Curr Pediatr Res2021; 25 (2): 355-357 *ISSN 0971-9032*
www.currentpediatrics.com

Tertiary centre experience of laparoscopic-assisted percutaneous endoscopic gastrostomy in children: A 9-year review.

Rana Bitar[1*], Amer Azaz[1], Huda AlGhfeli[1], Hisham Natour[1], David Rawat[1], Mohamed Hobeldin[2], Mohamed Miqdady[1], Seifeleslam Abdelsalam[2]

[1]**Department of Paediatric Gastroenterology, Sheikh Khalifa Medical City, Abu Dhabi, United Arab Emirates**

[2]**Department of Paediatric Surgery, Sheikh Khalifa Medical City, Abu Dhabi, United Arab Emirates**

Abstract

Objectives: Laparoscopic-Assisted Percutaneous Endoscopic Gastrostomy (LAPEG) is a well-recognised technique used for the placement of gastrostomies in patients with complex medical conditions or postsurgical difficult anatomy. We introduced LAPEG in our centre to improve outcome and increase safety in our complex paediatric population. We aim to review the outcome and complications of LAPEG in children since our change in practice.

Methods: A retrospective tertiary centre review over 9 years (September 2010- September 2019) was conducted. Children under 16 years undergoing LAPEG were reviewed for risk factors and major complications.

Results: 76 patients were identified, 44 males. Median age was 1 year (1 month–14 years), median weight was 8.4 kg (2.8-33.9 kg). A third was less than 7 kg and a third were in Paediatric Intensive Care Unit at the time of the procedure. A quarter had underlying congenital heart disease, a quarter had previous abdominal surgery and 15% (11/76) had American Society of Anaesthesia score of 4.

The median procedure time was 29 min (18-83 min). No patient required conversion into open surgery. There was no adjacent bowel or organ injury, fistula formation, intraperitoneal leek, bleeding and no complications requiring surgical intervention. Three patients (3.9%) experienced early tube dislodgement. All dislodged gastrostomies were successfully replaced at bedside.

Conclusions: LAPEG in our study was a safe method for gastrostomy insertion particularly in our complex high-risk patients. The procedure's high safety profile appears to stem out of direct visualization of the gastrostomy tube insertion process during the entire course of the procedure.

Keywords: Gastrostomy, Percutaneous Endoscopic Gastrostomy (PEG), Laparoscopic Assisted Gastrostomy (LAG), Percutaneous Image Guided Gastrostomy (PIG).

Accepted on January 28, 2021

Introduction

Gastrostomy tube insertion is recommended as the method of feeding when long term enteral nutritional support is required in children [1]. The first gastrostomy insertion was described in 1894 [2]. In the last 30 years, endoscopic, laparoscopic and radiological techniques have been introduced. LAPEG, the most recently introduced technique was reported in 1993 [3-8].

PEG has supplanted surgery for placement of feeding tubes because of its reduced need for anesthesia and surgical intervention while offering a low cost and quick patient recovery. LAG and LAPEG have been reserved for patients whom PEG appears to be contraindicated or cannot be performed [3,4,9-12]. Conventional PEG appears to have increased major complications when compared to LAG [13-18] and although LAG is safe, it is a longer procedure and more surgically invasive [3,14,15]. However, LAPEG is quick, has a high safety profile and requires minimal surgery [3,7-11,13,19,20]. LAPEG's safety stems from the ability to visualize the peritoneal cavity, adjacent bowels and organs and endoscopic intragastric gastrostomy insertion while fixing the stomach to the abdominal wall.

The significant advancements in paediatric and neonatal medicine have resulted in children with residual co-morbid complex medical issues and postsurgical anatomy who require gastrostomy feeding. The standard gastrostomy insertion techniques such as PEG can be difficult or impossible in these patients. Therefore, LAPEG needs to be considered for this group of patients. We introduced LAPEG in our centre in September 2010 aiming to improve outcomes and increase safety in our complex paediatric population. We aim to present the largest case series on paediatric LAPEG.

Methods and Operative Technique

This study was approved by the Institutional Review Board for Research and Ethics Committee in Sheikh Khalifa Medical City. Children who underwent Laparoscopic-Assisted Percutaneous Endoscopic Gastrostomy (LAPEG) in Sheikh Khalifa Medical City between September 2010 and September 2019 were included. Patients were included in this study if they were less than 16 years old and underwent a planned LAPEG insertion. Written informed consent to perform the procedure was obtained from the patients' parent or legal guardian prior to performing the procedure in all patients. The plan for

LAPEG insertion was made following a patient review in a Multi-Disciplinary Meeting (MDT). The decision for LAPEG insertion in the MDT meeting was considered based on presence of significant patient comorbidities, complex surgical background, the anaesthesia risk, cardiorespiratory and intensive care needs. Patients were excluded if they were over 16 years and if they underwent planned Percutaneous Endoscopic Gastrostomy (PEG), laparoscopic, radiological or open gastrostomy insertion.

Participants were identified retrospectively using the electronic medical record. Data collected included demographic parameters, weight and age at time of procedure, history of previous abdominal surgery, history of cardiac disease, and admission in Paediatric Intensive Care Unit (PICU), American Society of Anaesthesia (ASA) score, major complications and length of procedure. The major complications included; adjacent bowel injury, fistula formation, intraperitoneal leek, bleeding, early tube dislodgement and need for further intervention under general anaesthesia. Minimum follow up was 9 months. Minor complications such as granuloma, gastrostomy site infection, vomiting and pain are not considered as major complications and therefore not collected.

Demographics, clinical characteristics, ASA score, major complications and length of procedure of enrolled patients was analysed accordingly. Continuous data was presented as median and range, and dichotomous variables were presented as percentages.

Endoscopic/Operative technique

Prior to LAPEG, the patient receives standard preanesthetic evaluation. Co-Amoxiclav is administered pre-procedure as prophylactic antibiotic. The procedure itself essentially combines the methods of Laparoscopic Assisted Gastrostomy (LAG) and PEG and is therefore undertaken by a paediatric surgeon and a paediatric gastroenterologist.

One laparoscopic port is placed through the umbilicus *via* standard laparoscopic approach. Pneumoperitoneum is achieved at a pressure of 6-10 mmHg, the pressure used will depend on the age of the child. When adhesions or other situations prevent displacement of overlying organs to visualize the stomach, additional ports can be easily added. Simultaneous upper endoscopy is performed, the stomach is inflated and an appropriate internal location for gastrostomy insertion on the greater curvature of the stomach is chosen using external finger indentation. At the same time any internal pathology (e.g. hiatus hernia) is excluded.

We routinely use an introduction kit which comes inclusive of a scalpel, introducer needle, guide wire, dilators, peel-away sheath and 4 percutaneous T-fasteners. We also use a non-skin level balloon gastrostomy device as the initial gastrostomy tube. However, a skin level device has been used by other centres [20]. The surgeon introduces sequentially 3 percutaneous T-fasteners through the peritoneum and into the stomach under direct laparoscopic and endoscopic visualization (Figure 1).

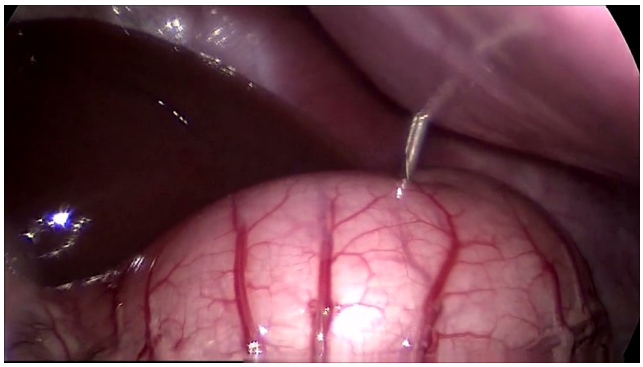

Figure 1. Introduction of T-fastener needle with laparoscopic guidance into the stomach through the peritoneal cavity.

It is our routine to fix the stomach to the abdominal wall using 3 trans-abdominal trans-gastric tuckers; an alternative is to use a U-stitch. Once the stomach is fixed to the abdominal wall, the introducer needle is inserted between the T-fasteners into the stomach through which a guide wire is inserted. The dilators and eventually the peel away sheath are placed over the guide wire into the stomach this is then followed by introduction of the balloon type gastrostomy tube into the stomach through the peel away sheath (Figure 2).

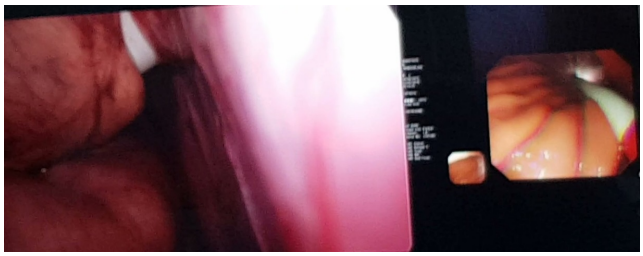

Figure 2. The dilators being placed over the guidewire into the stomach under laparoscopic and endoscopic guidance.

The peel away sheath is then peeled off and the gastrostomy tube is fixed to the skin at an appropriate length. By the end of the procedure the stomach is attached to the anterior abdominal wall with three transabdominal trans gastric tuckers with the gastrostomy tube placed in the centre between the three tuckers (Figure 3).

Figure 3. The stomach fixed to the abdominal wall using three trans-abdominal trans-gastric tuckers and gastrostomy tube placed in the middle of the three tuckers.

All steps are performed under both direct endoscopic and laparoscopic visualization. Routine post procedure wound care was applied for the gastrostomy as well as for the laparoscopy sites. Early initiation of tube feeds was safe; we usually start feeding the following day after LAPEG insertion. However, if the patient's intravenous line was lost shortly post procedure, feeds were initiated on the same day as the procedure. Tuckers generally fell off spontaneously. If any of the tuckers remained, they are removed between 2-3 weeks post-procedure as part of the routine clinic follow up. Generally, the feeding tube is changed into a skin level balloon device 8 weeks post LAPEG insertion in clinic.

Results

Demographic characteristics are summarized in Table 1. Seventy-six infants and children who underwent LAPEG at our centre during the study period were identified. There were 44 males and 32 females. Median age was 1 year (0.08-14 years).

Variable	N=76 (%)
Sex male	44 (57.9%)
Median age at insertion in years (min, max)	1 (0.08-14)
Weight	
<7 kg	23 (30.3%)
7-9.9 kg	25 (32.9%)
>10 kg	28 (36.8%)
Median weight at insertion in kg (min, max)	8.4 kg (2.8-33.9)
Morbidity Risk factors	
PICU patient at time of procedure	25 (32.9%)
Previous abdominal surgery	20 (26.3%)
Congenital heart disease	19 (25.0%)
ASA score	
1: Healthy, no medical problems	0 (0%)
2: Mild systemic disease	3 (3.9%)
3: Severe systemic disease, not incapacitating	62 (81.6%)
4: Severe systemic disease, constant threat	11 (14.5%)

Table 1. Demographic data.

Median weight 8.4 kg (2.8-33.9 kg). A third (23/76) of the patients was less than 7 kg, a third (23/76) was less than 1 year and 16% (12/76) were less than 7 months. A third (25/76) was in PICU at the time of gastrostomy insertion, one quarter of the patients (20/76) had previous abdominal surgery prior to gastrostomy insertion and one quarter (19/76) had congenital heart disease. The ASA score was 3 for the majority of the patients (62/73), a score of 4 was recorded for 11 patients and only 3 patients scored 2. ASA score of 2 represents a patient with mild systemic disease, ASA score of 3 represents a patient having a severe systemic disease that is not incapacitating and an ASA score of 4 represents a patient having incapacitating disease that is a constant threat to life. The presence of weight less than 7 kg, age less that 7 months, PICU admission, previous abdominal surgery, congenital heart disease and ASA score of 4 were considered as risk factors that increased the likelihood of procedure related complications. There were 20 patients (26%) with three or more of these risk factors.

Table 2 demonstrates the incidence and type of complications encountered. In all subjects, LAPEG was performed and completed safely with no perioperative complications. There was no conversion to open procedure, no fistula formation, no adjacent bowel or organ injury, no bleeding and no intraperitoneal leakage. There were no complications that required further intervention under general anaesthesia. Three patients (3.9%) developed tube dislodgement within the first 6 weeks after placement.

Outcome	N=76 (%)
Conversion to open procedure	0 (0%)
Bowel injury	0 (0%)
Organ injury	0 (0%)
Bleeding	0 (0%)
Intraperitoneal leakage	0 (0%)
Fistula formation	0 (0%)
Complication requiring intervention under general anesthesia	0 (0%)
Tube dislodgement within 6 weeks of placement	3 (3.9%)
Time of tube dislodgement	
0-2 weeks	1 (1.3%)
2-4 weeks	2 (2.6%)
4-6 weeks	0
Median procedure duration in minutes (min, max)	29 (18, 83)

Table 2. Procedural complications with minimum follow up for 9 months.

The earliest tube dislodgement was 10 days after LAPEG insertion. However, all patients had the gastrostomy tube replaced at bed side with no complications and without the need for further surgical intervention or general anaesthesia. Follow-up to 4 years or over was completed for 22 patients (29%), follow up to 2 years was completed for 56 patients (74%), follow up to 1 year was completed for 70 patients (92%) and all patients completed 9 months follow up.

Median time required for LAPEG placement was 29 min (18-83 min). The patient who had his LAPEG inserted over a period of 83 min was our very first patient undergoing the first LAPEG procedure within our centre.

Discussion

Gastrostomy tubes are placed using different methods, each placement method has different characteristics and complications. Table 3 describes the different gastrostomy placement characteristics for the main insertion methods. Rates of complications associated with gastrostomies vary according to the placement method. In children, rates for major and minor complications associated with LAG and PEG range from 2%-17.5% and 7%-22.5% respectively [13,16-18]. In a metanalysis; the LAG technique was associated with fewer major complications (1%) compared to PEG (5.4%), major complications were defined as the need for operation within 30 days or death. The overall pooled OR was 3.86 (95% CI 1.90-7.81, p=0.0002) favouring LAG and the number needed to treat to reduce one major complication was 2314. In a systemic review, 8.4% (2.1%-19.4%) of children who underwent PEG and 2.5% (0%-8.6%) of children who underwent LAG required reintervention under general anaesthesia with a significant difference (RR=2.79; P=0.0008) in favour of LAG [15].

Parameters compared	PEG	PIG	LAG	LAPEG
Operation under general anaesthesia	Yes (occasionally under sedation)	No	Yes	Yes
Blind puncture through the abdominal cavity	Yes	Yes	No	No
Adhesion of the stomach to the abdominal wall	Reliance on wound healing and granulation tissue formation	Reliance on wound healing and granulation tissue formation	Suturing of stomach to the abdominal wall	Suturing of stomach to the abdominal wall
Gastropexy	No	No	Yes	Yes
Pneumoperitoneum	No	No	Yes	Yes
Invasiveness, number of transabdominal wall wounds	1	1	3	2
Cosmetics; number of scars on abdominal wall	0	0	2	1
Repeat general anaesthesia/ sedation for tube change	Yes	No	No	No
Length of procedure (+)	+	+	+++	++

Table 3. Characteristics of different gastrostomy placement techniques.

Major complications are thought to occur as a consequence of the partly blind placement technique and failure to fix the stomach to the abdominal wall. In LAPEG the placement is not blinded at any stage and the stomach is fixed to the abdominal wall. Therefore, LAPEG in our group demonstrated no major complications except for early tube dislodgement. Despite the increased comorbidity and high anaesthetic risk in our group LAPEG was safe.

Routinely, the first tube change is done after 6-8 weeks from gastrostomy placement [15,21,22]. Early tube dislodgement is seen in 3%-7.5% of PEG and in 1%-12.6% of LAG [4,15,21]. All patients with early tube dislodgement after PEG require reintervention under general anaesthesia [4,15]. Three patients (3.9%) in our group developed tube dislodgement within 6 weeks of placement; the earliest dislodgement was 10 days post LAPEG. All patients had feeding tubes replaced in clinic or the emergency department. LAPEG and LAG offer the advantage of fixing the stomach to the abdominal wall and thus reducing the risk of peritoneal leakage and the need for surgical intervention with early tube dislodgement.

The time needed for PEG placement is shorter than that for LAG and LAPEG. As expected, LAG is the longest procedure. The mean operating time for PEG in children is 25.6 min (SD ± 2.4), 51.0 min (SD ± 2.8) for LAG [15,21] and 32.4 min (SD ± 6.2) for LAPEG [10]. The median time for LAPEG is reported to be 20 min (12-76 min) [20]. In our study the median time for LAPEG placement was 29 min (18-83 min). Whilst we appreciate the slightly longer operative time and anaesthesia time in our patients, this is acceptable considering the increased need for a second operative procedure for first tube change in PEG.

Although LAG offers a high safety profile, LAPEG offers the added advantage of allowing the visualization of the stomach lumen while placing the gastrostomy tube avoiding the blind puncture of the stomach for tube placement. Luminal visualization is of specific importance especially in children who have a small gastric cavity and short distance between the anterior and posterior wall of the stomach hence preventing the risk of through and through puncture of the anterior and posterior stomach walls and thus reducing the risk of injury to adjacent organs and tube misplacement. LAPEG also generally allows placement of the gastrostomy using a single peri-umbilical incision rather than the multiple incisions used in LAG, this achieves a good cosmetic outcome and may reduce the risk of wound related infection. However, LAPEG requires two clinicians to perform the endoscopic and laparoscopic parts of the procedure and the cost implications to this has not yet been studied or reported. Further studies comparing LAPEG to LAG may give more insight on the different advantages and drawbacks of each procedure.

There are few limitations to this study. The authors accept that this is a retrospective study and that there may be selection bias by excluding LAG, PEG and PIG patients. Moreover, follow up to four years was only available for 22 patients (29%), follow up to 2 years was completed for 56 patients (74%). None the less, 100% of charts were reviewed to capture 9-

month LAPEG insertion related complications and 92% of charts were reviewed to capture complications within one year of insertion. Most clinically relevant procedure related complications are identified within 1 year of initial procedure completion. Third, we didn't perform a comparative study. Lastly, although this study represents the largest review of LAPEG in children, still the small sample size limits the power of the study which precludes definitive conclusion regarding the safety of this technique. A larger multicenter prospective study would provide a comprehensive incidence of LAPEG related complications.

Despite the various limitations, the results suggest that LAPEG is safe and carries low complication rates as previously described [3,7-11,13,19,20,23]. LAPEG maintains the fundamental advantage as that of the endoscopic technique of PEG insertion by virtue of the low procedural invasiveness despite the addition of the laparoscopy. It is a minimal surgical procedure and therefore does not require the surgeon to have advanced laparoscopic training and it minimises anaesthesia time whilst providing direct peritoneal visualisation of abdominal structures. It also has the added benefit of being a diagnostic and therapeutic procedure. Furthermore, the direct intragastric visualization of the gastrostomy insertion and fixation of the stomach to the abdominal wall allows for superior adherence to the safe principles of gastrostomy placement.

We conclude that in our study LAPEG placement was a time efficient, minimally invasive technique with reduced complications and should be considered in children with increased comorbid health burden. To date, there are no available studies directly comparing PEG to LAPEG or even LAG to LAPEG in children. Further randomised controlled trials comparing LAPEG to LAG or PEG are warranted.

Ethical Approval

All procedures performed in this study involving human participants were in accordance with the ethical standards of the national research committee and with the 1964 Helsinki declaration and its later amendments or comparable ethical standards.

Informed Consent

This was a retrospective study and so informed consent was not required for this study however Informed consent was obtained from all individual participants to undergo the surgical procedure.

What is known

- Laparoscopic-Assisted Percutaneous Endoscopic Gastrostomy (LAPEG) was introduced in 1993 as a new gastrostomy placement technique.
- LAPEG is used for patients in whom conventional PEG appears to be contraindicated or cannot be performed.
- Small case series in children and larger adult and paediatric case series have demonstrated the success and high safety profile of LAPEG.

What is new

- This is the largest review of LAPEG in children.
- LAPEG has minimal major complications in young children with low weight and in patients with complex medical background or postsurgical anatomy.
- LAPEG is safe, minimally invasive with reduced anaesthesia requirement.

References

1. Braegger C, Decsi T, Dias JA, et al. Practical approach to paediatric enteral nutrition: A comment by the ESPGHAN committee on nutrition. J Pediatr Gastroenterol Nutr. 2010;51(1):110-22.
2. Stamm M. Gastrostomy by a new method. Medical News. 1894;65:324-6.
3. Thaker AM, Alireza S. Laparoscopic-assisted percutaneous endoscopic gastrostomy. Curr Gastroenterol Rep. 2016;18(9):46.
4. kim J, koh E, chang EY, et al. Single center experience with gastrostomy insertion in pediatric patients: A 10-year review. Pediatr Gastroenterol Hepatol and Nutr. 2017;20(1):34-40.
5. Gauderer MW, Ponsky JL, Izant RJ Jr. Gastrostomy without laparotomy: A percutaneous endoscopic technique. J Pediatr Surg. 1980;15(6):872-5.
6. Georgeson KE. Laparoscopic fundoplication and gastrostomy. Semin Laparosc Surg. 1998;5(1):25-30.
7. Smitherman S, Pimpalwar A. Laparoendoscopic gastrostomy tube placement: Our-all-in one technique. J Laparoendosc Adv Surg Tech. 2009;19(1):119-23.
8. Raaf JH, Manney M, Okafor E, et al. Laparoscopic placement of a Percutaneous Endoscopic Gastrostomy (PEG) feeding tube. J Laparoendosc Surg. 1993:3(4):411-4.
9. Idowu O, Driggs X, Kim S. Laparoscopically assisted antegrade percutaneous endoscopic gastrostomy. J Pediatr Surg. 2010;45(1):277-9.
10. Tomioka K, Fukoe Y, Lee Y, et al. Clinical evaluation of Laparoscopic-Assisted Percutaneous Endoscopic Gastrostomy (LAPEG). Int Surg. 2015;100(6):1144-7.
11. Lodin D, Gupta AK, Rubay D, et al. The effectiveness of laparoscopic-assisted percutaneous endoscopic gastrostomy in patients with unfavorable anatomy: a single-center retrospective cohort study. Cureus. 2020;12(1):e6647.
12. Gillory LA, Megison ML, Harmon CM, et al. Laparoscopic surgery in children with congenital heart disease. J Pediatr Surg. 2012;47:1084-8.
13. Takahashi T, Okazaki T, Kato Y, et al. Laparoscopy-assisted percutaneous endoscopic gastrostomy. Asn J Surg. 2008;31(4):204-6.
14. Sandberg F, Viktorsdóttir MB, Salö M, et al. Comparison of major complications in children after laparoscopy-assisted

gastrostomy and percutaneous endoscopic gastrostomy placement: a meta-analysis. Pediatr Surg Int. 2018;34(12): 1321-7.

15. Suksamanapun N, Mauritz FA, Franken J, et al. Laparoscopic versus percutaneous endoscopic gastrostomy placement in children: Results of a systematic review and meta-analysis. J Minim Access Surg. 2017;13(2):81-8.
16. Gauderer MWL. Percutaneous endoscopic gastrostomy: A 10-year experience with 220 children. J Pediatr Surg. 1991;26(3):288-94.
17. Khattack IU, Kimber C, Kiely EM, et al. Percutaneous endoscopic gastrostomy in pediatric practice: complications and outcome. J Pediatr Surg. 1998:33(1):67-72.
18. Marin OE, Glassman MS, Schoen BT, et al. Safety and efficacy of percutaneous endoscopic gastrostomy in children. Am J Gastroenterol. 1994;89(3):357-61.
19. Abbassi Z, Naiken SP, Buchs NC, et al. Laparoscopic-assisted percutaneous endoscopic gastrostomy in two patients who failed percutaneous endoscopic gastrostomy. Int J Surg Case Rep. 2015;13:40-2.
20. Livingston MH, Pepe D, Butter A, et al. Laparoscopic-assisted percutaneous endoscopic gastrostomy: insertion of a skin-level device using a tear-away sheath. Can J Surg. 2015;58(4):264-8.
21. Akay B, Capizzani T, Lee A, et al. Gastrostomy tube placement in infants and children: is there a preferred technique? J Pediatr Surg. 2010;45:1147-52.
22. Zamakhshary M, Jamal M, Blair GK, et al. Laparoscopic vs percutaneous endoscopic gastrostomy tube insertion: A new pediatric gold standard? J Pediatr Surg. 2005;40(5): 859-62.
23. Lopes G, Salcone M, Neff M. Laparoscopic-assisted percutaneous endoscopic gastrostomy tube placement. Journal of The Society of Laparoscopic & Robotic Surgeons. 2010;14(1):66-9.

*Correspondence to

Dr. Rana Bitar

Department of Paediatric Gastroenterology

Sheikh Khalifa Medical City

Abu Dhabi, United Arab Emirates

Tel: +971568315759

E-mail: drranab@doctors.org.uk