

# A Comparison of Wound Complications and Post-operative Factors Following the Use of Hydrodissection for Mastectomy in Breast Cancer Patients

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## ABSTRACT

**INTRODUCTION:** Mastectomy with axillary clearance remains the hallmark of breast cancer treatment. The conventional use of electrocautery has been associated with the risk of post-operative complications. Hydrodissection may reduce surgery time and produce fewer wound complications with less post-operative pain. The aim of this study was to compare these 2 modalities. **MATERIALS & METHODS:** This prospective randomised control trial was performed with breast cancer patients in Hospital Selayang, Malaysia, between 1 June 2019 to 1 September 2020. The patients were randomised into conventional and hydrodissection groups. The outcomes of interest were post-operative wound complications and other post-operative factors. A chi-square test and independent Student *t*-test were used to compare the 2 groups. **RESULT:** A total of 94 patients were recruited. There was a significant reduction in post-operative seroma in the hydrodissection group compared to the conventional group (40.4 vs 19.1,  $p < 0.05$ ). The surgery in the hydrodissection group was also shorter (114.09 vs 100.15,  $p < 0.05$ ), and there was less 24-hour post-operative pain (3.28 vs 2.13,  $p < 0.05$ ). However, no significant association was observed with other post-operative wound complications (i.e. flap necrosis, surgical site infection and hematoma) or other post-operative factors (i.e. estimated blood loss, mean volume of drain and duration of drain). It was also demonstrated that the hydrodissection technique lowers the risk of developing seroma 3-fold (odds ratio=0.349,  $p < 0.05$ ). **CONCLUSION:** The use of hydrodissection with liposuction cannula reduced the rate of post-operative seroma and provided a shorter operative duration and better post-operative pain control.

## Keywords

Breast carcinoma, Hydrodissection, Tumescence, SSI, Seroma

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## INTRODUCTION

Breast cancer is one of the most common cancers among women in Malaysia and globally. In Malaysia, the overall lifetime risk is 1 in 27.<sup>1</sup> The hallmark of breast cancer treatment is surgery, and mastectomy with axillary clearance remains the most commonly performed surgery. Although there is an increased trend towards breast-conserving surgery, not all patients are suitable as it depends on the tumour size, patient's preference and adjuvant radiotherapy conditions.<sup>2</sup> The conventional technique of mastectomy often involves the use of electrocautery.<sup>3</sup> Studies have shown that the application of electrocautery provides a similar patient satisfaction outcome and reduced bleeding compared to scalpel dissection.<sup>3,4</sup> However, there are reports showing that it can cause significant damage to the surrounding tissue due to thermal injury. This tissue damage increases the risk of skin necrosis and may cause post-operative wound complications.<sup>5,6</sup> These complications can affect post-operative morbidity, require additional surgery and lead to prolonged wound care, poor aesthetic results, decreased patient satisfaction and, more importantly, delays in adjuvant treatment.<sup>7,8</sup> These surgical issues led to the development of an alternative approach. Hydrodissection is a technique in which a tumescent solution containing a crystalloid

solution and local anaesthetic with epinephrine is infused into subcutaneous and pre-pectoral tissue to create a bloodless plane for sharp dissection.<sup>9</sup> It was first described by Worland in 1996, who utilised the tumescent technique for mastectomy, and it has subsequently been applied for oncological and aesthetic purposes.<sup>10</sup> This technique aims to reduce the use of electrocautery and hence avoid thermal injury. It facilitates surgery by distending and enlarging the space between the subcutaneous and glandular tissue for sharp dissection following the oncoplastic plane while preserving the subdermal vascular plexus and achieving more even breast flaps.

Intraoperative blood loss is reduced due to the vasoconstrictive effects of adrenaline together with the hydrostatic effect of the large volume infusion tamponading the small blood vessels.<sup>10</sup> Studies have also shown that sharp dissection offers shorter operative times, leading to reduced exposure to prolonged general anaesthesia risk.<sup>11</sup> Furthermore, it can provide longer adjunct analgesia due to the combination of epinephrine and local anaesthesia via slow systemic absorption.<sup>12</sup>

Despite its numerous benefits, hydrodissection has been criticised for the higher rate of post-operative complications, such as skin necrosis, bleeding and hematoma, compared to conventional techniques.<sup>13</sup> Notwithstanding the reported complications, up to 25%–65% of mastectomies are performed using this technique.<sup>14</sup> This growing interest, albeit with contrary evidence in the literature, warrants further investigation on patient outcomes. By understanding the potential impact of hydrodissection on complication rates and other known risk factors, surgeons can be more objective in determining the appropriateness of this technique. The aim of this study was therefore to evaluate the outcomes in breast cancer patients following the use of the hydrodissection technique compared to the conventional technique. We compared the 30-day post-operative complications in patients undergoing mastectomy with axillary clearance using the hydrodissection and conventional techniques.

## METHODOLOGY

### STUDY TYPE AND DESIGN

This prospective randomised clinical study included 94 female patients undergoing mastectomy with axillary clearance in the Surgical Department at Selayang Hospital, Malaysia, from 1 June 2019 to 1 September 2020. The inclusion criteria were patients aged 18 years or older who underwent mastectomy with sentinel lymph node or axillary clearance for breast cancer. The exclusion criteria were inflammatory breast cancer, superficial breast cancer, uncontrolled diabetes mellitus, prolonged steroid usage, recurrent breast cancer, immediate breast reconstruction, history of radiation to the affected breast and allergies to lignocaine and adrenaline. The study complied with the ethical principles outlined in the Declaration of Helsinki and Malaysian Good Clinical Practice Guidelines. Ethical clearance was obtained from the Ethical Committee of the National University of Malaysia (Ethics UKM: FF-2019-175) and National Malaysia Research Register (NMRR-18-3530-43842 [IIR]).

The procedure was explained to the patients in detail in an information sheet provided to them, and written consent was obtained a day prior to surgery. This study did not interfere with the patient's standard management, investigations or any further decisions regarding their breast cancer management. All medication for pre-existing conditions was continued throughout the study and in accordance with the current standard preoperative management and hospital protocols. The participants were randomised into 2 groups prior to surgery using automated computer software-generated numbers (randomizer.org) with a ratio of 1:1. The post-procedure care was similar for both groups as per standard protocols.

The surgical wounds were inspected on day 3 post-surgery. The surgical vacuum drain was removed when the drain volume was less than 30 ml/24–48 hours. Post-operative pain was assessed over 24 hours following surgery using a visual analog scale. All the patients

received standardised analgesia IV tramadol 50 mg TDS and oral paracetamol 1 g QID.

The patients were monitored during ward rounds or clinic follow-ups for up to 30 days. Wounds were assessed for flap necrosis (i.e. necrotic skin requiring local wound care), surgical site infection (SSI) (i.e. skin erythema that requires intravenous antibiotics or wound breakdown), seroma formation (i.e. a collection of serous fluid after removal of drain that requires aspiration) and wound hematoma (i.e. a collection of blood clots requiring exploration or drainage). Data pertaining to the duration of surgery, 24-hour post-operative pain, the duration of drain, the total vacuum drainage volume, the estimated blood loss and the length of hospital stay were also collected.

### **Description of the Hydrodissection Technique**

All the modified radical mastectomies in this study were performed in line with standard surgical procedures as described by Staradub et al and Shoher et al.<sup>4,11</sup> The surgery was performed only by 2 breast and endocrine senior consultants in Hospital Selayang, Malaysia.

During hydrodissection, a tumescent solution was prepared by the operating surgeon prior to surgery. The solution contained 500mls of normal saline mixed with 10 ml of 2% lignocaine and 1 ml adrenaline at 1:1000. The other instruments included an infusion pump with a drip set and a liposuction cannula (size 2.3–2.5 cm/dm). Preoperatively, each patient was placed in the supine position with the involved site of the upper limb abducted and flexed. Once the area had been marked and cleaned, 2 small incisions (1 cm) were made at the middle upper and lower flaps of the breast to allow for the insertion of the liposuction cannula. The cannula was placed in the upper flap in the layer between the subcutaneous tissue and breast parenchyma. It was then radially infused with the tumescent solution so that it covered the skin flap to create the plane for dissection. The procedure was then repeated at the lower flap. Once the surgeon had completed the hydrodissection, the surgeon began the mastectomy procedure using Mayo scissors or a scalpel to

open the space, thus creating the skin flap. Once both flaps have been created up to the pectoralis fascia, electrocautery was used to remove the breast parenchyma from the pectoral muscle. A sentinel lymph node dissection or complete level I and II axillary dissection was performed in the usual fashion. If an allergic reaction developed following the administration of the tumescent solution, intravenous hydrocortisone 200 mg was delivered. Such patients were subsequently monitored in the ward and excluded from the study.

The patients in the conventional electrocautery group did not undergo hydrodissection, and these surgeries were performed primarily using electrocautery.

### **Statistical Analysis**

The data were analysed using SPSS version 22. The descriptive data were expressed as mean  $\pm$  standard deviation (SD) unless otherwise stated. The categorical data were analysed using a chi-square or Fisher's exact test. A value of  $p < 0.05$  was considered statistically significant. The collected data were analysed using an intention-to-treat methodology. The dependant variable was analysed in the multivariable regression analysis to determine the odds ratio (OR).

### **Conflicts of Interest**

The authors declare no conflicts of interest regarding this study.

### **RESULTS**

Among the 94 patients, 47 patients were in the conventional group and the remaining 47 patients were allocated to the hydrodissection group.

The majority of the patients were Malays (52, 55%), followed by Chinese (29, 31%), Indians (12, 13%) and other 1 (1%). The ages of the patients ranged between 38 and 83 years (mean,  $57.26 \pm 10.35$  years). Fifty percent of the patients in our study had hypertension, and 21.3% had diabetes mellitus. Furthermore, 21.3% of patients had undergone neoadjuvant chemotherapy.

**Table 1:** Sociodemographic characteristics and co-morbidities distributions of the patients in the conventional and hydrodissection groups

Characteristics	Conventional n (%)	Hydrodissection n (%)	p-value
Age	58.62 ± 10.77	55.89 ± 9.83	0.204
Race			0.437
Malay	27 (57.4)	25 (53.2)	
Chinese	16 (34)	13 (27.7)	
Indian	4 (8.5)	8 (17)	
Others	0	1 (2.1)	
Diabetes Mellitus			0.1
Yes	10 (21.3)	10 (21.3)	
No	37 (78.7)	37 (78.7)	
Hyper tension			0.837
Yes	23 (48.9)	24 (48.9)	
No	24 (51.1)	23 (51.1)	
Smoking			0.1
Yes	0 (0)	0 (0)	
No	47 (100)	47 (100)	
BMI (>30)			0.139
Yes	6 (12.8)	2 (4.3)	
No	41 (87.2)	45 (95.7)	
Neoadjuvant			0.313
Yes	12 (25.5)	8 (17)	
No	35 (74.5)	39 (83)	

<sup>a</sup> Chi-square test, \* Significant if  $p < 0.05$

There were no significant differences in terms of race, age, comorbidities and the surgical technique employed during mastectomy.

### Post-operative Wound Complications

Of the patients in our study, 35.1% experienced post-operative wound complications, with flap necrosis at 1.1%, SSI at 7.4%, seroma at 29.8% and hematoma at 3.2%.

Table 2 shows a lower rate of overall total complications (42.6% vs 27.7%, respectively), SSI (8.5% vs 6.4%), seroma (40.4% vs 19.1%, respectively) and hematoma (2.1% vs 4.3%, respectively) in the hydrodissection group compared to the conventional group. There was only 1 case of flap necrosis, which was seen in the hydrodissection group. These results were statistically significant for seroma but not the other complications.

There was a significant association with a reduction in the rate of seroma in the hydrodissection group. There were no significant associations with the other post-operative wound complications. Table 2 also shows that the use of the hydrodissection technique in mastectomy reduces the likelihood of seroma 3-fold, but the same was not found in relation to the other complications.

### Other Post-operative Factors

The surgery time was around 10 minutes shorter in the hydrodissection group; however, the estimated blood loss

**Table 2:** Comparison of the post-operative wound complications in the conventional and hydrodissection groups

Characteristics	Conventional n (%)	Hydrodissection n (%)	p-value	OR
Total complications <sup>a</sup>				
Yes	20 (42.6)	13 (27.7)	0.13	0.516
No	27 (57.4)	34 (72.3)		
Flap necrosis <sup>a</sup>				
Yes	0 (0)	1 (2.1)	0.315	0.495
No	48 (100)	46 (97.9)		
Surgical site infection <sup>a</sup>				
Yes	4 (8.5)	3 (6.4)	0.694	0.733
No	43 (91.5)	44 (93.6)		
Seroma <sup>a</sup>				
Yes	19 (40.4)	9 (19.1)	<b>0.024*</b>	0.349
No	28 (59.6)	38 (80.9)		
Hematoma <sup>a</sup>				
Yes	1 (2.1)	2 (4.3)	0.557	2.044
No	46 (97.9)	45 (95.7)		

<sup>a</sup> Chi-square test

\* Significant if  $p < 0.05$ , OR, odds ratio

was about 50 ml higher (Table 3). In addition, the total drain volume was approximately 70 ml lower, the duration of drain was 1 day longer and the 24-hour pain score lower in the hydrodissection group.

**Table 3:** Comparison of the post-operative factors in the conventional and hydrodissection groups

Characteristics	Conventional (mean ± SD)	Hydrodissection (mean ± SD)	p-value
Operative time (minutes) <sup>b</sup>	114.09 ± 16.93	100.15 ± 13.59	<b>*0.001</b>
Estimated blood loss (ml) <sup>b</sup>	173.40 ± 154.93	219.15 ± 212.78	0.237
Total drain volume (ml) <sup>b</sup>	882.77 ± 605.57	813.30 ± 498.75	0.545
Duration of drain (days) <sup>b</sup>	10.13 ± 3.88	10.51 ± 5.48	0.697
24-hour pain score (VAS) <sup>b</sup>	3.28 ± 0.97	2.13 ± 1.05	<b>*0.01</b>

<sup>b</sup>Independent *t*-test

\*Significant if  $p < 0.05$

SD, standard deviation; VAS, visual analogue scale

The duration of surgery was significantly shorter and the post-operative 24-hour pain score significantly better in the hydrodissection group compared to the conventional group. There was no significant association with the other post-operative factors (i.e. estimated blood loss, total drain volume and duration of drain).

## DISCUSSION

Mastectomy with axillary clearance is one of the main surgeries performed to treat breast cancer. Surgeons have been exploring new techniques not only to lower the risk of complications, but also to expedite the recovery period for adjuvant treatment. The conventional technique

involves the use of electrocautery to generate heat energy for tissue dissection, while in the hydrodissection technique, sharp dissection is used in a bloodless plane created by a tumescent solution. Evidence suggests that wound complications are higher following electrocautery, however, several studies have suggested otherwise as the skin flaps that are created have better tensile strength, more fibroblasts and collagen and fewer leucocytes.<sup>5,15</sup> The hydrodissection technique, which can reduce the use of electrocautery, can be used as an alternative.

Post-operative wound complications were present in 35.1% of the patients in our study. Although these findings were considerably high, they are comparable with those of previous studies, which have reported a post-operative wound complication rate of 49% for mastectomy.<sup>15</sup> The causes of wound complications are multifactorial. The surgery requires tissue dissection, which leaves large dead spaces that can lead to seroma formation. This can in turn develop into flap necrosis and seroma infection and delay wound healing.<sup>15</sup> A patient's pre-morbid status, such as diabetes, obesity, smoking and neoadjuvant chemotherapy, may also affect their post-operative outcomes. In our study, we found the overall rate of wound complications was lower in the hydrodissection group; however, this was not statistically significant.

The highest prevalence of wound complications in this study was in the form of seroma fluid collection (29.8%). This is in accordance with the findings of other studies where seroma formation accounted for 30%–40% of wound complications.<sup>16,17</sup> Seroma collection raises the skin flaps from the chest wall and axilla, preventing adherence to the tissue bed for wound healing and leading to delayed wound healing, wound infection, haematoma, lymphoedema, poor cosmetic outcomes, prolonged hospital stay and frequent post-operative visits. Our study showed that the rate of seroma was significantly lower in the hydrodissection group compared to the conventional group (40.4% vs 19.1%, respectively;  $p < 0.05$ ). Although the pathophysiology remains uncertain, some researchers have postulated that direct thermal energy increases the risk of thrombosis in the subdermal vessels, lysis of the subcutaneous tissue and inadequate sealing of the

lymphatic vessels.<sup>18</sup> Electrocautery can elevate the temperature of the surrounding tissues and subsequent cause tissue inflammation with higher cytokine release and capillary leakage.<sup>7,18,19</sup>

The hydrodissection technique requires the use of a tumescent solution to create a plane for dissection. It can also provide a vasoconstrictive effect and overdistension within the breast flap plane to produce tension and reduce bleeding during sharp dissection. The thickness of the breast flap during dissection is important for preserving the viability of the flap: a thicker flap increases the risk of local recurrence from residual breast tissue, while flaps that are too thin increase the risk of necrosis. A single institution, retrospective study reported the incidence of flap necrosis in patients when a tumescent solution was used.<sup>20</sup> A separate retrospective review by Chun et al reported an increase in the risk of flap necrosis when using the tumescent technique, especially in immediate breast reconstruction.<sup>13</sup> However, this result could have been influenced by a large number of potential variations, including the more than 20 oncologic surgeons who performed the procedures. The rate of flap necrosis in our study was 1.1%, and there was no significant association with hydrodissection compared to the convention technique (0% vs 2.1%, respectively;  $p = 0.315$ ). This correlates with studies by Laudrup et al and Khavanin et al, which showed that the tumescent technique was not associated with increased complications.<sup>21,22</sup> The studies also failed to identify it as an independent risk factor for complications. The hydrodissection plane allows for the precise sharp separation of the subcutaneous tissue containing the subdermal plexus, which is vital for skin flap survival.

Mastectomy with axillary clearance is known to be a clean surgery. However, it can be highly variable depending on the procedure and patient disease characteristics. Studies have reported the incidence of SSI as ranging from 3% to 18% in mastectomy.<sup>18,23</sup> Our study showed a 7.4% rate of SSI which, although higher in the conventional group than the hydrodissection group (8.5% vs 6.4%, respectively), was not statistically significant ( $p = 0.19$ ). One randomised study found a higher incidence of cellulitis in the electrocautery group than the scalpel group.<sup>6</sup> Porter et

al demonstrated a significant relationship between seroma formation and SSI using electrocautery.<sup>9</sup> Olsen et al reported longer operative time can contribute to SSI.<sup>23</sup> One of the advantages of hydrodissection is that it is faster than the conventional technique, so we postulate that a shorter surgery time may reduce the risk of infection.

Our study showed a shorter operative time in the hydrodissection group than the conventional group by a mean of 10 minutes (114.09 vs 100.15, respectively;  $p < 0.05$ ). This result was similar to that seen in a study by Shoher et al who reported that the tumescent technique was faster than either sharp dissection or electrocautery dissection alone as it reduces both the operative time and blood loss. Our study showed that the estimated blood loss was higher in the hydrodissection group than the conventional group although this was not statistically significant (173.04 vs 219.815, respectively;  $p = 0.237$ ). The haematoma rate was 3.2% in the hydrodissection group, which was slightly lower than that of the conventional group, but the difference was not statistically significant (2.1 vs 4.3, respectively;  $p = 0.557$ ). Such results can be variable and are dependent on the size of the tumour, the weight of the breast and the presence of underlying comorbidities. Ozdogan et al also reported that the estimated blood loss was lower in the electrocautery group compared to the sharp dissection group in their study.<sup>24</sup>

Other important risk factors for SSI are prolonged post-operative drainage and seroma-hematoma formation.<sup>25</sup> The duration of drain was slightly longer in the hydrodissection group than the conventional group, but this was not statistically significant (10.13 vs 10.51, respectively;  $p = 0.697$ ). Pogson et al stated that there was good evidence to support early drain removal to reduce seroma and infection, but it should be individualised with consideration of patients' premorbid conditions, operative findings and disease distribution. Studies have further shown that there is a reduction in infection rates with the use of local anaesthesia as it can inhibit bacterial proliferation and growth.<sup>26</sup> Local anaesthesia not only serves as an agent for pain control, but also inhibits

microbial activity. The 24-hour pain score in our study was significantly lower in the hydrodissection group compared to the conventional group (3.14 vs 2.11, respectively;  $p < 0.05$ ). The addition of local anaesthesia significantly improves recovery by acting as a post-operative analgesia. The reported safety of this technique has been verified by many authors based on the slow systemic absorption of lignocaine as a result of the vasoconstrictive effect of epinephrine and, to some extent, vessel compression by the hydrostatic effect of the solution itself.<sup>27</sup>

This was a single blinded study as we could only blind the patients, not the surgeon. The findings of this study are limited due to the small sample size. Furthermore, our study included mastectomy with axillary clearance but not other types of breast surgery, such as breast-conserving surgery, nipple-sparing mastectomy or immediate reconstruction. We therefore were not able to study the benefits of other breast surgery procedures. While the rates of flap necrosis and haematoma were very low in our study, they may not be representative of the true value of the procedures. Our sample size was limited to our centre and therefore does not represent the entire population in Malaysia.

We recommend a further multicentre trial over a longer period that includes a larger sample and multiple procedures to compare the subtle differences between each wound complication. Hydrodissection is an acceptable alternative technique which can be used to reduce complications. The procedure is rather simple with easy learning curve and cheap as it doesn't require any advance technology equipment to perform.

## CONCLUSION

In conclusion, our study showed that hydrodissection using a liposuction cannula is safe, provides a lower rate of seroma and a faster operative time and reduces post-operative pain compared to the conventional technique. It should be considered as an alternative to the conventional method of mastectomy using diathermy.

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## CONFLICT OF INTEREST

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