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Use of CO₂ Laser in Head and Neck Surgery: NHS Grampian Experience

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Letter to Editor

There has been an increasing number of laser assisted surgical procedures in the Ear, Nose and Throat (ENT). Lasers have first been used in laryngeal surgery in 1972, when Strong and Jako reported the use of carbon dioxide laser (CO₂) in the human larynx [1]. Despite initial criticism, endoscopic laser treatments have achieved universal acceptance and been successfully used in Endo-laryngeal Micro Surgery (EMS) [2]. Most of the laser procedures involve either excision or tissue vaporisation, depending on the interaction between the wavelength (λ) and the chromophores of the tissue. For years, the CO₂ ($\lambda=10$ mm) seemed to be the preferred laser for transoral laser microsurgery due to its precise cut [3], given that it is better absorbed by water. However, it has some limitations, such as difficulty in the management of deep and curved areas. In addition, it has short penetration in tissues (0.1-0.3 mm on average), which reduces effective sealing of vessels.

Methods

In our institution, we have been using CO₂ laser since 2005. We have conducted a retrospective review of our CO₂ laser use in head and neck surgery. The primary aim of this exercise has been to assess frequency of laser use and the indications of laser use to identify training demands and scope of future expansion of the service.

Results

A total of 654 (age $\pm$ STD, 62 $\pm$ 14 years; M:F, 1.1:1) head and neck procedures using CO₂ laser were performed between 2005 to 2017 (Figure 1). Overall there has been a decrease in the number of laser-assisted procedures performed in our center. An increase in laser use from year 2015 onward is observed after appointment of a new consultant with special interest in laser laryngeal work (Figure 2). The most common procedures performed included microlaryngoscopy with biopsy, cordotomy, transoral pharyngeal diverticulotomy and cricopharyngeal bar division. The CO₂ laser setting ranged between 2-15 watts in continuous mode. For oral, laryngeal and tracheal surgery, the setting is usually at 5-10 watts continuous mode. The setting was at 15 watts continuous mode for rhinophyma resurfacing. There were no major complications recorded and no adverse event such as airway fire was reported.

Discussion

In the last three decades, there has been a steady increase in CO₂ laser use in Ear, Nose and Throat (ENT) operations. The list of laser-assisted ENT procedures continues to grow. This ranged from turbinoplasty [4] and rhinophyma [5] therapy for the nose to stapedotomy [6] in the ear to transoral laser resection of the tongue and upper aerodigestive tract [7-10] pathologies. Transoral CO₂ Laser Microsurgery (TLM) has been the treatment of choice for early glottis carcinoma based on the national guidelines published in UK [11] (T1a/b and T2) and Holland [12] (T1a mid cord lesion). This has helped to reduce variation in practice and improve survival [11]. In other countries, more extended glottis tumours have been treated with TLM with good outcomes [13-15]. The advantage for TLM is that this can be carried out at Day Surgical Unit with short hospitalization, less morbidity to patient compared to radiotherapy, earlier recovery, reasonable voice quality and swallow with cost saving to the healthcare system. In addition to TLM as primary treatment in head and neck cancers, it is also a treatment option for cancer recurrence with better outcome and less morbidity [16,17]. Van Loon et al. had looked at treatment preferences and considerations of patients with early glottis carcinoma (T1-2). In their study, patients were given a choice between TLM and radiotherapy. Of 175 patients, 96% of their patients had chosen TLM due to shorter treatment and more treatment modality options in case of tumour recurrence [18]. McNeil et al.,

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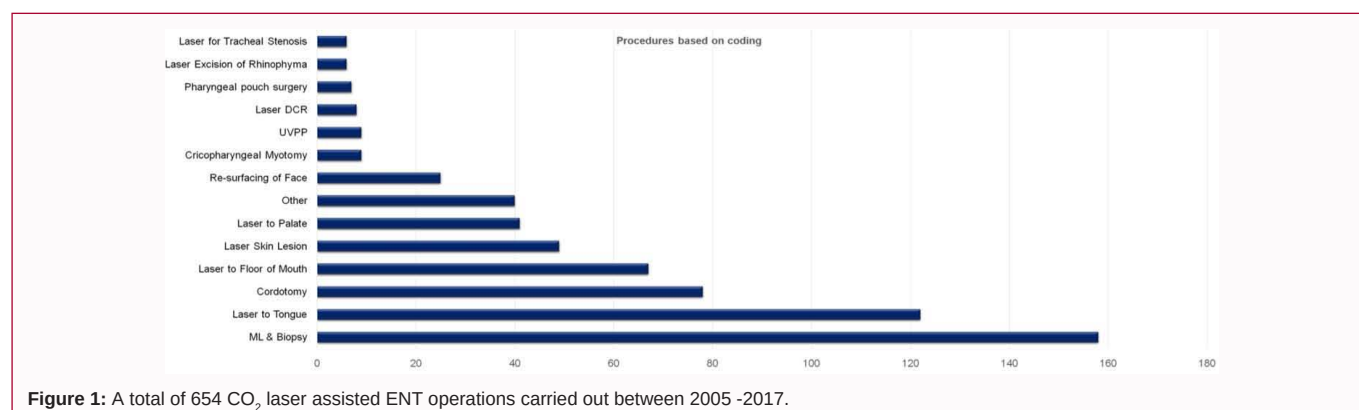


Figure 1: A total of 654 CO₂ laser assisted ENT operations carried out between 2005 -2017.

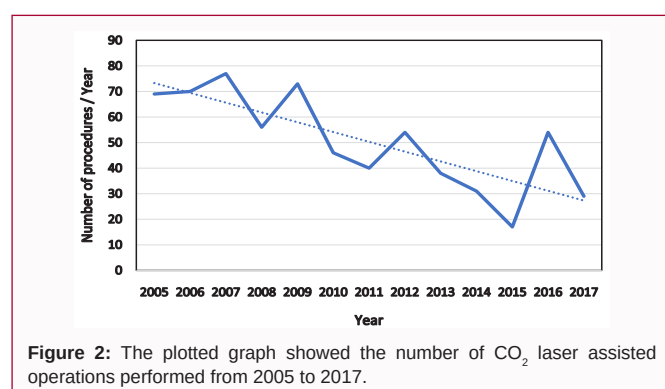


Figure 2: The plotted graph showed the number of CO₂ laser assisted operations performed from 2005 to 2017.

reported all of their 64 patients chose CO₂ laser resection as opposed to radiation therapy for definitive treatment for their early-stage glottis cancer despite the controversial issue of voice outcome [19]. In view of this, patients' treatment decisions should incorporate patients' personal values and preference and not based solely on the clinicians' recommendation, which in turn may be based on medical factors and not on patients' personal views of the relative advantages and disadvantages of treatment options. Several potential complications have been reported with the use of the CO₂ laser in the upper aerodigestive tract. These include intraoperative airway fire, early and late postoperative sequelae that require intensive medical treatment, blood transfusion and or revision surgery. Leibowitz studied the effects of CO₂ laser radiation on the cornea in an animal model in 1969. The potential for serious injury was directly related to the amount of power output (power density) or exposure time (radiant exposure) of the laser beam [20]. Strong warned of the possibility of endotracheal tube fire in 1972. Since then, there are numerous publications on laser safety. One such study published by Dhar et al., looked at impact of oxygen concentration and laser power on occurrence of intraluminal fires during shared-airway surgery. They have recommended surgical patties should always be soaked and should be used for relatively short periods, in order to prevent drying. Prolonged laser use at high power settings and ventilation with 100% oxygen should be avoided [21]. Therefore, precautions on laser safety are necessary when performing CO₂ laser surgery of the upper aerodigestive tract. It is also mandatory for all staffs operating the laser and the laser controller in theatre should have the required training and revalidation of their training periodically to ensure all laser safety regulations and checks are carried out for safe lasers deployment. To conclude, we are using the CO₂ laser regularly for head and neck procedures with excellent safety record. There has been a steady increase in laser laryngeal surgery in our department

over recent years. However, there is a huge potential to expand our service. In future this data will help us to redesign our head and neck service expanding our capability to offer full spectrum of endoscopic/microscopic trans-oral laser surgery for laryngeal cancers.

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