Carbon dioxide laser: A surgical modality in the treatment of oral leukoplakia

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Abstract

Introduction: The purpose of this study was to assess the clinical usefulness of carbon dioxide (CO\textsubscript{2}) laser as a surgical modality in the excision of oral leukoplakia.

Aims and Objectives: (1) Hemostasis intraoperatively, (2) post-operative inflammation, healing, short-term recurrences if any.

Materials and Methods: A total of 23 patients with oral leukoplakia were included in this study; Surgical CO\textsubscript{2} laser unit with power output between 0.5 and 15 W and focal length of 12.5 cm was used in this study.

Results: Minimal intraoperative bleeding was seen. All patients had complete epithelization by 5 weeks and the ones who took longer than 3 weeks for epithelization to complete, had lesions >4 cm. Slight contraction of the wound was seen at three months. Mouth opening was not restricted during followed up period. There was no short-term recurrence observed in any of the patients within the regular followed up period.

Conclusion: CO\textsubscript{2} laser is an effective tool in the surgical treatment of oral leukoplakia and gives predictable results in the management of these lesions.

Introduction

In South East Asia, oral cancer accounts for 40% of all cancers. Among all the cancers,[1] oral cancer is the leading cause of mortality and morbidity in India and is also most commonly heralded by clinically definable potentially malignant disorders (PMDs). The World Health Organization divides PMDs into precancerous lesion and condition.[2,3]

The most common precancerous lesion in the mouth is leukoplakia, which was first reported by Schwimmer, in 1877, as a white plaque on the tongue.[4]

The frequency of carcinomatous changes in leukoplakia of the oral cavity has been found to vary between 2.2% and 17.5%. [5] While other studies have reported a 15-39% transformation change.

The lesion is more common in men between 3\textsuperscript{rd} and 6\textsuperscript{th} decades of life.[6,7] The incidence of leukoplakia is higher in males as compared to females; latter has a higher risk of developing oral malignancy.[3] Oral leukoplakia most commonly occurs on the buccal mucosa, lip vermilion, and gingivae. However, lesions involving the floor of the mouth have most chances toward malignant transformation. Leukoplakia has been known to precede oral squamous cell carcinoma (OSCC) by 5 years.[6,8] Prevention of malignant transformation of precancerous lesions is particularly important in view of poor prognosis of OSCC, a condition in which the patients’ survival rate, after being diagnosed is approximately 5 years.[9] Waldron and Shafer[9] demonstrated that nearly 20% of leukoplakia had some degrees of dysplasia, whereas 3% were frank carcinoma. Since leukoplakia is not morbid or lethal by itself and it may or may not transform into malignancy, the treatment of the same should have minimum side effects.

Use of conventional methods such as scalpel surgery, cryosurgery, and electrocoagulation causes scarring, contraction and can mask early signs of recurrence.[10] Laser surgery for oral mucosal lesion has been reported to have many advantages such as excellent hemostasis, precise cutting, and minimal damage to adjacent structures, and it is widely used in the treatment of red and white lesions.

Application of lasers in the field of dentistry was only realized by the 1980s, and the carbon dioxide (CO\textsubscript{2}) laser was the first to be used,[11] because of its remarkable cutting abilities and astonishingly, even after more than 3 decades, it still remains a suitable choice in intraoperative ablative surgeries.

The CO\textsubscript{2} laser creates coherent laser energy at the 10,600 nm wavelength (infrared spectrum) and does not have a particular
preferred chromophore of absorption. It shows good absorption by water (intracellular and extracellular). It generates rapid heating of target tissues and causes the cells to explode, creating a zone of tissue vaporization, and a surrounding zone of thermal damage, which hypothetically seals lymphatic and blood vessels, thereby providing good hemostasis, low post-operative inflammation. When used in the focused mode, it acts as an excisional instrument ensuring precise surgical margin with minimal char. This also helps in the accurate assessment of surgical margins. Furthermore, it can be used for surface ablation in defocused mode and also excellent patient acceptance and faster healing.[11]

The aim of this study was to assess the clinical usefulness of CO₂ laser in excising oral leukoplakia and to assess the rate of recurrence after the surgery.

Materials and Methods

This study was conducted on patients reporting to the Department of Oral and Maxillofacial Surgery, Bengaluru, Karnataka, India. A total of 23 patients with diagnosed leukoplakia were included in this study. Collection of data included general information such as name, age, sex, and address, medical history, personal history, and dental history was assessed; intraoral examination of soft tissue and routine blood investigation were carried out, histopathological diagnosis of the lesion, informed consent for voluntary participation in the study was obtained. Inclusion criteria: Patients between the age group of 18-60 years, systemically healthy subject, clinically and histopathologically diagnosed as leukoplakia, patients who are willing to voluntarily participate in our study. Exclusion criteria: Patients with underlying systemic diseases, in which the surgical procedure is absolutely contraindicated, differently abled and non-co-operative patients, patients with uncontrolled diabetes and hypertension, patients not willing to voluntarily participate in the study and who cannot come for follow-up. The equipment required for our study includes routine diagnostic and surgical instruments, surgical CO₂ laser unit with power output between 0.5 and 15 W and focal length of 12.5 cm, eye protective wear, plastic suction tips and high volume suction apparatus, and wooden spatula.

Procedure

For all patients, detailed history which included habit history was obtained, lesion was clinically examined, necessary investigations as per the department protocol for leukoplakia such as bleeding time, clotting time, random blood glucose and informed consent was obtained from the patients before the procedure. Patients underwent routine draping and head/facial preparation [Figure 1]. The procedure was conducted under local anesthesia using 2% lignocaine with adrenaline (1:80000). Once adequate anesthesia was achieved, surgical CO₂ laser unit with power output between 0.5 and 15 W and focal length of 12.5 cm was used [Figures 2 and 3]. Focal spot and penetration depth were adjusted by changing the power density of the machine. A focal spot (approximately 0.2 mm) for excision of the lesion with voltage in the range of 10-15 W in focused mode [Figures 4 and 5] was used. High volume suction was continuously used during the procedure to suck away the plume which arose. The patient was prescribed non-steroidal inflammatory drugs (NSAIDS) and antibiotics for five days postoperatively. The tissue was fixed...
with 10% formalin and was sent for histopathology examination. All patients were regularly followed up on 2nd, 7th, 14th, 30th day, 3rd and 6th month subsequently.

**Results**

Out of 23 patients, 2 had bilateral lesions were taken for excision with CO\textsubscript{2} laser. The age of the patients ranged from 32 to 72 years with male:female ratio being 10:1 [Graphs 1 and 2]. The mean age was 50.6 years; a history of tobacco usage was found in 21 patients, and the most common form of tobacco was smoking followed by use of smokeless tobacco with pan.

The most common site of the lesion was predominantly in the buccal mucosa in 12 patients followed by commissures in 5 patients, tongue in 3 patients, and vestibule in 3 patients [Graph 3]. The size of lesion was <2 cm in 10 out of 23 patients; the size of lesion was between 2 and 4 cm in 10 out of 23 patients; the size of lesion was >4 cm in 5 out of 23 patients [Graph 4]. 21 patients had lesions which were homogenous and in 2 out of 23 patients, the lesions were speckled [Graph 5]. The patients were followed up for 6-3 months with mean of 10.4 months. A fibrous clot was seen in the surgical site in about 2-3 days following surgery which was protective toward the raw granulating surface; no infection was reported during post-operative followed up period. All the patients were prescribed antibiotics and NSAIDS for 5 days, 21 patients did not need to use analgesics beyond the prescribed 5-day period, and those who used beyond the 5-day period had lesions >4 cm. All patients had complete epithelization by 5 weeks and the ones who took longer than 3 weeks for epithelization to complete had lesions >4 cm [Graph 6]. Slight contraction of the wound was seen at 3 months. Mouth opening was not restricted during followed up period. Patient satisfaction with the procedure was graded from very satisfied, averagely satisfied, and not satisfied. All patients were very satisfied with the procedure. There was no short-term recurrence observed in any of the patients within the regular followed up period [Figure 6].

**DISCUSSION**

Oral leukoplakia is a common PMD. The risk of developing malignancy at the lesion site is five times greater in patients with leukoplakia. Rates of malignant transformation for oral leukoplakia range from 0.1% to 17%,\textsuperscript{13} whereas the 5-year cumulative malignant transformation rate range from 1% to 14%\textsuperscript{13}.

Conservative treatment includes the use of antioxidants, beta-carotene, and other chemotherapeutic agents has been found to have a variable success rate of 50%, discontinuation of treatment lead to increase recurrence rate and undesirable side effects such as desquamation and erythema.

Conventional type of surgical treatment has been excision by scalpel and cryosurgery. The recurrence rate for excision range from 10% to 34%\textsuperscript{14} and for cryosurgery range from 12% to 25%\textsuperscript{15-17}. These modalities, lead to scarring; contraction and can mimic early signs of recurrence.\textsuperscript{18} This study used CO\textsubscript{2} laser with wavelength of 10.6 µm as a surgical modality for excision. In this study, 5 out of 23 patients had lesions which were more than
4 cm in greatest dimension. Managing such lesions is challenge as the large raw surface tends to get infected and healing by secondary intention leads to scar formation and hypomobility of the area. Four patients who were known diabetics also had satisfactory healing as compared to other patients. None of the patients reported with infection during the post-operative followed up period, and no grafting was carried out in any of the cases.

Wound healing after laser surgery is excellent, because of the limited contraction,[19] using laser as a modality for excision of a white patch has many advantages for both the surgeon and the patient. Laser excised lesions have considerably lesser blood loss and hence sealing of lymphatics and blood vessels by the laser helped to explain minimal inflammatory response around the operative field and less post-operative pain. Literature suggests that wounds after laser excision exhibit histological features that offer advantages such as reduced number of myofibroblasts, which leads to minimal degree of wound contraction. In this study, we assessed the outcome of using this modality, and we found that healing was satisfactory, and they had minimal fibrosis, which meant a better quality of life for the patient.

The primary disadvantage with laser is radiation hazards to the patients, surgeon, and operating team from inadvertent exposure. These accidents may result in severe accident/occupational hazard such as laser skin burns, retinal damage, and blindness, other disadvantages are high expense of laser equipment, its service fees.

**Conclusion**

In our study, surgical excision of oral leukoplakia was done using CO₂ laser. We found CO₂ laser to be a versatile tool and very effective for the management of PMDs. We encountered a near bloodless operating field giving the surgeon an almost ideal operating field, good patient compliance, minimum edema after the procedure and precise cutting ability. None of the treated patients reported with infection; there were minimal scarring and no short-term recurrences observed in followed up period.
Hence, we conclude that CO2 laser can be used effectively for the management of oral leukoplakia with predictable results with minimal morbidity. However, longer duration of follow-up and larger sample size are needed to assess the rate of recurrences and malignant transformation of lesions. Hence, the study is still under progress in our department for further research.

Acknowledgment

We would like to thank Dr. Madhura MG, Reader in the Department of Oral and Maxillofacial Pathology, D.A.P.M.R.V. Dental College, for the scientific and technical inputs.

References

