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ULTRASONIC COAGULATION DEVICE VS MONOPOLAR ELECTROCAUTERY IN RESECTION OF TUMORS OF TONGUE – A RANDOMISED CONTROL TRIAL

Oncology

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ABSTRACT

Background: Although oral cancerous lesions are curable with surgical involvement, certain values necessitate the development of newer techniques and newer equipment to promote the prognosis of the patient towards the long-term survival and quality of life. **Methods:** Forty adult tongue cancer patients with advanced cancer staging from TNM stage 1 and 2, requiring surgical removal are included in this study and randomly alloted into two groups. Group 1 undergoing excision with electrodiathermy and Group 2 undergoing excision with ultrasonic coagulation device. **Results:** Mean duration in Monopolar cautery is 13.6 minutes whereas in ultrasonic coagulation device is 8.9 minutes. Mean blood loss in Monopolar cautery is 160ml and blood loss in ultrasonic coagulation device is 97ml. **Conclusion:** Patients who underwent excision with ultrasonic coagulation device had wider margins and short duration of surgery when compared to monopolar cautery. Simultaneous hemostasis and cutting are achieved with ultrasonic coagulation device – reduction in duration for primary tumor excision.

KEYWORDS

Ultrasonic Coagulation Device, Monopolar Electrocautery, Blood Loss, Oral Squamous Cell Carcinoma

INTRODUCTION:

Oral Squamous Cell Carcinoma (OSCC) is among top ten most prevalent malignancies affecting patients worldwide[1]. OSCC accounts for over 200000 cases a year worldwide reported and one third of the cancer cases are from India[2-3]. Glossectomy is always the treatment of choice for carcinoma of the tongue with satisfactory local control[4]. Though primary treatment for carcinoma of tongue is surgical removal, various surgical aids have been used in primary tumour resection. Steel scalpel, cold steel scissors, monopolar and bipolar electrodiathermy, laser and ultrasonic coagulation devices has been used in its surgical removal.[5] Each device has its own advantages and potential drawbacks.

Although there have been studies on blood loss, post operative pain and wound healing there is little literature regarding the time taken for surgery, histopathological margins and intraoperative blood loss which probably impacts the treatment time and treatment outcome.

The purpose of this study is to evaluate and compare the histological margin status, blood loss and duration of surgery in patients treated with ultrasonic coagulation device and electrodiathermy for the resection of tumors of tongue.

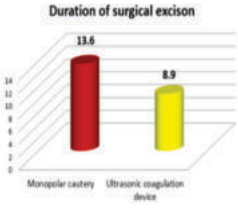
The concept of 'ultracision' revolves around using an electrical current applied to a set of linked pairs of negatively charged, ferroelectric, ceramic, disc-shaped crystals within a transducer. This process generates a well-balanced sinusoidal (or harmonic) ultrasonic waveform with high electroacoustic efficiency. When a metallic rod is connected to this device, the wave motion is transformed into high-frequency mechanical motion at the blade's tip situated at the end of the rod. This blade can then be used to cut and coagulate tissue simultaneously, offering precise and controlled surgical capabilities.[7]

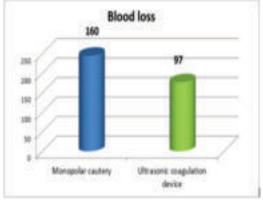
Subjects and Methods:

A sample size of 40 patients diagnosed as squamous cell carcinoma of tongue, who are previously untreated for squamous cell carcinoma of tongue and patient with Stage 1 and 2 (TNM Staging) of age group between 25 to 40 were included in this study. Patients with bleeding disorders and postradiotherapy and chemotherapy were excluded from this study. A gross margin of 1.5 to 2.0cm is taken for surgical removal. Two groups of Group 1 (20): patients undergoing excision with conventional electrodiathermy and Group 2(20): Patients undergoing excision with ultrasonic coagulation device were randomly divided and the procedure was carried out. Evaluation of surgical time, surgical bleeding and histopathological margins has been carried out. Surgical time evaluation is from the beginning of the incision to excision of tumour. Surgical bleeding is by total volume of drainage in suction canister and weight of the sponges used (subtracting the dry weight of the mop and any irrigants used) using the conversion of 1g=1ml. Histopathological margins is by excised specimens was tagged at cut margins, fixed in 10% formalin and was sent for histopathological examination. 20 patients of group 1 will undergo excision with monopolar electrodiathermy adjusted at 40 W power using a standard tip. 20 patients in group 2 will undergo excision with ultrasonic coagulation device. Obtained samples were sent to lab diagnostic for histopathological examination. The obtained results were tabulated and sent to statistical analysis.

Statistical Analysis:

Statistical analysis was done by SPSS Software version 20.0 MS Excel 2019. Descriptive data was tabulated and also graphically represented. Unpaired t– test was performed to assess the difference b/w two groups $p<0.05$ was considered to be statistically significant.





The difference is statistically significant with a p value of 0.000
The difference is not statistically significant with a p value of 0.05

Tabular representation of obtained

Margins	Groups	Mean	Standard deviation	t-value	p-value
Anterior	Monopolar cautery	1.1740	.42802	-5.667	.000*
	Ultrasonic coagulation device	2.0420	.22675		
Posterior	Monopolar cautery	1.2000	.35277	-2.154	.045*
	Ultrasonic coagulation device	1.5780	.42848		
Lateral	Monopolar cautery	1.6500	.34075	-5.558	.000*
	Ultrasonic coagulation device	2.5700	.39735		
Deep	Monopolar cautery	.9420	.19742	-3.558	.002*
	Ultrasonic coagulation device	1.3060	.25635		

RESULTS

**p<0.05 is considered as statistically significant*

Results showed that duration of the surgical excision shows there is a statistical difference with a *p*- Value of 0.000. Blood loss of the patient shows no statistical difference.

DISCUSSION

Tongue is the most sensitive part in the oral cavity with torturous blood course and highly vascularized. Even experienced hands, bleeding from lingual vessels is unavoidable[8]. Glossectomy either partial or complete is the treatment of choice in treating the primary cancerous lesions. Localized tumour control is satisfactory with glossectomy[4,9,10]. Introduction of newer materials and recent advances in surgical arena made the improvisation of treatment procedures and decreased blood loss. One of the newer advances in surgical field is ultrasonic coagulation device which works on the application of an electrical current across a series of coupled pairs of negatively charged, ferroelectric, ceramic, disc-shaped crystals in a transducer to produce a balanced sinusoidal (or harmonic) ultrasonic wave form of high electroacoustic efficiency[7]. This device dissects by using ultrasonic vibrations of around 55,000 Hz transmitted between the instrument blades[11]. The active blade of the instrument vibrates longitudinally against an inactive blade over an excursion of 50 to 100 mm by disrupting tertiary hydrogen bonds within the tissue. This takes place at a relatively low temperature (80 °C), causing less tissue injury than the other adopted techniques[12,13].

The ultrasonic device cuts the tissue layer with efficient hemostasis providing less tissue damage. Since the water content within the tissue does not reach its boiling point, the moderate temperature increases results in the denaturation of proteoglycans and collagen fibres within the tissues. These denatured elements combine with intracellular and interstitial fluids to create a cohesive, glue-like substance referred to as a coagulum[14]. The instrument's shaft maintains a relatively cool temperature, and there is no electrical conduction through the handpiece[7]. This feature helps minimize the risk of unintended injury to nearby structures like the lingual nerve, hypoglossal nerve, or the normal mucosal margin during a hemiglossectomy procedure.

The advantage of achieving both hemostasis (the control of bleeding) and cutting simultaneously is that it allows for a seamless surgical procedure without the need for interruptions to address bleeding issues, even when clear margins are desired, leading to a bloodless surgical field. Oral cancerous lesions can be treated surgically, but in order to improve the patient's prognosis and quality of life over the long term, newer methods and tools must be developed[15].

Figure 1. Post-Op UCD Image

On the other hand, monopolar electrodiathermy functions by administering alternating electrical currents with varying frequencies to the patient's tissue. These electrical currents are absorbed by molecules in the tissue, resulting in a substantial increase in tissue temperature, typically reaching temperatures ranging from 300 to 400 °C. Depending on the settings and how the device is applied, this heating process can lead to tissue disruption through either boiling or coagulation. However, this heat-based mechanism of action is associated with a relatively large zone of tissue injury near the surgical incision site[16].

In our study, patients who underwent resection using an ultrasound coagulation device had broader margins and a shorter surgical duration compared to those treated with conventional electrodiathermy. This may be due to the reduced zone of tissue trauma and clearer assessment of the tumour-free margin[6].

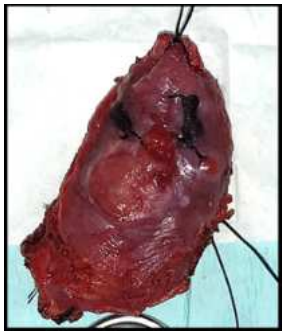


Figure. 2 Excised Lateral tongue

Surgical resections were performed significantly sooner with ultrasonic coagulation device in comparison with electrodiathermy. Simultaneous haemostasis and cutting are achieved with ultrasonic coagulation device explaining the reduction in duration for the primary tumour excision.

While the ultrasonic scalpel is effective in controlling bleeding from lingual vessels with a diameter of 2 to 3 mm[17,18], there is a risk of bleeding if the lingual artery is partially gripped and tears before being completely sealed. In such instances, the vessel should be grasped in a cross-sectional manner, and sufficient time should be allowed for it to seal. Some authors recommend ligating the lingual artery when it becomes visible during the dissection[19].

Ultrasonic coagulation device has been cost effective, and annual maintenance of the equipment is also high compared to that of monopolar cautery. Nevertheless, when considering various aspects, including the consumables used, operative time, and staff time cost, the utilization of an ultrasonic scalpel for glossectomy is warranted and justifiable[8].

Shorter sample size and limited use of the devices has been the limitations of the study. Further studies have to be conducted regarding the post operative healing and pain assessment of the tissues underwent for the treatment.

CONCLUSION

The current study's findings suggest that patients who underwent excision with an ultrasonic coagulation device experienced broader margins and shorter surgical durations when compared to those treated with monopolar cautery. The ultrasonic coagulation device allows for simultaneous hemostasis and cutting, resulting in a reduction in the time required for primary tumor excision. This technique also leads to a reduced zone of tissue trauma and enables a clearer assessment of tumor-free margins, ultimately resulting in wider margins for those who underwent resection with the ultrasonic coagulation device.

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