Comparison of Efficacy of Carbon Dioxide (CO₂) Laser with Cutting Diathermy in Surgical Excision of Early Carcinoma Tongue

Muhammad Rashid, Muhammad Ali Hashmi, Shahzad Maqbool and Majid Dastigir

ABSTRACT
Objective: To compare the efficacy of carbon dioxide (CO₂) laser with cutting diathermy as a cutting device in surgical excision of early carcinoma tongue.
Study Design: Experimental study.
Place and Duration of Study: Combined Military Hospital (CMH), Rawalpindi and CMH, Lahore, from July 2008 to July 2011.
Methodology: Twenty two biopsy proven cases of T₁ and early T₂ squamous cell carcinoma of tongue were divided in two equal groups of 11 each labeled as A and B. Tumor was excised by CO₂ laser in group A while cutting diathermy was done in group B. For both groups tumor excision time, per-operative blood loss, postoperative oral swelling and pain was recorded. Excision time of tumor was assessed in minutes and amount of blood loss in milliliters till complete hemostasis after removal of primary tumor. Postoperatively patients were assessed on 12 hourly basis for 48 hours for pain. Pain was analyzed on visual analogue score 1 - 10. Oral swelling was assessed once after 24 hours and labeled as mild, moderate and severe. Independent sample t-test was applied for analysis of excision time, postoperative pain and per-operative blood loss for both groups. Postoperative swelling was analyzed using Fisher’s exact test. P-value of < 0.05 was considered significant.
Results: The mean age at diagnosis in group A was 49.36 ± 5.27 years, while in group B patients had mean age of 50.73 ± 8.13 years. In group A, 4/11 (36.3%) patients were having tumor stage T₁ while 7/11 (63.6%) had T₂ stage tumor. In group B, 5/11 (45.4%) were having T₁ and 6/11 (54.5%) were having stage T₂ tumor. Excision time was significantly shorter for group B (p=0.003), but group A had less postoperative pain (p=0.001), less per-operative blood loss (p=0.001) and less postoperative oral swelling (p=0.021).
Conclusion: Early carcinoma tongue is better removed by laser than electrocautery in terms of postoperative morbidity, per-operative blood loss, postoperative pain and oral swelling.
Key Words: Carcinoma tongue. Carbon dioxide (CO₂) laser. Cutting diathermy.
specimen margins may be difficult for pathologists to interpret.\textsuperscript{8} Strong et al. successfully introduced the use of CO\textsubscript{2} laser for transoral resection of localized oral cavity and oropharyngeal malignancies.\textsuperscript{9}

Several laser systems, such as the diode, ruby, Ho:YAG (Holmium yttrium aluminum garnet), Er:YAG (Erbium yttrium aluminum garnet), Nd:YAG (Neodymium-doped yttrium aluminum garnet), and yellow light lasers, as well as dye lasers for photodynamic therapy are being used in various diseases. However, the argon and CO\textsubscript{2} lasers were the first laser systems to be clinically used in otorhinolaryngology. The CO\textsubscript{2} laser currently has an important role in otorhinolaryngology, predominantly in the treatment of carcinomas of the upper aero digestive tract. The advantages of CO\textsubscript{2} laser surgery over conventional surgical methods have been well documented, including rapid tissue destruction, less bleeding, precise excision, and minimal damage to the surrounding normal tissue. Besides low morbidity and good functional preservation, the local control rate is the most direct measure of the success of transoral surgery.\textsuperscript{10}

The aim of this study was to compare the efficacy of CO\textsubscript{2} laser and cutting diathermy in excision of primary tumor of early carcinoma of tongue (T\textsubscript{1} and T\textsubscript{2} stages as per American Association of Otolaryngology), regarding the excision time, amount of blood loss, postoperative pain and oral swelling in two groups.

**METHODOLOGY**

It was an experimental study conducted at the Department of ENT, Combined Military Hospital, Rawalpindi and Lahore, between July 2008 till July 2011. All diagnosed patients of squamous cell carcinoma of anterior two-third of tongue in stage T\textsubscript{1} and early T\textsubscript{2}, of either gender, who consented to participate in the study, were included. Informed consent was taken on a specially designed proforma explaining the protocol of the study. All of the patients were clinically and pathologically staged using the American Joint Committee on Cancer system.

Patients had the right to withdraw from the study at any time. As institutional policy, anonymity and confidentiality of the participants and the collected data was ensured. Study was approved by the Hospital Ethical Committee. Criteria of having previously untreated, biopsy-proven, resectable (based on both disease extent and acceptable exposure) primary tongue carcinoma of mobile tongue without distant metastasis and who desired surgery as a primary modality of treatment. Exclusion criteria was patients treated earlier with primary chemotherapy or radiation, tumor stage more than T\textsubscript{2}, involvement of base of tongue and presence of distant metastasis. Patients with co-morbid conditions like diabetes, hypertension or those using anticoagulants were also excluded from study.

The patients were divided by convenient random sampling in two groups of 11 each labeled as A and B. Group A patients were operated upon by CO\textsubscript{2} laser for excision of primary tumor while in group B patients were operated by cutting diathermy.

General anesthesia with nasal endotracheal intubation was used in all cases. The eyes and other regions unrelated to the operation were covered with wet gauze to prevent CO\textsubscript{2} laser injury. The tongue was retracted with an Allis clamp on the tip to reveal the lesions. A monopolar coagulation-suction device was prepared for checking bleeders and aspirating smoke. The primary transoral resection was accomplished using a MD 40 Superpulse Laser Engineering Co., USA, with both straight and protected hand pieces under loupe magnification. After the primary resection, laser was mounted on Zeiss microscope with a 300-mm lens to see the left over margins. Excisions usually began from the anterior aspect of the tongue with a 1 - 2 cm safe margin.

Because only smaller vessels are contained in this area, heavy bleeding rarely occurred. The tumors could be excised relatively quickly with the laser at 18 - 25 watts of power, at a beam size of 1 - 1.5 mm, delivered in a continuous pulsed manner. If the main trunk of the lingual artery was exposed during the operation, it was always ligated with vicryl. The surgical wounds were not closed with sutures or grafts. Specimens were sent to the pathology department for examination in all patients. Operative time was measured in minutes from start of surgery till achievement of complete hemostasis after removal of primary tumor. Blood loss in two groups was assessed in milliliters.

Throat pain was monitored on 12-hourly basis for 48 hours. Pain was assessed postoperatively by using a 10 points “faces” Visual Analogue Score (1 = no pain and 10 = severe pain). Patients were asked to number the severity of pain from 1 to 10. Postoperative swelling of oral cavity was assessed once after 24 hours of surgery as mild, moderate and severe depending upon its extent to base of tongue and floor of mouth.

All the data was entered on a pre-designed proforma and analyzed using SPSS version 16. Independent sample t-test was applied for comparison of time, postoperative pain and per-operative blood loss in two groups, while postoperative swelling was analyzed using Fisher’s exact test. P-value of < 0.05 was considered significant.

**RESULTS**

The mean age at diagnosis in group A was 49.36 ± 5.27 years, while in group B patients had mean age of
Comparison of efficacy of carbon dioxide (CO₂) laser with cutting diathermy in surgical excision of early carcinoma tongue

Table I: Demographic data and tumor stage in two groups.

<table>
<thead>
<tr>
<th>Parameters</th>
<th>Group A (n=11)</th>
<th>Group B (n=11)</th>
<th>p-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age in years (mean ± SD)</td>
<td>49.36 ± 5.27</td>
<td>50.73 ± 8.13</td>
<td></td>
</tr>
<tr>
<td>Male / female</td>
<td>5/6</td>
<td>7/4</td>
<td></td>
</tr>
<tr>
<td>Tumor stage T₁</td>
<td>4/11 (36.3%)</td>
<td>5/11 (45.4%)</td>
<td></td>
</tr>
<tr>
<td>Tumor stage T₂</td>
<td>7/11 (63.4%)</td>
<td>6/11 (54.5%)</td>
<td></td>
</tr>
</tbody>
</table>

Table II: Comparison of two groups in terms of operation time, bleeding and postoperative pain at different intervals.

<table>
<thead>
<tr>
<th>Parameters</th>
<th>Group A Mean ± SD</th>
<th>Group B Mean ± SD</th>
<th>p-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Operation time</td>
<td>31.45 ± 4.9</td>
<td>24.9 ± 4.1</td>
<td>0.003</td>
</tr>
<tr>
<td>Per-operative bleeding</td>
<td>28.7 ± 9.2</td>
<td>52.9 ± 6.9</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>Postoperative pain at 12 hours</td>
<td>6.0 ± 0.6</td>
<td>7.18 ± 1.0</td>
<td>0.005</td>
</tr>
<tr>
<td>Postoperative pain at 24 hours</td>
<td>5.18 ± 0.4</td>
<td>6.27 ± 1.0</td>
<td>0.003</td>
</tr>
<tr>
<td>Postoperative pain at 36 hours</td>
<td>4.36 ± 0.5</td>
<td>5.45 ± 0.6</td>
<td>0.001</td>
</tr>
<tr>
<td>Postoperative pain at 48 hours</td>
<td>3.72 ± 0.6</td>
<td>5.36 ± 0.5</td>
<td>0.001</td>
</tr>
</tbody>
</table>

Figure 1: Postoperative pain measures as VAS 1 - 10 in two groups.

presentation 50.73 ± 8.13 years without any significance (p=0.64). In group A, there were 5 (45.4%) female and 6 (54.5%) male patients. In group B, there were 7 (63.6%) male and 4 (36.6%) female patients. In group A, 4/11 (36.3%) patients were having tumor stage T₁ while 7/11 (63.6%) had T₂ stage tumor. In group B, 5/11 (45.4%) were having T₁ and 6/11 (54.5%) were having stage T₂ tumor. Mean excision time was shorter (24.9 ± 4.18 minutes) in group B, patients where tumor was excised with cutting diathermy while it was 31.45 ± 4.91 minutes in group A where CO₂ laser was used for excision of primary tumor (p=0.003). Per-operative blood loss was less in patients operated upon by CO₂ laser than the cutting diathermy group. Mean blood loss in group A was 28.7 ± 9.2 ml while it was 52.9 ± 6.9 ml in group B (p < 0.001). Postoperative pain was 1.3 times less in patients operated upon by CO₂ laser than in the diathermy group (p=0.005). Similarly, postoperative swelling was less marked in patients operated upon by CO₂ laser than the diathermy group. In group A, 7/11 (63.63%) patients had a mild, 2/11 (18.1%) moderate and 2/11 (18.1%) had severe swelling of the oral cavity postoperatively. In group B, 1/11 (9%) had mild, 4/11 (36.36%) had moderate and 6/11 (54.54%) patients had severe oral swelling postoperatively (p=0.042). This shows that postoperatively patients in group B were having more cases of moderate to severe swelling.

DISCUSSION

There are different treatment options for head and neck squamous cell carcinoma including tongue carcinoma ranging from surgical excision, radiotherapy, chemotherapy and combination of both. However, every treatment affects not only the aesthetics but also compromise the functions of speech and swallowing. Different surgical tools being used for resection of primary tumor of tongue are knife, diathermy, laser, radiofrequency ablation and harmonic scalpel.

Tongue being a multifunction organ, optimum structural and functional integrity of this muscular organ of the human body is vital for the life of the suffering patients. The speech, swallowing and breathing is affected with integrity of the reconstructed tongue muscles after surgical resection.¹¹ The word LASER is an acronym for Light Amplification by Stimulated Emission of Radiation. Since 1960, lasers as surgical tools have evolved and now play an important role in the diagnosis and treatment of oral cancer. Laser treatment is more precise, decreases the chances of infection, and reduces healing time, bleeding, swelling, and scarring.⁹ Several laser systems have been used for treating various diseases. However, the Argon and CO₂ lasers were the first laser systems to be clinically used in the treatment of otorhinolaryngology. Strong and Jako introduced the CO₂ laser into microsurgery of the larynx in the early 1970s. The CO₂ laser was increasingly utilized in the 1980s in the treatment of benign lesions of the larynx, especially recurrent laryngeal papillomatosis. However, lasers were accepted more slowly in the treatment of head and neck malignancies.¹⁰ The CO₂ laser currently has the greatest significance in otorhinolaryngology; predominantly in the treatment of carcinomas of the upper aero digestive tract. The advantages of CO₂ laser for intraoral excision have been well documented, such as precise tissue dissection without nuisance oozing, minimal postoperative edema, and no need for sutures or skin grafts. Furthermore, the morbidity is relatively lower and hospital stay is shorter for patients. Panje et al. also reported that transoral CO₂ laser ablation for oral and oropharyngeal lesions can preserve excellent oropharyngeal functions for the patients.¹² Several articles have reported the long-term results of transoral CO₂ laser resection of tongue cancers. In addition to the low morbidity and good functional preservation, the local control rate is the most direct measure of the success of transoral surgery for tongue cancer.

The thermal damage zone with CO₂ laser is shallow: less than 500 µm. Therefore, it is a comparatively poor...
haemostatic, not being effective in controlling bleeding from vessels greater than 0.5 mm in diameter. It is not fibre-transmissible through the common silica optical fibre, although flexible guides are available with limited flexibility for delivery. Its use on the cords is well proven with advantages of minimal scarring and preservation of vocal function. It causes a minimal inflammatory reaction, and glottic competency is rarely jeopardized, even after extensive application.1

Its advantage on reduced postoperative edema, pain and inflammation is said to be because of formation of less necrotic tissue, sealing of small lymphatics and vessels, reduced inflammatory response and scarring.13 Animal study has also proved that when operated by CO₂ laser than scalpel it reduces postoperative edema and early wound healing.14

Laser application has its own limitation besides its cost as it should be used with certain anesthetic protocol and personal protection measures. Anesthesia protocol revolves around rapid evacuation of plum produced, prevention of combustion by using wet swabs, reflective wrapping of endotracheal tubes and use of jet ventilation anesthesia with intermittent apneic technique. All operation theater staff has to use special glasses for protection of eyes. Risk of combustion is also less in lasers that operate in a pulsed mode, as heat can dissipate between bursts.

Cutting diathermy on the other hand has the advantages of low cost, easy availability, easy handling and low maintenance, but causes extensive thermal damage to adjacent structure, accumulation of tissue debris at operation site, more tissue edema and delay healing of wound.

It was found that early lesions of carcinoma tongue were better removed by laser than electrocautery in terms of postoperative morbidity, perioperative blood loss, postoperative pain and oral swelling. However, excision time is less with electrocautery. The results of this study are supported by other studies as well.15-18 Speech intelligibility is also said to be better in patients operated by CO₂ laser as well as oncological acceptable clearance.19,20

Gottschilich also supported that laser excision is better in terms of low postoperative morbidity.21 Transoral laser excision is an innovative method for excision of squamous cell carcinoma of base of tongue with an improved approach in terms of survival and quality of life.17

However, some studies have shown that wound healing is delayed after laser surgery but it does not affect the functional outcome. The duration of wound healing after laser surgical tumor resection revealed a clear dependence on the size of the initial defect.22-24

**CONCLUSION**

The transoral CO₂ laser microsurgery is an efficient and advantageous modality for excision of cancer of the anterior two-thirds of the tongue, especially for stage I and II lesion. It has less postoperative morbidity as compared to cutting diathermy in the resection of primary early tumor of this region.

**REFERENCES**


