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Main Article

Holmium:YAG laser: 12-year study of indications for use and outcomes in benign and malignant otolaryngological conditions

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Abstract

Background: We present the largest recorded case series of holmium:YAG laser use in otolaryngology. This laser's hand-held delivery device is easier to manipulate compared with other ENT lasers, and its pulsed delivery mode gives it enhanced cutting and coagulation properties.

Methods and results: We conducted a 12-year, retrospective study of holmium:YAG laser use in a tertiary referral centre. Sixty-eight patients were included. Nineteen received primary laser treatment of squamous cell carcinoma of the upper aerodigestive tract (nine with simultaneous neck dissection), and 49 underwent either palatine or lingual tonsillectomy for benign disease. One cancer patient developed a pharyngo-cutaneous fistula, and a second suffered a secondary haemorrhage. No other complications were recorded. There were no local recurrences.

Conclusions: The holmium:YAG laser is safe and effective for benign and malignant otolaryngological conditions. In cancer treatment, it may be best to delay neck dissection until the primary site has healed, in order to avoid fistula formation.

Key words: Laser Surgery; Holmium; Head And Neck Neoplasms; Otorhinolaryngological Surgical Procedures

Introduction

In England and Wales, a new diagnosis of head and neck cancer is made approximately 6000 times annually. This comprises 3 per cent of the annual registration of 200 000 new cancer cases.[1]

Head and neck cancer is treated with a combination of radical surgery, transoral laser surgery, chemotherapy and radiotherapy. The debilitating effects of chemo-radiotherapy are wide-ranging, and include osteoradionecrosis, xerostomia, mucositis, loss of taste and loss of smell. In many cases, these are permanent.[2]

The risks of radical surgery and reconstruction are significant, and other post-operative sequelae (such as significantly altered swallowing, speech and quality of life) can cause the patient considerable distress.

The carbon dioxide laser is used in many centres for the treatment of glottic tumours, with five-year local control rates of 81–92 per cent in tumour stage (T) one lesions and 64–90 per cent in T_2 lesions, and laryngeal preservation rates of 90–100 per cent and 64–90 per cent, respectively.[3] Carbon dioxide laser is also the mainstay for more radical transoral cancer surgery (i.e. the 'Steiner' technique).

The holmium:YAG laser has been used in medicine for many years, but rarely within ENT. It has a 2150 nm wavelength of light. The energy is delivered in a pulsatile fashion through low water density quartz fibres. When in a water-based medium, the thermal effect on surrounding soft tissue is confined due to a vaporisation bubble formed at the tip of the fibre. These characteristics allow the holmium:YAG laser to vaporise bone with little collateral damage, which has led to its use by urologists for lithotripsy of ureteric calculi[4] and treatment of transitional cell carcinoma.[5]

A few isolated examples of the use of this laser within ENT are found in the literature, including: the successful treatment of congenital posterior choanal atresia[6] and acquired stenosis following radiotherapy for nasopharyngeal carcinoma,[7] and a case series of laser septochondrocorrection in which septal deviation was corrected in non-sedated patients.[8]

One randomised, controlled study compared the efficacy of holmium:YAG laser in endoscopic sinus surgery with that of conventional instrumentation. The laser enabled precise bone ablation, efficient soft tissue coagulation and fibre-optic transmission, facilitating a degree of symptom relief from chronic sinusitis similar to that gained by traditional surgical methods, but with less blood loss. The laser did however result in increased post-operative tissue oedema.[9]

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We present our experience of using the holmium:YAG laser for the treatment of benign and malignant head and neck conditions over a 12-year period. This laser's precise, hand-held delivery system makes it easy to direct into the correct region, and its ability to cut through soft tissue and bone with a bloodless field and little collateral damage provide excellent versatility.

Method

We performed a retrospective analysis of all patients operated upon with a holmium:YAG laser within an otolaryngology tertiary referral centre between 1997 and 2009. Information was gathered by searching through operating theatre records for the above time period and noting all cases in which the laser was used.

We then searched the hospital computer database for clinic letters and outcome statements for each patient which provided information on the diagnosis, planned surgery, post-operative complications, disease recurrence and other factors such as co-morbidity. Records were missing in some cases, so individual patient's clinical notes were obtained from the medical records department.

The laser settings varied according to the specific surgical procedure undertaken. Most of the procedures were conducted with energy settings of 1 joule/pulse at 20 Hz, equalling 20 W. Lingual tonsil patients were treated at a slightly lower energy, 0.8 joules/pulse at 20 Hz, equalling 16 W. Laser light was delivered via a 550 μm fibre, using a twin channel device (Dilkes twin channel laser suction device; Exmoor Plastics, Taunton, UK). An operating microscope was used for all cancer excisions to magnify the operative field and allow close inspection of excision margins. The laser light was delivered in virtual contact mode. Tip carbonising was not encountered due to the pulsed nature of the light.

Results

Sixty-eight patients were treated with the holmium:YAG laser during the study period. Nineteen patients had biopsy-proven squamous cell carcinoma (SCC) of the upper aerodigestive tract. The other 49 patients underwent the following laser procedures for benign conditions: palatine tonsillectomy (36 patients), lingual tonsillectomy (12 patients) and reduction of tonsils (one patient). There were no recorded episodes of post-operative haemorrhage or infection.

Of the 19 SCC patients, six underwent extended laser excision of the tonsil, three with simultaneous neck dissection. Three patients had laser excision of pharyngeal wall tumours, two with simultaneous neck dissection. Five patients underwent laser excision of tongue base tumours, all with simultaneous neck dissection and lateral pharyngotomy. Two patients had laser excision of anterior tongue tumours. Three patients with laryngeal SCC had laser excision or ablation.

One major complication occurred in the immediate post-operative period. This case involved laser excision of a lateral pharyngeal wall tumour with neck dissection, with subsequent development of a pharyngo-cutaneous fistula. Another patient experienced a secondary haemorrhage following laser surgery to a posterior pharyngeal wall tumour and neck dissection. No local recurrence of primary tumours was detected at follow up, although some patients went on to have adjunctive post-operative radiotherapy.

Discussion

The treatment options for head and neck cancer and other benign ENT conditions are expanding, with lasers being at the forefront of this progress. When patients are selected appropriately, lasers are often a useful option, achieving 5-year cancer survival rates equivalent to radical surgery and chemoradiotherapy without the morbidity associated with these treatments.[3]

Only a few ENT applications of holmium:YAG laser have been reported. Our results show that this laser can be a useful option for the head and neck surgeon.

We have found this laser to be most useful in the treatment of conditions involving the palatine and lingual tonsils, oropharynx, hypopharynx, anterior tongue, and tongue base. This is due to the ease with which the hand-held fibre-optic device can be manipulated, and the accuracy with which the beam can be directed. The holmium:YAG laser's ability to dissect tissue and bone with immediate haemostasis and minimal collateral damage also provides an excellent surgical field, particularly when excising malignant tissue. As with the CO_2 laser, we have found that the characteristics of holmium:YAG laser dissection through malignant tissue are different to those for healthy tissue. This is in accordance with the premise of Steiner surgery. Along with the presence of a bloodless field, these dissection characteristics provide the best chance of achieving clear oncological margins, although this can only be proven after histological assessment.

- **This paper reviews the use of holmium:YAG laser for benign and malignant ENT conditions in 68 patients over a 12-year period**
- **There were no recurrences in the malignant cases, and only two cases of post-operative complication**
- **Holmium:YAG laser's pulsed delivery appears to confer enhanced cutting and coagulation properties, compared with other lasers used in ENT**
- **This hand-held device is particularly useful for lingual tonsillectomy as it provides good access to the operative site**
- **Holmium:YAG laser is a safe and effective laser for benign and malignant ENT conditions**

There were no reported complications following the benign procedures. There appeared to be no improvement in post-operative pain levels, however, following palatine tonsillectomy.

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The holmium:YAG laser offers significant advantages when treating lingual tonsil disease, since the flexible nature of the laser fibre and handpiece allow improved access to this difficult area. This laser provides excellent haemostasis, enabling surgery in this challenging area to be relatively safe and straightforward.

The most significant complication observed was the development of a pharyngo-cutaneous fistula following laser excision of a lateral pharyngeal wall cancer and neck dissection. This occurred in a patient who had undergone previous radiotherapy to the neck, resulting in impaired healing. As a result of this event, our department changed its protocol such that post-radiotherapy patients with similar lesions were instead treated with a two-stage procedure, involving laser excision of the pharyngeal wall lesion, two weeks' healing and then neck dissection.

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Mr J Joseph takes responsibility for the integrity of the content of the paper.
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