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A Prospective Observational Study of Harmonic Scalpel and Electrocautery in Modified Radical Mastectomy

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Abstract Modified Radical Mastectomy (MRM) is a standard surgical procedure for operable breast cancer. Surgical tools like the harmonic scalpel and electrocautery are routinely used for dissection and haemostasis. This study aims to study the intraoperative and postoperative outcomes of these two modalities.

Methods: In this prospective observational study, patients undergoing MRM were divided into two groups based on the dissection method used: harmonic scalpel (Group A) and electrocautery (Group B). Intraoperative parameters including operative time and blood loss were recorded. Postoperative outcomes such as drain output, seroma formation, wound complications, and duration of hospital stay were analysed.

Results: Preliminary analysis showed that the harmonic scalpel group had significantly reduced blood loss but required more operative time. Postoperative drain output, seroma incidence and wound-related complications were also favourably reduced in the harmonic scalpel group compared to electrocautery.

Conclusion: The harmonic scalpel appears to be a superior tool in MRM with better intraoperative efficiency and improved postoperative outcomes. Its use may contribute to enhanced recovery and reduced morbidity in breast cancer surgery.

Keywords: Harmonic scalpel, electrocautery, modified radical mastectomy, breast cancer surgery, seroma, postoperative outcomes.

Introduction

Breast cancer is the most frequent cancer among women accounting for 21.8% of the total cancer burden in women as measured by DALYs (ICMR-NCDIR). Modified Radical Mastectomy (MRM) is a standard surgical procedure used for operable breast cancer in this study from stage 1A to stage 3A. MRM entails removal of entire breast tissue, pectoralis fascia, nipple-areolar complex and overlying skin with axillary dissection (level I,II,III lymph nodes).

In this study, patients undergoing MRM were divided into two groups based on the dissection method used: harmonic scalpel (Group A) and electrocautery (Group B).). Intraoperative parameters including operative time and blood loss were recorded. Postoperative outcomes such as drain output, seroma formation, required drain days, wound complications such as suture site infection, flap necrosis and cuticular necrosis and duration of hospital stay were analysed.

Monopolar cautery is the most common surgical instrument used for dissection with an additional benefit of haemostasis. Electrocautery significantly reduces blood loss compared with conventional scalpel use. Electrocautery performs its action by converting electric current into thermal energy. Blend mode (cut + coagulation) is used at 40-50 W. It is reduced to 15-30 W during axillary dissection. Use of electrocautery causes thermal tissue damage in the skin flaps, leading to local inflammatory reaction, subdermal vascular plexus disruption, and incomplete lymphatic and vascular occlusion due to its lateral thermal spread of 3.5mm.

Harmonic scalpel uses ultrasonic vibrations of frequency around 55,000 Hz and converts into mechanical energy to cut and coagulate tissue during surgery providing precision and controlled tissue dissection. The settings used for MRM are of amplitude 4-5 for cutting and dissection and 2-3 for axillary dissection.

Ultrasonic wave technology enables blood vessels less than 5 mm in diameter to be sealed in the coagulation mode and has the ability to dissect and create flaps with minimal extensive thermal damage that will not exceed 1.5 mm, resulting significant decrease in blood loss, cuticular necrosis and seroma formation.

Compared with electrocautery, harmonic dissection has several advantages, including less scar formation compared with blades, the narrow circumference of collateral thermal damage to encircling tissue, the lack of smoke (although there is a transient mist), the lack of injury or excitement to motor nerves in the axilla, and the ability to utilize the technique in patients with pacemakers.

The aim of this study was to evaluate the aspects of the harmonic scalpel and electrocautery in MRM such as Intraoperative blood loss, operative time, Post-operative drain output, Post-operative complications such as seroma formation, suture site infection, cuticular necrosis and flap necrosis.

Materials and Methods

Type of study: This study was designed as a prospective observational study

Study setting and period: Department of General Surgery of a Tertiary care hospital and teaching institute in Maharashtra, India from January 2023 to July 2025.

Study participants: The study was conducted among patients who were biopsy proven cases of operable carcinoma of breast in a tertiary care hospital and teaching institute.

- Sample size analysed was 21 each with harmonic and electrocautery.

- Follow up was taken at 0,1,6 months following postop.

Inclusion criteria

1. All biopsy proven and operative cases under General Surgery department.
2. Stage 1A to 3A breast carcinoma
3. Patients willing to give consent
4. Patients not willing for Concurrent Chemoradiotherapy (CRT)
5. Harmonic scalpel method can be used in patients with implanted metallic devices and electronic devices such as pacemakers

Exclusion criteria

1. Stage 3B and above
2. Pregnant patients
3. Bilateral breast carcinoma
4. Recurrence
5. previous radiation to chest wall

Pre-op evaluation

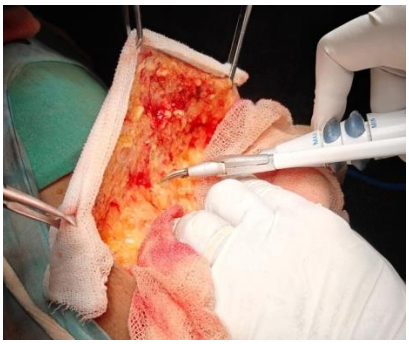
- Complete blood count, KFT, LFT
- HIV, HbsAg
- Coagulation profile
- Blood sugar levels
- Ultrasonography – bilateral breasts, bilateral axillae, abdomen and pelvis
- X-rays – skull with cervical spine AP and lateral, dorsolumbar spine AP and lateral, chest, abdomen, pelvis, PBH AP and lateral
- Fine Needle Aspiration Cytology
- Tru cut biopsy from breast lump

Methodology

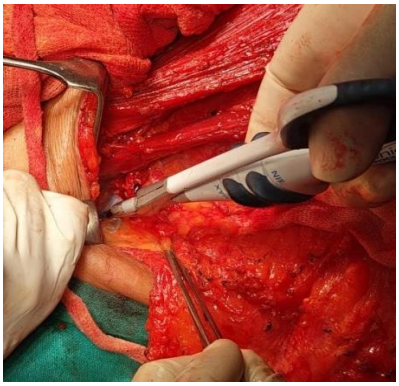
1. Ethical approval for Institutional Ethics Committee was obtained.
2. The present study was carried out in tertiary care teaching institute.
3. All patients fulfilling inclusion criteria were evaluated clinically, radiologically and pathologically.
4. Detailed history taking was done and if the patient fulfilled the inclusion criteria they were subjected to the study.
5. Preoperatively, fully informed consent was taken with explanation of risk.
6. Intraoperative and post-operative findings were noted and results were evaluated.
7. Follow up was taken post-operation, at 1 month and 3 months after data collection to note the complications.
8. The outcomes studied were – Operative time, blood loss during surgery, total drain output, number of days for drain, number of hospital stay days, complications.

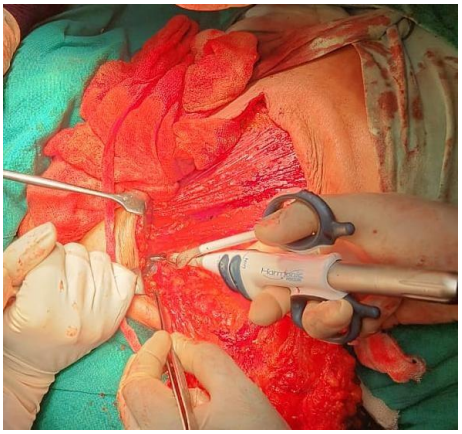
Operative images

Flap raising



Axillary dissection





Result and Outcome

Table 1: Patient and Tumour Characteristics

Parameter	Group A (Harmonic Scalpel)	Group B (Electrocautery)
Mean Age (years)	52.28 ± 12.39	48.52 ± 8.85
Commonest Age Group	41–50 yrs (47.62%)	41–50 yrs (52.38%)
Side of Tumour	Right: 61.90% Left: 38.10%	Right: 57.14% Left: 42.86%
Commonest Quadrant	UOQ (47.62%)	Central (57.14%)
TNM Stage Distribution	2A: 52.38% 2B: 33.33% 3A: 14.29%	1A: 4.76% 2A: 33.33% 2B: 19.04% 3A: 42.86%
Comorbidities	None: 57.14% HTN: 19.04% DM: 9.52% Hypothyroid: 9.52% Obesity: 14.29%	None: 52.38% HTN: 14.29% DM: 33.33% Hypothyroid: 4.76% Obesity: 0%

Table 2: Operative and Postoperative Outcomes

Parameter	Group A (Harmonic Scalpel)	Group B (Electrocautery)	p-value / Observation
Operative Time (min)	210.42 ± 10.15	157.76 ± 17.77	< 0.001 (↑ in A)
Blood Loss (ml)	40.57 ± 5.78	174.38 ± 18.72	< 0.001 (↓ in A)
Total Drain Output (ml)	338.09 ± 110.25	636.66 ± 278.41	< 0.001 (↓ in A)
Drain Duration (days)	7.47 ± 1.66	12.33 ± 3.65	< 0.001 (↓ in A)

Parameter	Group A (Harmonic Scalpel)	Group B (Electrocautery)	p-value / Observation
Average Daily Drain Output (ml)	44.3 ± 6.54	50.2 ± 10.8	0.039 (↓ in A)
Complications	SSI: 9.52% Flap necrosis: 4.76% Seroma: 0% Cuticular necrosis: 0%	SSI: 28.57% Flap necrosis: 14.29% Seroma: 9.52% Cuticular necrosis: 9.52%	Higher in B
Hospital Stay (days)	4.90 ± 4.72	9.76 ± 9.80	0.047 (↓ in A)

Post-operative images

Suture site

Cuticular necrosis

Flap necrosis

Suture site infection

For flap necrosis and suture site infection, debridement and daily cleaning and dressing was done along with antibiotics. After healthy granulation tissue, split skin grafting was done. Total hospital stay was recorded.

Discussion

This prospective observational study compared harmonic scalpel (Group A) and electrocautery (Group B) in 42 patients undergoing modified radical mastectomy (MRM). The mean age in our study was comparable to other literature, with most patients in the 41–50 age group, aligning with findings by Shrestha D et al. and Haval S et al.

Right-sided tumours predominated (59.5%), consistent with previous findings by Pabri S et al., although some studies, like Zahid A et al., showed equal distribution.

Most patients presented with stage 2 disease, aligning with studies by Archana A et al. and Faisal M et al. Hypertension was the most common comorbidity in

Group A, while diabetes predominated in Group B, differing slightly from other studies where hypertension was more prevalent overall.

Operative time was significantly longer in the harmonic scalpel group ($p < 0.001$), as observed in several studies including Mittal P et al. However, harmonic scalpel significantly reduced blood loss, drain output, drain duration, and hospital stay, which is consistent with findings from Haval S et al., Faisal M et al., and Anandaravi BN et al.

Postoperative complications were fewer in the harmonic group, with surgical site infections (SSIs) and seroma being more common in the electrocautery group. This trend is in line with Mittal P et al. and Faisal M et al., although some studies reported seroma as the most common complication overall.

Overall, the harmonic scalpel demonstrated advantages in reducing intraoperative bleeding, postoperative drainage, hospital stay, and complications, supporting its potential as a preferred tool in MRM.

Conclusion

In summary, harmonic dissection leads to significant decreases in intraoperative blood loss, total drainage volume and postoperative discomfort. Additionally, harmonic dissection results in early drain removal, a decreased incidence of seroma formation, decreased incidence in flap necrosis and cuticular necrosis with a mild increase in the operative time. Because these are important postoperative care factors, we recommend the harmonic dissection technique for use in MRM.

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