NATIONAL INSTITUTE FOR HEALTH AND CLINICAL EXCELLENCE

INTERVENTIONAL PROCEDURES PROGRAMME

Interventional procedure overview of circumferential epithelial radiofrequency ablation for Barrett's oesophagus

Barrett's oesophagus is a condition in which the lining of the gullet (oesophagus) becomes damaged by the long term reflux of stomach contents; this can be a precursor to the development of cancer. In circumferential radiofrequency ablation, a thin layer of the gullet lining is burnt off using a special coil-like device positioned down the throat and using video guidance, with the intention of destroying damaged cells and therefore possibly avoiding progression to cancer.

Introduction

This overview has been prepared to assist members of the Interventional Procedures Advisory Committee (IPAC) in making recommendations about the safety and efficacy of an interventional procedure. It is based on a rapid review of the medical literature and specialist opinion. It should not be regarded as a definitive assessment of the procedure.

Date prepared

This overview was prepared in April 2007.

Procedure name

- Circumferential epithelial radiofrequency (RF) ablation

Specialty societies

- Association of upper Gastrointestinal Surgeons of GB and Ireland
- British Society of Gastroenterology
- Association of Cancer Physicians

Description

Indications

Barrett's oesophagus is a condition characterised by abnormal lining (epithelium) of the oesophagus. It is associated with gastro-oesophageal reflux disease (GORD), as it tends to occur in patients with a long history of heartburn and gastro-oesophageal reflux. In a minority of people Barrett's oesophagus may progress through a series of precancerous stages (dysplasia) to cancer. High-grade dysplasia is the histological stage that immediately precedes cancer, but it is not possible to predict how soon such lesions will progress to cancer. The severity of dysplasia grading and the length of oesophagus affected by Barrett's changes are thought to be the most important risk factors for progression to cancer.

Current treatment and alternatives

Oesophagectomy is the most radical treatment option for Barrett's disease with an adverse prognosis (including high-grade dysplasia), because removal of the whole oesophagus also removes the risk of progression to cancer. The aim of oesophagectomy is therefore cure. However, oesophagectomy is a major operation, with the potential for high morbidity and mortality. Some patients are unfit for major surgery of this kind and others are reluctant to undergo this treatment for a premalignant condition.

Less-invasive treatments for high-grade dysplasia include laser ablation, endoscopic mucosal resection, and photodynamic therapy, which involves administration of a photosensitising agent by intravenous injection, which is then activated by the application of low-power laser light to the selected area. All of the above treatments aim to remove the specialised columnar epithelium that is affected by dysplasia and to promote the regeneration of normal squamous epithelium. Follow-up by endoscopic surveillance is usually required to detect the development of further dysplastic changes and/or cancer.

What the procedure involves

The aim of circumferential RF ablation is to destroy a thin layer of oesophageal epithelium around the lumen of the oesophagus for a length of a few centimetres.

The procedure is undertaken under conscious sedation. Under endoscopic visualisation, a balloon-mounted coil measuring a few centimetres in length is attached to a probe and is inserted into the targeted area of the oesophagus. The coil delivers a controlled emission of RF energy for a few seconds, which ablates epithelial tissue to a thin depth. Where there are large / long areas of Barrett's oesophagus, the probe is repositioned and further RF energy delivered. Repeat treatments may be necessary a few weeks after the initial treatment if follow-up endoscopy shows residual Barrett's oesophagus.

Efficacy

Ablation success

In one case series, 61% (19/31) of patients demonstrated a complete response to circumferential RF ablation (defined as 100% of biopsy samples reported negative for Barrett's oesophagus) at 12 months' follow-up in the dosimetry phase of the study, and there was a complete response in 70% (48/69) of patients in the efficacy phase[1]. Intent-to-treat analysis (missing data was considered as 'no response') produced outcomes of 59% (19/32) and 69% (48/70) for the dosimetry and effectiveness phases, respectively. A second case series of 7 patients receiving circumferential RF ablation for Barrett's oesophagus following previous fundoplication for GORD reported that 86% (6/7) of patients had no residual Barrett's oesophagus on endoscopic examination at 3 months' follow-up[2].

Quality of life (QOL)

One case series reported on QOL outcomes in 7 patients who had previously undergone fundoplication for GORD. Gastro-oesophageal health-related QOL score improved from a median of 2 points at baseline to 1 point at 1–2 weeks' follow-up (details of QOL scale are given in table 2) This difference was not statistically significant[2].

Operative characteristics

The mean operative time was 28 minutes in 70 patients in the effectiveness phase of a case series[1].

Discomfort

One case series reported that discomfort (not otherwise defined or described) 2 hours after the procedure was experienced by 9% (3/32) of patients in the dosimetry phase and 27% (15/70) of patients in the effectiveness phase of the study[1].

Safety

Adverse events reported in the 106 procedures undertaken in the effectiveness phase of one study (initial treatments and 36 repeat treatments) included nausea in 8% of patients (8/106) and fever in 2% (2/106)[1]. There was one occurrence each of mild bleeding, mucosal scarring, linear mucosal injury, transient airway obstruction and hypotension 1% (1/106), although the latter two complications were thought to relate to sedation. All complications were transient and resolved completely.

In the same case series there were no reports of strictures or buried glands in any of the 3007 biopsies taken during the study[1].

A second case series of 7 patients reported that there were no procedure-related complications at 3 months' follow-up[2].

Literature review

Rapid review of literature

The medical literature was searched to identify studies and reviews relevant to circumferential epithelial RF ablation for Barrett's oesophagus. Searches were conducted via the following databases, covering the period from their commencement to 4th April 2007: Medline, PreMedline, EMBASE, Cochrane Library and other databases. Trial registries and the Internet were also searched. No language restriction was applied to the searches. (See Appendix C for details of search strategy.)

The following selection criteria (Table 1) were applied to the abstracts identified by the literature search. Where these criteria could not be determined from the abstracts the full paper was retrieved.

Table 1 Inclusion criteria for identification of relevant studies

Characteristic	Criteria
Publication type	Clinical studies were included. Emphasis was placed on identifying good quality studies. Abstracts were excluded where no clinical outcomes were reported, or where the paper was a review, editorial, or laboratory or animal study. Conference abstracts were also excluded because of the difficulty of appraising methodology.
Patient	Patients with Barrett's oesophagus
Intervention/test	Circumferential epithelial RF ablation
Outcome	Articles were retrieved if the abstract contained information relevant to the safety and/or efficacy.
Language	Non-English-language articles were excluded unless they were thought to add substantively to the English-language evidence base.

List of studies included in the overview

This overview is based on two case series[1,2].

Other studies that were considered to be relevant to the procedure but were not included in the main extraction table (table 2) are listed in Appendix A.

Existing reviews on this procedure

No published systematic reviews with meta-analysis or evidence-based guidelines were identified at the time of the literature search.

Related NICE guidance

Below is a list of NICE guidance related to this procedure. Appendix B details the recommendations made in each piece of guidance listed below.

Interventional procedures

‘Photodynamic therapy for high-grade dysplasia in Barrett's oesophagus’. NICE interventional procedures guidance 82 (2004). Available from http://guidance.nice.org.uk/IPG82 .

‘Thoracoscopically assisted oesophagectomy’. NICE interventional procedures guidance 189 (2006). Available from http://guidance.nice.org.uk/IPG189 .

Technology appraisals

None

Clinical guidelines

None

Public health

None

Table 2 Summary of key efficacy and safety findings on circumferential epithelial radiofrequency ablation for Barrett's oesophagus

Abbreviations used: BO, Barrett's oesophagus; GORD, gastro-oesphageal reflux disease; ITT, intent-to-treat [analysis]; QOL, quality of life; RF, radiofrequency

Study details	Key efficacy findings	Key safety findings	Comments
Sharma V K (2007)[1] **Case series** USA – 8 centres Study period: Sept 2003 – Sept 2005 **n = 102** (32 in dosimetry study, 70 in effectiveness study) Population: Mean age 56 years, male 79%, GORD history = 100%, BO length = 1–6 cm. Indications: Patients with non-dysplastic BO, confirmed by pathology within 6 months of enrolment. BO length 2–3 cm for dosimetry study; 2–6 cm for efficacy study. Exclusion criteria included active oesophageal stricture, oesophagitis or varices, history of oesophageal malignancy, and any prior intervention. Technique: Under local anaesthesia, the proximal extent of BO was determined by endoscopy, the oesophagus was irrigated, and the balloon coil ablation device (HALO 360) introduced and inflated; 2 × 10 J/cm^2 (2 x 6–12 J/cm^2 in the dosimetry study) pulses were delivered in < 1 sec. **Follow-up: 1 year** Conflict of interest: Study was supported by device manufacturer.	**Operative characteristics** Mean procedure time for the index ablation was 24 minutes in the dosimetry study and 28 minutes in the effectiveness study. 9% (3/32) of patients reported discomfort during ablation and 9% (3/32) reported discomfort 2 hours after the procedure in the dosimetry study. Corresponding values for the effectiveness study were 4% (3/70) and 21% (15/70), respectively. **Ablation success** The success of ablation was evaluated by histology following biopsy. 'Complete', 'partial' and 'no response' outcomes were defined as 100%, 50–99% and 0–5% of biopsies negative for BO, respectively. ***Dosimetry study, 3 months' follow-up, n = 32*** Response: Complete 0% / 0% / 30% (3/10) / 36% (4/11); Partial 100% (1/1) / 80% (8/10) / 50% (5/10) / 45% (5/11); No response 0% / 20% (2/10) / 20% (2/10) / 18% (2/11) (6 J/cm^2 / 8 J/cm^2 / 10 J/cm^2 / 12 J/cm^2) ***Dosimetry study, 12 months' follow-up, n = 31*** Response rate: Per protocol / ITT Complete: 61% (19/31) / 59% (19/32) Partial: 26% (8/31) / 25% (8/32) No response: 16% (5/31) / 16% (5/32) ***Efficacy study, 12 months' follow-up n = 69*** Response rate: Per protocol / ITT Complete: 70% (48/69) / 69% (48/70) Partial: 25% (17/69) / 24% (17/70) No response: 6% (4/69) / 7% (5/70)	**Complications** **Outcomes per procedure** ***Dosimetry study (initial treatment)*** Mucosal scarring 3% (1/32) Chest pain 9% (3/32) Linear mucosal injury 3% (1/32) ***Dosimetry study (repeat treatment)*** Fever 12% (3/26) Mucosal scarring 4%(1/26) Abdominal pain / constipation 4%(1/26) Nausea (sedation related) 4%(1/26) Hypotension (sedation related) 4%(1/26) All outcomes were transient and resolved spontaneously. ***Effectiveness study (initial and repeat treatment)*** Fever 2% (2/106) Chest / throat pain 8% (9/106) Linear mucosal injury 1% (1/106) Mild bleeding 1% (1/106) Mucosal scarring 1% (1/106) Transient airway obstruction (sedation related) 1% (1/106) Hypotension (sedation related) 1% (1/106) Nausea 8% (8/106) All outcomes were transient and resolved completely. There was no histological evidence of stricture formation or buried glands in 3007 biopsies taken during the study.	All patients were assessed by endoscopy at 1 and 3 months' follow-up per protocol; if BO was still present treatment was repeated (n = 26 patients for dosimetry study; n = 36 patients for effectiveness study). Previous operator experience with this procedure is not stated. Some centres may have contributed only a small number of cases. Method of patient accrual not reported. ITT analysis for 12 months' follow-up attributed a 'no response' outcome for patients not available for follow-up. Post-treatment symptoms were assessed by a standardised exit survey and a 14-day symptom diary. Follow-up endoscopy at 3 months for the dosimetry study and 12 months for the effectiveness study was used to evaluate treatment response Biopsy outcomes were assessed by an independent laboratory technician unaware of treatment.

Abbreviations used: BO, Barrett's oesophagus; GORD, gastro-oesphageal reflux disease; ITT, intent-to-treat [analysis]; QOL, quality of life; RF, radiofrequency

Study details	Key efficacy findings	Key safety findings	Comments
Hubbard N (2007)[2] **Case series** USA Study period: Not stated **n = 7** Population: mean age 61 years, male 71%, GORD QOL = 2.14 points, BO length = 1–12 cm (mean 4.4 cm). Indications: Patients with BO, confirmed by endoscopy. Previously undergone Nissen fundoplication; satisfied with reflux surgery. Technique: Under local anaesthesia, the proximal extent of BO was visualised endoscopically, the oesophagus was irrigated, and the balloon coil ablation device (HALO 360) introduced and inflated and RF ablation delivered. Patients were discharged on the same day. **Follow-up: 3 months** Conflict of interest: Not stated	**Resection success** At planned 3 months' follow-up, 86% (6/7) patients had no residual BO identified. **QOL** All patients were reported to be satisfied with the ablative process (time and method of assessment not stated). GORD heath-related QOL score improved from a median of 2 points at baseline to 1 point at 1–2 weeks after the procedure (not significant).	**Complications** No procedure-related complications were reported. During the 3 months after the procedure, no patients reported new or recurrent GORD-like symptoms.	The GORD health-related QOL questionnaire is a 10-item instrument that scores from 0 (asymptomatic in all items) to 50 (incapacitated in all items). **The energy dose delivered during each application was not reported.** The use of repeat treatment is not reported. Authors suggested that the presence of a fundoplication may hinder good contact between the oesophageal mucosal surface and the RF device, although this did not appear to have been the case in this study. **Method of patient accrual not reported.**

Validity and generalisability of the studies

- One of the study populations specifically excluded Barrett's oesophagus patients with dysplastic changes, while the other (smaller) study did not specify the dyplasia status of the Barrett's oesophagus patients included.
- Longest follow-up available is only to 1 year. No data are available to demonstrate prevention of oesophageal cancer, or prevention of recurrence of changes characteristic of Barrett's oesophagus. Recurrence of Barrett's oesophagus is possible if GORD continues.
- Similarly, safety outcomes extend only up to 1 year.
- Many patients received repeat treatment at subsequent sessions if the initial treatment had not completely removed Barrett's oesophagus; this makes it difficult to evaluate single treatments.
- One of the studies included patients who had previously undergone Nissen fundoplication to treat GORD. It is not clear whether the safety and efficacy profile of the circumferential RF ablation procedure will be different in this subgroup of patients.

Specialist advisers' opinions

Specialist advice was sought from consultants who have been nominated or ratified by their Specialist Society or Royal College.

Dr S Riley, Mr R Mason, Prof. H Barr, Dr A Gillams, Dr R Fitzgerald, Mr G Fullerton, Dr A Morris

- Three Specialist Advisers considered that the procedure was novel and of uncertain safety and efficacy, two that it is the first in a new class of procedure, whereas two were undecided about its current status.
- The perceived benefit of the procedure is to provide complete ablation of Barrett's oesophagus without creating strictures.
- One Specialist Adviser noted that in the UK the incidence of adenocarcinoma in the lower third of the oesophagus is increasing faster than any other adenocarcinoma; if Barrett's oesphagus is treated early, progression may be prevented.
- Specialist Advisers identified stricture, perforation, haemorrhage, and buried carcinoma beneath neo-squamous epithelium as adverse events reported in the literature or anecdotally.
- Additional theoretical adverse events include pain, thermal damage to the oesophageal wall, and failure to completely ablate the targeted area of Barrett's oesophagus.
- Four Specialist Advisers commented that long-term data are not currently available, and one noted that it was being marketed to patients despite this.
- The Specialist Advisers considered that the procedure was a relatively simple technique for an experienced endoscopist, and should be within the remit of specialist upper gastrointestinal surgeons.

- Specialist Advisers highlighted that studies are ongoing in Europe and the USA.
- One Adviser stated that it is an exciting procedure and looks very effective.
- The Specialist Advisers were divided in their opinion on the likely uptake, and therefore potential impact of this procedure on the NHS, should it prove to be effective and safe. One commented that the impact would be minor if treating high grade dysplasia alone, although it could become a more important treatment modality if used all patients with Barrett's.
- The Specialist Advisers identified the key outcomes by which to consider efficacy as visual and histological reversal of metaplasia, reduction in cancer risk / presence of dysplasia, and reduced incidence of carcinoma.
- The key safety outcomes identified were stricture formation / requirement for dilatation, bleeding that requires transfusion, and oesophageal perforation.

Issues for consideration by IPAC

- Three studies were identified that reported on the use of this procedure immediately before planned oesophagectomy. These studies were not thought to offer any clinical outcomes and were thus excluded.
- A manufacturer-sponsored randomised controlled trial of circumferential RF ablation vs sham procedure in patients with intestinal metaplasia is currently recruiting in the USA and is due to complete in 2009.

References

1 Sharma VK, Wang KK, Overholt BF et al. (2007) Balloon-based, circumferential, endoscopic radiofrequency ablation of Barrett's esophagus: 1-year follow-up of 100 patients. *Gastrointestinal Endoscopy* 65: 185-195.

2 Hubbard N and Velanovich V. (2007) Endoscopic endoluminal radiofrequency ablation of Barrett's esophagus in patients with fundoplications. *Surgical Endoscopy* 21: 625-628.

Appendix A: Additional papers on circumferential epithelial radiofrequency ablation for Barrett's oesophagus not included in summary Table 2

The following table outlines studies that are considered potentially relevant to the overview but were not included in the main data extraction table (Table 2). It is by no means an exhaustive list of potentially relevant studies.

Article title	Number of patients/ follow-up	Direction of conclusions	Reasons for non-inclusion in Table 2
No studies were identified			

Appendix B: Related published NICE guidance for circumferential epithelial radiofrequency ablation for Barrett's oesophagus

Guidance programme	Recommendation
Interventional procedures	IPG82 Photodynamic therapy for high-grade dysplasia in Barrett's oesophagus 1.1 Current evidence on the safety of photodynamic therapy for high-grade dysplasia in Barrett's oesophagus appears adequate to support the use of this procedure. Photodynamic therapy appears efficacious in downgrading dysplasia in Barrett's oesophagus, when used for the treatment of high-grade dysplasia (a premalignant lesion). However, its efficacy in preventing the progression of Barrett's oesophagus to invasive cancer is not clear. 1.2 Clinicians wishing to undertake photodynamic therapy for high-grade dysplasia in Barrett's oesophagus should take the following actions. • Inform the clinical governance leads in their Trusts. • Inform patients, as part of the consent process, about the uncertainty of influencing their long-term prognosis and provide them with clear written information. Use of the Institute's Information for the Public is recommended. • Audit and review clinical outcomes of all patients having photodynamic therapy for high-grade dysplasia in Barrett's oesophagus. 1.3 Publication of long-term efficacy outcomes will be useful in reducing the current uncertainty. Randomised trials are in progress and clinicians are encouraged to consider entering patients into these (www.cancerhelp.org.uk/trials/trials/default.asp). The Institute may review the procedure upon publication of further evidence. 1.4 This guidance is limited to the procedure using pharmaceuticals licensed for photodynamic therapy of oesophageal dysplasia.

	IPG189 Thoracoscopically assisted oesophagectomy 1.1 Current evidence on the safety and efficacy of thoracoscopically assisted oesophagectomy appears adequate to support the use of this procedure, provided that normal arrangements are in place for consent, audit and clinical governance. 1.2 This procedure is technically demanding, and surgeons undertaking it should have special expertise and specific training in laparoscopic and thoracoscopic surgical techniques and should perform their initial procedures with an experienced mentor. 1.3 Patient selection and management should be carried out in the context of a multidisciplinary team that has a regular practice in open oesophagectomy. 1.4 Clinicians should submit data to the Minimally Invasive Gastro-Oesophageal Cancer Surgery (MIGOCS) National Database (www.e-dendrite.com/databases.htm) or the Association of Upper Gastrointestinal Surgeons of Great Britain and Ireland (AUGIS) data set (www.augis.org/news/default.html).
Technology appraisals	None applicable
Clinical guidelines	None applicable
Public health	None applicable

Appendix C: Literature search for circumferential epithelial radiofrequency ablation for Barrett's oesophagus

IP: 397 Circumferential RF ablation (HALO360) for Barrett's Oesophagus		
Database	**Date searched**	**Version searched**
Cochrane Library	04/04/2007	Issue 1, 2007
CRD databases (DARE & HTA)	04/04/2007	Issue 1, 2007
Embase	04/04/2007	1980 to 2007 Week 13
Medline	04/04/2007	1950 to March Week 3 2007
Premedline	04/04/2007	April 03, 2007
CINAHL	04/04/2007	1982 to March Week 4 2007
British Library Inside Conferences	04/04/2007	-
NRR	11/04/2007	2007 Issue 1
Controlled Trials Registry	04/04/2007	-

The following search strategy was used to identify papers in Medline. A similar strategy was used to identify papers in other databases.

1	Barrett Esophagus/
2	(Barrett$ adj3 ($esophagus or syndrome or metaplasia)).tw.
3	(intestin$ adj3 metaplas$).tw.
4	CELLO.tw.
5	(column$ adj3 lin$ adj3 $esophag$).tw.
6	CLO.tw.
7	Epithelium/su [Surgery]
8	($esophag$ adj3 epithel$).tw.
9	Esophagus/ab [Abnormalities]
10	Esophageal Neoplasms/

11	(abnormal$ adj3 $esophag$).tw.
12	(dysplas$ adj3 $esophag$).tw.
13	((high-grade or low-grade) adj3 dysplas$).tw.
14	or/1-13
15	(radiofrequency adj3 ablation).tw.
16	(radio adj3 frequency adj3 ablation).tw.
17	RFA.tw.
18	(RF adj3 ablation).tw.
19	(thin adj3 layer adj3 ablation).tw.
20	(circumferen$ adj3 ablation).tw.
21	(endoscop$ adj3 ablation adj3 therapy).tw.
22	Catheter ablation/is [Instrumentation]
23	Esophagoscopes/
24	(stellartech adj3 coagulation adj3 system).tw.
25	(HALO360 adj3 ablation adj3 system).tw.
26	(electro$ adj3 coagulation).tw.
27	BARRX.tw.
28	or/15-27
29	14 and 28
30	Animals/
31	Humans/
32	30 not (30 and 31)
33	29 not 32