ESGE 'low-risk procedure' guidelines[27] are relative indications for inclusion for performing TNE once training phase is complete.
†Check of gastric ulcer healing can also be considered for inclusion based on risk of needing endoscopic therapy.
ASA, American Society of Anaesthesiologists; BSG, British Society of Gastroenterology; DOAC, direct acting oral anticoagulants; EMR, endoscopic mucosal resection; ENT, otorhinolaryngology; ESGE, European Society of Gastrointestinal Endoscopy; RFA, radiofrequency ablation; TNE, transnasal endoscopy.

the procedure required conversion to an oral route. Fujifilm ultra-thin endoscopes (700 series) were used for the initial pilot phase with the addition of Olympus XP290N endoscopes for the roll-out phase. A portable suction device was used. Biopsies were taken with paediatric biopsy forceps in all cases.

Of the 225 procedures (comprising 98 from the pilot and 127 from the full roll-out), there were 209 completed TNE procedures (defined as successful nasal and oesophageal intubation with subsequent examination of the upper GI tract to achieve the clinical intent without needing to abort the procedure due to patient factors), giving an unadjusted TNE completion rate of 92.9%. This included three patients in whom initial discomfort with TNE was remedied with the adjunctive use of nitrous oxide and oxygen mixture (ENTONOX) to successfully complete the transnasal procedure and six patients in whom ENTONOX was used pre-emptively to achieve the same result.

Reasons for the 16 incomplete procedures were difficult nasal intubation (n=7), patient intolerance at any point during the procedure (n=8) and food in the stomach (n=1). The 3.1% failure rate of nasal intubation was comparable with other TNE studies showing rates of 3%–8%.[6]

Of these initially incomplete procedures, 5 of 16 were completed as an unsedated transoral endoscopy using the ultra-thin scope, giving an adjusted completion rate of 95.1% (214 of 225). Total procedure length was 9.9±5 min, with the longest procedures occurring in those requiring conversion to a transoral route.

Of those patients who underwent a successful TNE procedure, 98.1% achieved D2 intubation and all successfully performed a retroflexion procedure (table 2). Inlet patch detection was 5.7% and comparable with the background rate.[12]

Comfort scores were documented in 190 of 225 procedures. Of these cases, 176 (92.6%) had no or minimal discomfort, and only 8 of 190 (4.2%) documented severe discomfort or were unable to tolerate the procedure.

Table 2 Summary of TNE procedures during the full roll-out of the service

	All completed procedures via the transnasal route only (n=209)*	All attempted procedures (n=225)	
		Attempts via transnasal route (n=225)	Attempts with subsequent conversion to oral route if permitted (n=214)†
Oesophageal intubation	209/209 (100%)	211/225‡ (93.8%)	216/225 (96.0%)
J manoeuvre rate	209/209 (100%)	211/225‡ (93.8%)	216/225 (96%)
D2 intubation	205/209§ (98.1%)	205/225 (91.1%)	210/225 (93.3%)
Inlet patch detection	13/209 (6.2%)	13/225 (5.7%)	13/225 (5.7%)

*Two hundred twenty-five procedures were performed of which 209 patients had a completed TNE in which the clinical intention was achieved.
†Of these 16 incomplete procedures, a further 5 patients for whom the nasal route was unsuccessful were successfully converted to the oral route; there were also 3 patients who also did not tolerate the oral route either.
‡Of the 16 incomplete procedures, 2 patients had examinations of the oesophagus and stomach in retroflexion before withdrawing consent, giving a figure of 211.
§Four of these patients scoped for Barrett's or EoE surveillance did not have D2 intubation as they had recent completed examinations.
EoE, eosinophilic oesophagitis; TNE, transnasal endoscopy.

A post-procedure survey collected feedback on the service in 29 patients. Eleven had previously undergone upper GI endoscopy (37.9%), of which 10 (91%) found TNE more comfortable than a c-OGD. Only one patient (9.1%) preferred a standard transoral OGD.

Two cases of mild epistaxis gave an overall complication rate of 0.88%. One required a period of observation in the recovery suite and treatment with a silver nitrate stick while the other resolved spontaneously; both were discharged the same day. Retrospective review of notes revealed no delayed complications (including epistaxis, sinusitis or pain) up to 30 days post-procedure, with 8-day readmission rates and 30-day mortality rates both zero.

Biopsies were taken in 95 procedures, totalling 448 individual biopsy samples. The average size of the largest biopsy was 4.27 mm^3. All sets of biopsies were deemed sufficient for analysis and diagnosis; this included sets taken for the diagnosis or assessment of eosinophilic oesophagitis (EoE) (n=42) and Barrett's oesophagus (n=12).

DISCUSSION

The current status of TNE

With the exception of Japan, the worldwide uptake of TNE has so far been low, with one study from 2016 demonstrating 9% of hospitals and 34% of clinics used TNE as first line in Japan compared with 1% worldwide.[13] This is also reflected in the low number of procedures recorded in the 2019 JAG census. The slow adoption of TNE may reflect the current lack of formal training and accreditation that make TNE appear daunting or inaccessible; however, our department's experience of TNE as easy to learn despite the varying levels of prior endoscopic experience mirrors prior work illustrating the quick learning curve with TNE.[14]

Our experience has highlighted that a standalone TNE service is safe and effective and has numerous benefits that justify an expanded role in tackling the backlog of upper GI procedures as endoscopy units recover from the impact of the COVID-19 pandemic (see table 3).

Existing literature has previously demonstrated that TNE is a comparable alternative to c-OGD as a diagnostic modality for numerous GI pathologies.[5] Here, the inlet patch detection, a proposed surrogate of endoscopic quality, was 5.7% and comparable with the background rate from c-OGD,[15] which suggests a similar degree of mucosal inspection quality. We used a mucolytic drink which provided excellent mucosal visualisation. However, data on the quality of mucosal visualisation in TNE with this approach compared with c-OGD are lacking and further studies are warranted in this area.

Prior data also highlight the safety and tolerability of TNE which our data confirm, with the 0.88% epistaxis rate comparable with the 0.85%–2% seen in other large series[16 17] and with no other recorded immediate or delayed complications. A total of 92.6% of patients had no or mild discomfort suggesting that TNE is well tolerated and mirrors the considerable evidence favouring TNE over unsedated c-OGD.[6] In the few times TNE was poorly tolerated, our novel use of ENTONOX as an adjunct to topical nasal preparation allowed completion in three cases and offers an innovative solution in further improving patient comfort, while obviating the need for repeat procedures with sedation or general anaesthetic.

TNE also permits comparable histological sampling. Despite its 2.4 mm working channel, the finding that all biopsies were of sufficient diagnostic quality mirrors data elsewhere on the high performance of TNE biopsies.[18 19] Their performance here in all cases of EoE and short-segment Barrett's oesophagus lends support to an expanded role of TNE in the surveillance and follow-up of these conditions, although further work comparing dysplasia detection rates in Barrett's oesophagus between TNE and c-OGD would be welcomed.

With workforce shortfalls relating to COVID-19 illness and isolation, limiting numbers within an endoscopy room has clear financial, staffing and infection control advantages. Our TNE model, with the use of one trained nurse rather than the mandated two nurses for c-OGD, helps maintain efficient staffing levels. Additionally, due to higher tolerability from less retching and stimulation of the gag reflex,[6 10] the typical aerosol generation risk from c-OGD is theoretically lower with TNE[7] and may be further limited by use of a surgical mask to reduce droplet dispersal via the mouth.[8] It should be recognised that some areas outside the endoscopy footprint may have lower ventilation and air exchange, although the above measures combined with robust pre-assessment and pre-procedural COVID-19 testing would counter this.

It should be acknowledged that there are barriers to establishing a TNE service (see table 3). Foremost is the upfront investment in hardware that includes connectors for drying cabinets and a sufficient inventory of scopes; this is especially pertinent for services set up outside the footprint of the endoscopy department where equipment must be transported to and from the unit. However, it stands to reason that the short-term start-up cost would soon be repaid by the long-term gains in capacity provided by the service as waiting lists are tackled and pressures on services are alleviated. This issue could be addressed by future work and detailed cost-analyses to establish the financial benefits of a TNE service and pave the way for more widespread TNE provision.

The COVID-19 pandemic has been undoubtedly disastrous for healthcare systems globally, but this adversity should provide the impetus for novel and innovative service development and any designs should arguably have TNE at its core.

Table 3 Potential advantages and foreseeable challenges of establishing a TNE service in a COVID-19 era

	Features of a TNE service	Potential benefits applicable to a post-COVID-19 era	Potential challenges
Pre-procedure considerations	Utilisation of space otherwise not used for endoscopic procedures, which may be inside or outside the endoscopy unit footprint (eg, bowel preparation rooms, capsule endoscopy rooms, physiology rooms, outpatient clinics, etc)	Increased capacity for patient procedures without significant restrictions to other services	Not all hospitals will have a suitable area to repurpose. If operating outside the endoscopy unit, a larger inventory of scopes may be required to ensure sufficient equipment to run the list. This financial outlay for this and other resources may be offset by the increased productivity from using previously unused areas for TNE.
	Twilight/evening endoscopy timings	Extended timings without large staffing requirements	May not fall within the existing job plans of all endoscopy departments. May be met by appropriate restructuring of resources as ultimately less staff are needed for a TNE list.
	Shallow learning curve to training of new operators[14]	Ability to expand services to both medical and non-medical endoscopists and build resilience in staffing and general departmental skillset	ENT support needed within the training phase. There may be a transient drop-off in procedure completion rates as new endoscopists are trained up that should improve once procedural independence has been achieved.
Intraprocedural considerations	Single nurse assistant	Ability to expand endoscopy services without significant increase in staffing requirement	Nursing staff require initial training to assist with TNE procedures.
	TNE procedure associated with less coughing/gagging	Theoretical reduction in aerosols[7 8]	Reduced ventilation and air exchange in some outpatient areas, although can be counteracted by robust pre-procedural COVID-19 testing; use of face mask to cover the patient's mouth may provide further aerosol reduction.[8]
	Unsedated procedure	Total patient interaction time likely to be shorter, thereby improving turnaround time and patient flow	There may be the occasional need to convert a failed nasal intubation to the oral route in a patient who hasn't received sedation. This is generally more comfortable than c-OGD without sedation, and ENTONOX can be used adjunctively.
	Improved patient tolerability when compared with unsedated conventional transoral endoscopy	Theoretical improved lesion detection rate in comfortable patients	Some patients will still find the procedural uncomfortable. This can be ameliorated by adjunctive use of ENTONOX as noted above.
Post-procedure considerations	Better patient tolerability	Improved compliance and attendance for repeat procedures (surveillance, etc)	As above
	Immediate discharge from endoscopy procedure room	No requirement for social distancing in endoscopy recovery or interference with other endoscopy department patient flow	None significant foreseen

c-OGD, conventional oesophagogastroduodenoscopy; TNE, transnasal endoscopy.

The future of TNE

The versatility of a TNE service allows for a dynamic approach to its future placement within a service, in both diagnostic and therapeutic situations (summarised in table 4).

From a diagnostic perspective, there is the potential to use a TNE service within outpatient clinics, including specialist clinics for the assessment of patients with portal hypertension.[20 21]

Furthermore, this technology lends itself readily to the evaluation of patients with dysphagia[11] potentially alongside an oesophageal physiology service as part of a 'one-stop clinic'.

Another potential use of the manoeuvrability of a transnasal portable stack and scope is to investigate inpatients as part of a triage service that could include suspected upper GI bleeding[22] and thereby assist with early discharge and improved patient flow. TNE services could easily expand to community clinics and hospitals to improve access to services, or in mobile units as part of wider surveillance strategies as has been previously demonstrated for the investigation of patients with Barrett's oesophagus.[23]

Therapeutic options for TNE include the potential for procedures to support the nutrition of complex or high-risk patients such as a TNE approach for NJ tube insertion[24] or PEG placement through either a direct puncture (Pexact) or pull-through technique.[12]

TNE may also guide stricture characterisation by using an ultra-thin scope to assess stricture length and angulation as well as obtaining accurate histology prior to subsequent management. It may also have a role in direct observation of balloon dilatation of the

Table 4 Potential methods in which a transnasal endoscopy service can be expanded beyond standard diagnostic procedures within an endoscopy department

Category	Scenario	Example
Diagnostic	GI bleed	Assessment of lower risk bleeds (eg, Glasgow Blatchford score 0 or 1) in the emergency department to triage towards therapeutic endoscopy or facilitate early discharge
	Portal hypertension	Hepatology/portal hypertension outpatient clinic to diagnose/grade varices
	Dysphagia	Dysphagia outpatient clinic encompassing focused history, and if appropriate direct endoscopic examination
	Community screening	Procedures performed in community diagnostic hubs or mobile vehicle
Therapeutic	NJ tube	Placement of guidewire and NJ tube to overcome difficult oronasal transfer step
	PEG placement	Nasal unsedated seated PEG placement
	Stricture management	Able to more easily traverse difficult strictures to characterise them and assist with guidewire passage and dilatation Direct visualisation of dilatation of upper oesophageal strictures Can be passed through gastrostomy to assist with combined antegrade–retrograde dilatation procedure
	Dual endoscopy	Scope passed alongside a gastroscope to assist in retraction of lesions and facilitate endoscopic dissection

GI, gastrointestinal; NJ, naso-jejunal tube; PEG, per oral endoscopic gastrosotomy.

cricopharyngeus or proximal oesophageal strictures[25] or to assist alongside another scope, either as part of a combined antegrade–retrograde endoscopic dilatation procedure[26] or to provide traction in endoscopic submucosal dissection technique.

Green endoscopy

With a drive towards a more environmentally friendly approach to endoscopic practice,[9] TNE may have some clear advantages over standard transoral approaches. These benefits may be modest but could be part of a wider series of changes that reduce the carbon footprint of endoscopy. While this is yet to be studied in detail, there is a theoretical reduction in plastic, including lack of need for mouthguard and plastic syringes for sedation. There are also the benefits of patients being able to be discharged directly without requiring a chaperone and hence the indirect advantages of patients able to use public transport more easily for a procedure rather than an over-reliance on cars.

CONCLUSION

TNE has been demonstrated to be a safe, effective and well-tolerated alternative to c-OGD but is underused despite its potential for scaling up to meet the increasing demands in a post-COVID-19 workplace. In a time of mounting pressures on endoscopy services, the productive output generated from a smaller footprint of resources should make TNE central to the future of upper GI endoscopy, whether as an adjunct to c-OGD in traditional hospital settings or supplanting c-OGD as a first-line investigation in a breadth of new and exciting outpatient services.

Correction notice This article has been corrected since it published Online First. The title has been amended.

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REFERENCES

1 Shenbagaraj L, Thomas-Gibson S, Stebbing J, *et al*. Endoscopy in 2017: a national survey of practice in the UK. *Frontline Gastroenterol* 2019;10:7–15.
2 Ravindran S, Bassett P, Shaw T, *et al*. National census of UK endoscopy services in 2019. *Frontline Gastroenterol* 2021;12:451–60.
3 Rutter MD, Brookes M, Lee TJ, *et al*. Impact of the COVID-19 pandemic on UK endoscopic activity and cancer detection: a national endoscopy database analysis. *Gut* 2021;70:537–43.
4 Maringe C, Spicer J, Morris M, *et al*. The impact of the COVID-19 pandemic on cancer deaths due to delays in diagnosis in England, UK: a national, population-based, modelling study. *Lancet Oncol* 2020;21:1023–34.
5 Grant RK, Brindle WM, Robertson AR, *et al*. Unsedated transnasal endoscopy: a safe, well-tolerated and accurate

alternative to standard diagnostic peroral endoscopy. *Dig Dis Sci* 2022;3:1–11.
6 Parker C, Alexandridis E, Plevris J, *et al*. Transnasal endoscopy: no gagging no panic! *Frontline Gastroenterol* 2016;7:246–56.
7 Phillips F, Crowley J, Warburton S. Quantifying aerosol and droplet generation during upper and lower gastrointestinal endoscopy: whole procedure and event- based analysis. medRxiv. *medRxiv* 2021.
8 Higashimori A, Maruyama H, Nadatani Y, *et al*. The "New Normal" Following the COVID-19 Pandemic: A Simple Infection-Prevention Measure Using a Surgical Mask during Transnasal Endoscopy. *Clin Endosc* 2021;54:618–20.
9 Maurice JB, Siau K, Sebastian S, *et al*. Green endoscopy: a call for sustainability in the midst of COVID-19. *Lancet Gastroenterol Hepatol* 2020;5:636–8. –.
10 Alexandridis E, Inglis S, McAvoy NC, *et al*. Randomised clinical study: comparison of acceptability, patient tolerance, cardiac stress and endoscopic views in transnasal and transoral endoscopy under local anaesthetic. *Aliment Pharmacol Ther* 2014;40:467–76.
11 Alsaied AS, Postma GN. In-Office evaluation and management of dysphagia. *Otolaryngol Clin North Am* 2019;52:577–87.
12 McCulloch A, Roy O, Massey D, *et al*. Nasal unsedated seated percutaneous endoscopic gastrostomy (nuPEG): a safe and effective technique for percutaneous endoscopic gastrostomy placement in high-risk candidates. *Frontline Gastroenterol* 2018;9:105–9.
13 Tanuma T, Morita Y, Doyama H. Current status of transnasal endoscopy worldwide using ultrathin videoscope for upper gastrointestinal tract. *Dig Endosc* 2016;28(Suppl 1):25–31.
14 Maffei M, Dumortier J, Dumonceau J-M. Self-training in unsedated transnasal EGD by endoscopists competent in standard peroral EGD: prospective assessment of the learning curve. *Gastrointest Endosc* 2008;67:410–8.
15 Rusu R, Ishaq S, Wong T, *et al*. Cervical inlet patch: new insights into diagnosis and endoscopic therapy. *Frontline Gastroenterol* 2018;9:214–20.
16 Trevisani L, Cifalà V, Sartori S, *et al*. Unsedated ultrathin upper endoscopy is better than conventional endoscopy in routine outpatient gastroenterology practice: a randomized trial. *World J Gastroenterol* 2007;13:906–11.
17 Dumortier J, Napoleon B, Hedelius F, *et al*. Unsedated transnasal EGD in daily practice: results with 1100 consecutive patients. *Gastrointest Endosc* 2003;57:198–204.
18 Walter T, Chesnay A-L, Dumortier J, *et al*. Biopsy specimens obtained with small-caliber endoscopes have comparable diagnostic performances than those obtained with conventional endoscopes: a prospective study on 1335 specimens. *J Clin Gastroenterol* 2010;44:12–17.
19 Jeon SJ, Shin SJ, Lee KM, *et al*. Can the 1.8 mm transnasal biopsy forceps instead of standard 2.2 mm alter rapid urease test and histological diagnosis? *J Gastroenterol Hepatol* 2012;27:1384–7.
20 de Faria AA, Dias CAF, Dias Moetzsohn L, *et al*. Feasibility of transnasal endoscopy in screening for esophageal and gastric varices in patients with chronic liver disease. *Endosc Int Open* 2017;5:E646–51.
21 Castro Filho EC, Perazzo H, Guimaraes RAP, *et al*. Reliability and safety of transnasal compared to conventional endoscopy for detecting oesophageal varices in cirrhotic patients. *Liver Int* 2018;38:1418–26.
22 Rivory J, Lépilliez V, Gincul R, *et al*. "First look" unsedated transnasal esogastroduodenoscopy in patients with upper gastrointestinal bleeding? A prospective evaluation. *Clin Res Hepatol Gastroenterol* 2014;38:209–18.
23 Sami SS, Dunagan KT, Johnson ML, *et al*. A randomized comparative effectiveness trial of novel endoscopic techniques and approaches for Barrett's esophagus screening in the community. *Am J Gastroenterol* 2015;110:148–58.
24 Zhang L, Huang YH, Yao W, *et al*. Transnasal esophagogastroduodenoscopy for placement of nasoenteric feeding tubes in patients with severe upper gastrointestinal diseases. *J Dig Dis* 2012;13:310–5.
25 Rees CJ, Fordham T, Belafsky PC. Transnasal balloon dilation of the esophagus. *Arch Otolaryngol Head Neck Surg* 2009;135:781–3.
26 Sami SS, Haboubi HN, Ang Y, *et al*. UK guidelines on oesophageal dilatation in clinical practice. *Gut* 2018;67:1000–23.
27 Veitch AM, Radaelli F, Alikhan R, *et al*. Endoscopy in patients on antiplatelet or anticoagulant therapy: British Society of gastroenterology (BSG) and European Society of gastrointestinal endoscopy (ESGE) guideline update. *Gut* 2021;70:1611–28.