COMPLETE VERSUS SELECTIVE AXILLARY DISSECTION AFTER LYMPH NODE MAPPING IN TREATMENT OF EARLY CANCER BREAST

By

Samir Sidhom; Ahmed Khashaba; Ali El-Shewy and Mohamed Riad

**Department of General Surgery, Zagazig University hospitals, Faculty of Medicine, Egypt.*

ABSTRACT

Background: Lymphedema is a condition that is feared by many breast cancer patients because of its irreversible nature, its associated negative body image, lower self-reported quality of life scores, sleeping disturbance, difficulty carrying objects and completing daily activities, and physical discomfort.

Methods: The study included 40 female patients with operable breast cancer (stage I and II). The forty patients were divided into two groups: Group I: included twenty patients (50%) who underwent modified radical mastectomy or radical conservative breast surgery together with axillary lymph node mapping (which means selective axillary dissection).Group II: included the other twenty patients (50%) who underwent modified radical mastectomy or radical conservative breast surgery without performing axillary lymph node mapping (which means complete axillary dissection.

Results: identification of blue lymph nodes was achieved in 11 patients from group I (55%) and could be preserved in 7 patients (63.6%) and excised in 4 patients (36.4%). Lymphedema developed in 3 patients from group I and 7 patients from group II. Lymphedema developed in one patient with preserved blue lymph nodes.

Conclusion: chronic upper limb lymphedema is statistically significantly less with selective axillary dissection (mapping of axillary lymph nodes) in comparison to complete axillary dissection (no mapping).

Key words: axillary dissection, breast cancer, lymph node mapping, methylene blue dye

INTRODUCTION

Axillary nodal status remains the single most important prognostic variable in the management of breast cancer. It directs the need for further axillary and adjuvant systemic treatment in patients with early breast cancer.(1)

Shoulder restriction, upper limb weakness, lymphedema, pain, and reduced quality of life (QOL) are commonly reported outcomes of surgery and radiation for early breast cancer. The prevalence and severity of these outcomes varies considerably. However, it is clear that breast cancer survivors continue to be affected by physical problems many years following treatment. These physical problems have the potential to disrupt activities of daily living and increase stress and anxiety for patients who are in remission and desire a return to normal life. Long-term physical side-effects also place pressure on health systems to supply physical therapy and other services for breast cancer survivors.(2)

Lymphedema is a condition that is feared by many breast cancer patients because of its irreversible nature, its associated negative body image, lower self-reported quality of life scores, sleeping disturbance, difficulty carrying objects and completing daily activities, and physical discomfort.(3)

Sentinel lymph node (SLN) biopsy has become a widely accepted method for surgical staging of axillary lymph nodes in breast cancer. This procedure can avoid unnecessary axillary lymph node dissection (ALND) in node-negative patients, thereby minimizing arm lymphedema. However, node-positive patients who undergo ALND do not benefit from SLN biopsy. Arm lymphedema develops in 7–77% of patients who undergo ALND. Moreover, SLN biopsy

does not completely eliminate arm lymphedema. Several trials have shown lymphedema rates in approximately the 7% range with SLN biopsy alone.(4)

Recently, the axillary reverse mapping (ARM) technique has been developed to map and preserve arm lymphatic drainage during ALND and / or SLN biopsy. The arm and breast lymphatic drainage can be separated using blue dye or radioisotopes, allowing safe removal of only the lymphatics of the breast and protection of the lymphatic channels draining the upper extremity during ALND or SLN biopsy. The ARM procedure is based on the hypothesis that the lymphatic pathway from the arm is not involved by metastasis of the primary breast cancer.(4)

PATIENTS AND METHODS

This study was carried out in the department of General Surgery, Faculty of medicine, Zagazig University during the period from April 2008 to April 2010. The study included 40 female patients with operable breast cancer (stage I and II). The patients' ages ranged from 26 – 65 years with mean age of 47 years. 24 patients (60%) were premenopausal and 16 patients (40%) were postmenopausal, only one patient (2.5%) was nulliparous while the remaining 39 patients were multiparous (97.5%). One patient (2.5%) gave positive family history of breast cancer.

Pre-operative mid-arm circum-ference of both upper limbs of each patient was taken and recorded.

After completing all investigations and confirming the stage and fitness of the patients for surgery; the forty patients were divided into two groups :

Figure (1): subcutaneous injection of methylene blue dye at the intermuscular groove of the upper limb.

Group I: included twenty patients (50%) who underwent modified radical mastectomy or radical conservative breast surgery together with axillary lymph node mapping (which means selective axillary dissection).

Group II: included the other twenty patients (50%) who underwent modified radical mastectomy or radical conservative breast surgery without performing axillary lymph node mapping (which means complete axillary dissection.

Procedure: As soon as general anesthesia was given, 3-4 ml of methylene blue were injected subcutaneously in the upper inner arm along the medial intermuscular groove (the groove between the biceps and triceps muscles) of the same arm where the breast surgery will be done, in order to locate the draining lymphatics of the arm, figure (1).

After injection, the site of injection was massaged and the arm was elevated for about 5 minutes to enhance the lymphatic drainage of the arm.

After having performed the breast surgery either modified radical mastectomy or radical conservative breast surgery whether radical lumpectomy or radical quadrant-ectomy. We began the axillary dissection with the identification of the classic landmarks and limits of axillary dissection determined with the axillary vein superiorly, pectoralis minor medially and latissimus dorsi muscle laterally, taking care not to injure the important structures e.g. the axillary vein, the long thoracic nerve, the thoracodorsal neurovascular bundle.

During dissection of the axillary fat and axillary lymph nodes, we were very careful to identify any blue lymphatics and/or blue lymph nodes especially at the lateral aspect of axillary dissection. When these lymphatics and/or lymph nodes were identified they are the lymphatic drainage of the arm, figure (2).

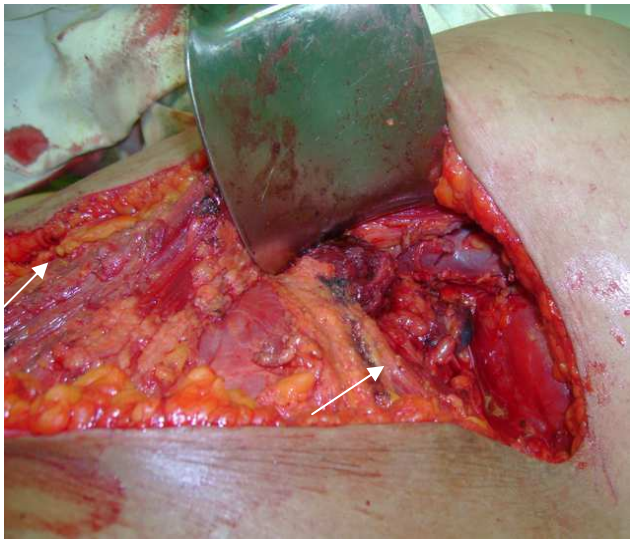

Figure (2): identified preserved blue lymph node (white arrow) in the lateral aspect of the axilla below the axillary vein.

After identification of these blue lymphatics and/or lymph nodes, careful dissection was done trying to separate them from the other axillary lymph nodes, especially if they were not grossly involved with metastases. When separated, they were kept in place in order to maintain the lymphatic drainage of the arm.

Then the classic axillary lymph node dissection was completed and the wound was closed after good haemostasis and suction drain was put.

The resected specimen (including the breast and axillary tissues) was sent for histopathological examination.

Post-operatively: patients were encouraged for early mobilization of the upper limb from the 2nd post-operative day, follow up of any post-operative complications such as wound infection, seroma, haematoma and numbness along the inner aspect of the arm, serial measurements of the mid arm circumference of both arms were taken every week during the first post-operative month, then every month for 6 months in order to diagnose the occurrence of lymphedema.

Follow up of the site of injection of methylene blue especially for any signs of infection and persistence of the tattoo mark.

Careful examination of the scar of the breast and the axilla during the follow up period for any possible recurrence,

The patients were referred to the oncology department with the final pathology report to complete their post-operative radiotherapy, chemo-therapy and/or hormonal therapy.

All data were collected from both groups then statistically analyzed and tabulated.

RESULTS

Table (1) shows the age distribution in both groups:

Age groups (in years)	Group I		Group II	
	No.	%	No.	%
21-30	1	5%	2	10%
31-40	4	20%	3	15%
41-50	6	30%	6	30%
51-60	7	35%	8	40%
61-70	2	10%	1	5%
Total	20	100%	20	100%

All patients had early breast cancer, where stage I (T1N0) included 11 patients (27.5%) and stage II (T1N1, T2N0 and T2N1) included 29 patients (72.5%).

17 patients (42.5%) presented with T1 (<2cm) tumors and 23 patients presented with T2 (2-5cm) tumors; with an overall incidence 57.5%.

25 patients presented with clinically negative axillary lymph nodes involvement (N0) with an overall incidence 62.5%, where 15 patients presented with clinically positive mobile axillary lymph nodes involvement (N1) with an overall incidence 37.5%.

32 patients (15 patients from group I and 17 patients from group II) underwent modified radical mastectomy with an overall incidence of 80%. And 8 patients (5 patients from group I and 3 patients from group II) underwent radical conservative breast surgery with an overall incidence 20 %.

7 patients from group I underwent levels I&II (selective) axillary lymph node dissection with an overall incidence 17.5%. And 33 patients (13 from group I and all patients from group II) underwent levels I, II & III (complete) axillary lymph nodes dissection with an overall incidence 82.5%.

The number of excised lymph nodes (LNs) in group I ranged from 6 to 24 with average number of 13.9 LNs. The number of excised LNs in group II ranged from 9 to 23 with average number of 15.4 LNs.

On histo-pathological examination, 12 patients (7 patients from group I and 5 patients from group II) had negative axillary lymph nodes with an overall incidence 30%. Where, 28 patients (13 patients from group I and 15 patients from group II) had positive axillary lymph nodes with average incidence of 70%.

Table (2) shows the levels of axillary lymph node dissection (ALND) in both groups included in the study:

Levels of ALND	**Group I**		**Group II**		**Total No. of patients**
	No.	**%**	**No.**	**%**	
Levels I&II (selective axillary dissection)	7	35%	0	0%	7
Levels I, II & III (complete axillary dissection)	13	65%	20	100%	33
Total	20	100%	20	100%	40

By correlation between the number of positive LNs and the total number of excised LNs, lymph node ratio (LNR) was calculated as shown in table (3).From this table 18 patients (64.3%) had LNR <0.2 and 10 patients (35.7%) had LNR >0.2 (from total 28 patients with positive axillary lymph nodes).

Table (3) lymph node ratio (positive LNs/total excised LNs):

LN ratio	Group I		Group II		P value signific-ant if <0.05)
	No.	%	No.	%	
< 0.2	9	69.23%	9	60%	P = 0.7
> 0.2	4	30.77%	6	40%	
Total	13	100%	15	100%	

Table (4) shows the post-operative adjuvant therapy in early breast cancer:

Adjuvant therapy	Group I		Group II	
	No.	%	No.	%
Radiotherapy	7	35%	6	30%
Chemotherapy + Hormonal therapy	17	85%	18	90%

Table (5) axillary lymph nodes mapping:

	No. of patients	percentage
Blue	11	55%
No blue	9	45%
Total	20	100%

The rate of identification of axillary lymph nodes in group I after methylene blue dye injection in the ipsilateral arm was seen only in 11 patients (55%), table (5).

The most common location of the identified blue axillary lymph nodes was in the apical group of axillary lymph nodes; seen in 5 patients (45.4%) followed by the lateral group; seen in 4 patients (36.4%) and least commonly seen in the pectoral group; only in 2 patients (18.2%).

These blue axillary lymph nodes could be preserved in 7 patients out of 11 patients, table (6).

Table (6) number of patients with preserved blue LNs:

	No. of patients	percentage
Preserved blue LNs	7	63.6%
Excised blue LNs	4	36.4%
Total	11	100%

The excised blue LNs included; 2 cases with identified pectoral LNs and 2 cases with identified apical LNs (the excision was done in the 4 cases because of the large size of the blue LNs (more than 1 cm) for fear of leaving metastatic foci in the axilla). On histopathological examination of these excised LNs the two pectoral LNs and one apical LN had metastases while the other apical LN was hyperplastic.

10 patients (25%) (3 patients from group I and 7 patients from group II) developed ipsilateral upper limb lymphedema (the mid-arm circumference difference between both upper limbs was more than 2 cm), table 7.

The three patients from group I who developed lymphedema were as follow: one patient with preserved identified blue axillary lymph node developed lymphedema after completing the course of adjuvant radiotherapy. Two patients underwent complete axillary LNs dissection due to expected extensive axillary LNs metastasis, although the apical LNs were mapped with methylene blue as the lymphatic drainage of the ipsilateral upper limb. Both patients received hormonal therapy and chemotherapy.

The seven patients from group II who developed lymphedema were as follow: all patients underwent complete axillary dissection, histo-pathological examination proved that the retrieved axillary LNs were positive (>10 positive LNs) in 4 patients; 1 patient had from 4 - 10 positive LNs and negative in 2 patients; Radiotherapy was given to 5 patients while the other 2 patients received chemotherapy and hormonal therapy.

Table (7) shows the post-operative complications in both groups:

Compli-cations	**Group I**		**Group II**		**P value (significant if <0.05)**
	No.	**%**	**No.**	**%**	
Wound infection	2	10%	1	5%	P = 1
Lymph-edema of the ipsilateral arm	3	15%	7	35%	P = 0.04 (signi-ficant)
Wound haema-toma	1	5%	0	0%	P = 1
Local recurrence	0	0%	0	0%	
No complic-ations	14	70%	12	60%	P = 0.51
Total	20	100%	20	100%	

Table (8) shows the relation between lymph node ratio (LNR) and the incidence of lymphedema:

LNR	No. of patients	Patients with lymph-edema		P value significant if <0.05
		No.	%	
<0.2	18	3	16.6	P =0.01
>0.2	10	7	70	significant

Table (9) shows the relation between the stage of the disease and the incidence of lymphedema:

Stage	**No. of patients**	**No. of patients with lymphedema**		**P value (significant if <0.05)**
		No.	**%**	
Stage I	11	2	18.2 %	P = 0.69
Stage II	29	8	27.6 %	(non significant)

Table (10) shows the relation between the type of adjuvant therapy and the incidence of lymphedema:

Adjuvant therapy	No. of patients	No. of patients with lymphedema		P value (significant if <0.05)
		No.	%	
Radiotherapy	13	6	46.2 %	P = 0.01
Chemotherapy + Hormonal therapy	35	4	11.4 %	(signific-ant)

Table (11) shows the relation between the level of axillary dissection and the incidence of lymphedema:

Levels of axillary dissec-tion	No. of patients	No. of patients with Lympedema		P value (significant if <0.05)
		No.	%	
Levels I&II (selective axillary dissection)	7	1	14.3 %	P = 0.04 (significant)
Levels I, II & III (complete axillary dissection)	33	9	27.3 %	

As regard the complications of methylene blue dye injection the procedure was painful in the 1st three patients (15%), this occurred when methylene blue was injected before anesthesia, so the injection was done after anesthesia in the following cases.

One patient (5%) presented with prolonged tattooing at the injection site for more than 2 weeks but it completely disappeared at the end of the 2nd month.

One patient (5%) presented with infection at the site of injection, but it responded to conservative management in the form of systemic antibiotics and repeated dressing.

No patient in the studied group I developed any allergic reaction to methylene blue dye injection either locally (at the injection site) or systematically.

No patient in group I (in which 7 patients had preserved mapped blue axillary LNs) developed local recurrence in the axilla during a follow up period up to one year.

Table (13) complications of methylene blue:

Complications	No. of patients	percentage
Pain	3	15%
Tattooing > 2weeks	1	5%
Injection site infection	1	5%
Allergy	0	0%
Total	5	25%

DISCUSSION

In our study 33 patients (82.5%) underwent complete axillary dissection and 7 patients (17.5%) underwent level I & II axillary dissection. This is against the recent trend of more conservative axillary dissection (levels I&II) to be the standard technique of axillary dissection (to decrease the post-axillary dissection morbidity) and keep complete axillary dissection only for extensively involved axillary lymph nodes, this as reported by other studies.[5,6,7]

From the excised LNs, 12 patients (30%) had negative axillary LNs and 28 patients (70%) had positive axillary LNs. 14 patients (35%) had less than 4 positive

LNs, 10 patients (25%) had between 4-10 positive LNs and 4 patients (10%) had more than 10 positive LNs. This is more than what was reported by Omar and Contesso [8] from the series of the National Cancer Institute (1994-1998); that, 11% of patients had 4-10 LNs. This is may be explained by that most of the cases presented with tumor size more than 2 cm and this supported by many reports [9,10,11] which stated that the association between increasing tumor size and axillary metastasis is obvious (e.g. the incidence of axillary metastatic disease in relation to the size and grade II tumors, was with tumor size 1-10 mm (15%), size 11-20 mm (34%) and size 21-50 mm (42%).

As regard the lymph node ratio (LNR); which is the number of invaded lymph nodes in the context of the total number of removed lymph nodes, it was > 0.2 in 10 patients (25%) and < 0.2 in 18 patients (45%). It was calculated because LNR appeared to be significantly predictive for disease outcome as stated by van der Wal et al [12].

As regard the axillary lymph node mapping in group I, the rate of blue lymph nodes identification was 55% (11 patients). This rate is near to what is reported by Cassina et al [13] who stated that the rate of identification was 54%. And it is less than what is reported by Thompson et al [14] and Nos et al [15] who stated that the rate of identification of blue lymph nodes was 61% and 71% respectively. The highest rate was reported by Casabona et al [16] and Britton et al [17], which was 89% and 100% respectively (after adding radioactive isotopes to the mapping technique).

Less rate of identification in group I could be explained by; the 5 cases that underwent conservative breast surgery were operated with axillary clearance first before performing radical lumpectomy or quadrantectomy that gives less time for the dye to travel along the lymphatics from the arm to the axillary lymph nodes. This matches with Nos et al [15] who stated that the time elapsed between dye injection and identification of blue lymph nodes ranged from 15 – 60 minutes.

Also, 7 cases from this group had clinically positive axillary lymph nodes (N1) which may resulted in slow rate of transmission of the dye or changing the direction of the blue dye flow to lymphatics away from the field of dissection, where the studies (e.g. Casabona et al [16]) with high rate of identification included all patients with clinically negative axillary lymph nodes.

The commonest location of the identified blue lymph nodes draining the arm was in the apical group of lymph nodes; 5 patients (45.4%) followed by the lateral group of lymph nodes; 4 patients (36.4%) and less commonly in the pectoral group; 2 patients (18.2%) (This is from total 11 patients with identified blue axillary lymph nodes). This matches with Drake et al [18] and Pavlišta and Eliska [19] who stated that lymphatics of the arm end in the apical axillary LNs and what is reported by Sakorafas et al [20] and Sinnatamby [21] that part of the lymphatics of the arm passes through the lateral axillary lymph nodes.

From the 11 identified blue axillary lymph nodes, these nodes could only be preserved in 7 patients (63.6%) and they were excised in 4 patients (36.4%) for fear of having metastasis. This more than what is reported by Nos et al [15], which was 47% and it is less than what is reported by Casabona et al [16], where the preservation rate was 89%.

3 cases from 4 cases with excised identified blue lymph nodes showed metastases on histopathological examination and the 4th case was hyperplastic. Containing metastases agrees with the results of Nos et al [15] and Noguchi et al [4] who stated that the identified blue axillary LNs contained metastases in 14% and 38% of the ARM lymph nodes. Although Thompson et al [14], Boneti et al [22] and Casabona et al [16] reported that no metastases were found in the blue lymph nodes excised during axillary lymph node dissection.

There are two possible explanations for the involvement of the ARM (Axillary Reverse Mapping) nodes with metastasis. The first explanation is related to the natural progression of metastatic disease through the nodes of the axilla. Anatomically, there are lymphatic interconnections between ARM nodes draining from the upper extremity and SLN draining from the breast. Therefore, it was suggested that effacement of nodes by the gross tumor may alter the pattern of lymph flow in these patients, allowing metastasis to the ARM nodes. The second explanation is a limitation of the ARM when the ARM nodes are located in the central nodal group. The central nodal group is closely related to the lymphatic drainage of the breast. If arm lymphatics join the common lymphatic pathway draining from the breast when they exit the axillary basin, their preservation would likely be impossible [4].

Also, if the SLN draining the breast is the same node (the ARM node) draining the upper extremity, it will be difficult to be preserved during SLN biopsy. This as reported by Britton et al [17] and Noguchi et al [23] who reported that ARM lymph node coincides with SLN of the breast in 13% and 21% respectively.

In the early post-operative period (before starting adjuvant therapy) 4 patients developed ipsilateral upper limb lymphedema, and another 6 patients developed lymphedema after completing their course of adjuvant radiotherapy making the total number of cases 10 patients (25%).

Lymphedema was seen in 7 patients out of 10 patients with lymphedema with lymph node ratio (LNR) > 0.2 and seen in 3 patients with LNR < 0.2. This matches with van der Wal et al [12] who stated that LNR appeared to be significantly predictive for disease outcome and with Sakorafas et al[20] who stated that the presence of extensive axillary metastatic disease is associated with increased incidence of lymphedema.

Also, Lymphedema incidence increased in patients with stage II disease (27.6%) more than patients with stage I disease (18.2%). This may be explained by the reports of Cetinas et al [9] and others [10,11] who stated that the association between increasing tumor size and axillary metastasis is obvious, which in turn increases the lymph node ratio (LNR).

The incidence of lymphedema was significantly more in patients who underwent complete axillary dissection (i.e. levels I, II & III): where 9 patients (27.3%) out of 33 patients developed lymphedema, while one patient (14.3%) out of 7 patients developed lymphedema after selective axillary dissection. This is near to the report Casabona et al [16] who stated that the incidence of lymphedema ranged between 11 – 20 % after complete axillary dissection. Also, it falls in the range reported by Noguchi [4] who reported that; the incidence of lymphedema ranges from 7 – 77 % in patients who undergo axillary lymph node dissection. Also Sakorafas et al [20] stated that complete axillary dissection is a risk factor for the development of lymphedema. And this explains the recent trend towards levels I & II axillary dissection to the standard technique to decrease the incidence of lymphedema as reported by Husen et al [5] and McCaig and Chetty [7]. Also, the arm lymphedema develops in 2.7-5% of patients treated with levels I and II ALND, as reported by Noguchi [4] provided that there is no extensive axillary lymph nodes involvement.

One patient (14.3%) out 7 patients with preserved identified blue lymph nodes developed upper limb lymphedema after completing the course of adjuvant therapy. This does not agree with the results of Boneti et al [22] who stated that after 6-months follow up period, there were no cases of lymphedema in the patient population that had ARM lymphatics preserved.

Although 4 patients had the identified blue lymph nodes excised, only the 2 with

excised apical lymph nodes developed upper limb lymphedema and the other 2 with excised pectoral lymph nodes did not develop lymphedema. This is more than the report of Boneti et al [22] who stated that of the 15 patients who had the blue nodes resected, only 2 patients (13%) developed lymphedema, much less than anticipated. The reason is still unclear but demonstrates the variable lymphatic anatomy of the axilla. At the time of the surgery, we did not specifically look for all blue lymphatic channels, and the hypothesis is that multiple lymphatic channels drain the arm, and the ligation of one does not necessarily translate into lymphedema.

The incidence of lymphedema was 25.8% (8 patients) in patients with invasive duct carcinoma. This may be explained by that invasive duct carcinoma was the most common pathology reported in the studied group (31 patients).

6 patients (15%) developed lymph-edema after having radiotherapy. This coincides with Ozaslan and Kuru [24] and Sakorafas et al [20] who stated that in most studies, radiation therapy has been found to be a major and independent risk factor for the development of upper limb lymphedema. Even without surgery, axillary radiation was associated with an increased incidence of lymphedema. The combination of ALND and radiation is synergistic in their effect on the development of lymphedema and therefore is associated with an even higher risk (×8–10) of late lymphedema.

No local recurrence at the mastectomy wound in patients treated with modified radical mastectomy or at the remaining breast tissue in patients operated with breast conservative therapy during a follow up period ranging from 8 months to 1 year. This indicates that modified radical mastectomy and conservative breast surgery are equal options (as regard the short term follow up) for the patients with early breast cancer provided there is a good selection of the patients who are candidates for breast conservative surgery. This matches with Newman and Washington [25] and Bland et al [26].

As regard the complications of axillary lymph nodes mapping with methylene blue dye, the procedure was painful in the first 3 patients when not done under anesthesia, so the rest of the patients were injected with the dye after general anesthesia was given.

No systemic or local allergic reactions were reported with methylene blue dye injection in the studied group. This coincides with Zakaria et al [27] and Boneti et al [22] who reported no systemic reactions to methylene blue occurred in their studies. Although Zakaria et al [27] stated that immediate hypersensitivity reactions in the form of wheal and flare response occurred in two of 399 patients (0.5%) and resolved with antihistamines in both patients.

Persistent blue tattoos at the injection site more than 2 weeks, was only seen in one patient (5%) but it disappeared within 2 months after the procedure. This coincides with Thompson et al [14], Zakaria et al [27] and Boneti et al [22] who stated that the blue staining disappeared within few days to few months after the procedure. However, Nos et al [15] reported that 90% of the patients had persistent blue staining with varying degrees after a follow up period of 7-11 months and disappeared after 24 months (this occurred when Patent blue dye was used).

One patient (5%) developed infection at the site of injection, which responded to conservative measures in the form of repeated dressing and antibiotics. This is less than what is reported by Stradling et al [28] that 21% of patients developed skin lesions at the injection site. Skin lesions presented in a variety of forms including intense erythematous macular lesions, superficial ulcers with profound pallor, and necrotic ulcerations. These lesions did not require debridement or other interventions, and all healed after the administration of the sulfadiazine cream.

No patient in group I (in which 7 patients had preserved mapped blue axillary LNs) developed local recurrence in the axilla during a follow up period of up to one year.

CONCLUSION

The identification of the mapped axillary lymph nodes draining the arm was achieved in 11 patients out of 20, and preservation of these LNs was achieved in 7 patients with significantly decreased incidence of lymphedema.

The procedure was not associated with any serious complications and is considered safe.

In conclusion chronic upper limb lymphedema is statistically significantly less with selective axillary dissection (mapping of axillary lymph nodes) in comparison to complete axillary dissection (no mapping).

One can recommend the following:

The identification rates of the blue lymph nodes draining the arm are still insufficient. The blue lymph nodes draining the arm may be involved with metastatic foci.

So, further studies including larger number of patients and long-term follow up to clarify the risk of missing positive axillary lymph nodes when preserving these blue nodes.

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