

Modified Charles procedure using delayed skin graft for advanced lymphatic filariasis: A single centre study

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Abstract

Background: Severe Lymphedema often causes significant disability to the patient. The patient can't lift his or her leg and often drag the leg during walking. Medical management in the advanced stage is ineffective and surgical management can reduce the bulk of lymphedematous tissue. **Objective:** The Charles procedure is an aggressive operation usually only indicated for severe lymphedema as it often yields an unpredictable outcome. We modified this procedure to achieve predictable results. **Methods:** We operated on 11 cases of lymphatic filariasis with a modified Charles procedure from July 2013 to June 2021. We excised the lymphedematous tissue in the modified technique and then put skin grafting after 14 to 21 days. Patient satisfaction and outcome were assessed pre and postoperatively. **Results:** Eleven patients with severe lymphatic filariasis underwent a modified Charles procedure. All patients underwent this procedure without any major complications. Minor complications included ulceration and wound infection. The average follow-up period was 5.6 months. **Conclusion:** Charles' procedure is an effective method to reduce the bulk, improve the quality of life, and bring good satisfaction to patients.

Key Words: lymphedema, filariasis, Charles procedure, and outcome.

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INTRODUCTION

Lymphedema of the lower limb is a chronic, refractory, and incurable disease of the lymphatic system. Excessive tissue causes impairment of quality of life, lacking psychosocial well-being, and physical and functional impairment. A greater number of symptoms and higher severity of lymphedema were associated with poorer quality of life.^{1,4} Primary lymphedema is characterized by congenital disease of the lymphatic system, while

secondary lymphedema results from obstruction or destruction of the normal lymphatic system, either by disease or iatrogenic process, such as filariasis or more commonly due to the various cancer treatment modalities.^{2,3} During chronic filarial infection, the lymphatic vessels demonstrate valve dysfunction, vessel dilatation, reduced lymphatic muscle contractility, and inadequate drainage in filarial elephantiasis. As a result, there is the fluid accumulation and retrograde lymph flow associated with severe lymphedema.⁵ Stage III lymphedema is the most severe form of lymphedema, characterized by lymphatic elephantiasis, non-pitting edema with skin alterations e.g., acanthosis, increase in thickness, nodularity, and fibrosis.⁶ Impaired limb function, recurring bouts of cellulitis and lymphangitis, chronic pain, lymphangiosarcoma, and cosmetics are all indications for surgery.⁷ Surgical techniques of lymphedema are divided into physiologic therapy and excisional procedure. Physiologic therapy is a microsurgical procedure that improves the physiologic drainage of lymphatic fluid through lymphatic venous

anastomosis or lymph node transfer. In contrast, excisional procedures such as the Homans or Charles procedures consist of multistage or single-stage radical excision of the affected tissue, followed by skin graft coverage.⁶ Physiologic therapy is beneficial in the early stages of lymphedema when the lymphatics are healthy and the tissues are supple and malleable. Simultaneously, because physiologic therapy may not offer significant volume reduction, the excisional operation remains the cornerstone and method of choice for patients with advanced-stage lymphedema and patients with large-volume progressive fibrotic illness.^{3,6,8} In a single stage, the Charles technique entails excision of the skin, subcutaneous tissue, and deep fascia of the legs, followed by skin grafting over the muscle.³ In the modified Charles procedure, the technique was modified using a negative pressure dressing after the initial debulking surgery and then the delay of skin grafting by 5 to 7 days.⁹ Although some writers have reported positive outcomes of the original Charles procedure, this treatment is invasive and may result in substantial consequences such as large fluid and blood loss necessitating blood transfusions, infection, skin graft failure, and wound healing.¹⁰ In the present study, we present a surgical technique called Staged Modified Charles Procedure, for stage 3 lymphedema of the lower limb consisting of two-stage excessive tissue excision up to deep fascia, followed by regular dressing for 2 to 3 weeks and delayed skin grafting on the granulated deep fascia. We modified the original Charles procedure to reduce unpredictable results. The study aimed to find out the outcome of this modified technique for severe lymphedema.

MATERIALS AND METHODS

This was a prospective study conducted in the department of burn and plastic surgery of Khulna medical college from July 2013 to June 2021. We operated on 11 cases of filarial lymphedema with a modified Charles' procedure during this period. The diagnosis was made based on the patient's medical history and clinical presentation. Preoperative routine tests such as blood tests to detect microfilariae,

CFT for filarial antigen, and USG to locate adult worms were performed in all cases. Patients with advanced-stage (stage-3) lymphatic filariasis were included and stage-1 and 2 were excluded from this study. All of the patients suffered lymphangitis and cellulitis on multiple occasions, as well as difficulties in movement and difficulty in wearing conventional clothing. Long-term preventative antibiotics had not reduced recurrent infections. The mean follow-up was 5.6 months. The Charles procedure was modified by delaying skin grafting until healthy granulation tissue appeared 2 to 3 weeks after the initial surgery. All patients were operated on under general anaesthesia. Tourniquet was used in all cases. Prophylactic antibiotics were used in all cases. The area to be excised was marked and the excision commenced. The excision was carried through skin and subcutaneous tissue down to the deep fascia. Proper haemostasis was done. After the initial surgery, all patients were followed for bleeding and extremities perfusion. The wounds were then dressed for 2 to 3 weeks until fluid leakage decreased and healthy granulation tissue appeared. Split skin from the same or opposite thigh was used after removing excessive granulation tissue. The dressings were removed 5 days after grafting, and local wound care was initiated. Small patches of graft loss were healed with regular dressing. After the skin grafts had stabilized, daily moisturizers were prescribed and wound care was continued as an outpatient. Pressure garments were prescribed once the wounds had healed fully and the grafted area become hypertrophic. Data on age, sex, clinical presentations, site, stage, type of surgery, donor area, recipient area, leg circumference before and after surgery, and complications of surgery were collected on the prescribed datasheet. Data collected were subjected to simple statistical analysis using the Statistical Package for Social Sciences (SPSS), SPSS® for Windows, version 16.0 (SPSS Inc., Chicago, IL) statistical software package. Frequencies and means of the variables were estimated. Both manual and computer-based statistical analyses of data were done. Written informed consent was taken from patients.

RESULTS

In the present study, the male-female prevalence was almost similar. The male prevalence was 54.55%, and the female prevalence was 45.45% (Table-I). The majority of the participants (54.55%) belonged to the older age group of 46-65 years, while the remaining 45.45% were from the younger age group of 25-45 years (Table-II). Pre-operative observations showed that left limb involvement was higher (54.55%), the leg was involved in all 100% of cases, and the foot was involved in 45.45% of cases (Table-III). Nodularity was observed in 45.45% of cases, and warty lesion in 9.09% of cases. Recurrent cellulitis was observed in 54.55% of cases, and ulceration in 54.55% of cases. Scrotum was involved in 1 (9.09%) case (Fig-1a,1b, 2a). Modified Charles procedure was followed for all 11 cases. All patients underwent this procedure without any major complications. More than 95% of Skin grafts were taken in 9 cases (Fig-1and2). Post-op wound infection was observed in 18.18%, small area ulceration in 18.18%, and hypertrophic scar was observed in all 100% of cases (Table-IV). The average follow-up period was 5.6 months.

Table 1: Sex distribution of study patients (N=11).

Sex	Frequency	Percentage
Male	6	54.55
Female	5	45.45

Table 2: Age distribution of study patients (N=11).

Age range	Frequency	Percentage
25-45	5	45.45
46-65	6	54.55

Table 3: Pre-operative observation of the study patients (N=11).

Characteristics	Frequency	Percentage
Limb involved		
Left	6	54.55
Right	5	45.45
The extent of limb involvement		
Leg	11	100.00
Thigh	1	9.09
Foot	5	45.45
Warty/Nodular lesion		
Nodularity	5	45.45
Warty lesion	1	9.09
None	5	45.45
Recurrent cellulitis		
Yes	6	54.55
No	5	45.45
Ulceration		
Yes	6	54.55
No	5	45.45
Involvement of other sites		
Yes	1	9.09
No	10	90.91

Table 4: Operational (Charles Procedure) outcome (n=11).

Characteristics	Frequency	Percentage
Operation procedure		
Charles procedure	11	100.00
Wound infection		
Yes	2	18.18
No	9	81.82
Ulceration		
Yes	2	18.18
No	9	81.82
Hypertrophic scar		
Yes	11	100.00
No	0	0.00



Figure-1: Digital photographs of case-1. (1a, 1b: pre-op, and 1c, 1d: 6 months post-op).



Figure 2: Digital photographs of case-2. (2a: pre-op, and 2b, 2c, 2d: 4 months post-op).

DISCUSSION

Lymphedema is characterized by an accumulation of protein-rich extracellular fluid as a result of insufficient lymphatic drainage. While estimates vary, it affects over 5 million people in the United States and over 200 million worldwide.¹¹ Secondary lymphedemas are the most prevalent cause of lymphedema globally; in the west, it is caused by iatrogenic parasite infections. The Charles Procedure is a surgical procedure used to treat limb lymphedema. The lymphedematous tissue is radically removed in this surgery and the limb is covered with skin grafts taken from the surgical specimen. Although favourable outcomes have been documented following Charles' technique, potential consequences include recurrence of lymphedema, particularly at the foot, necessitating re-grafting as well as a poor cosmetic result. In advanced lymphedema, the modified Charles' operation with lymph node flap is described to avoid this problem.¹² After the procedure, patients generally remain in the hospital for 2-3 days, while complete recovery can take as long as a month.¹⁴ As there is no clinical confirmation of truly long-term effective results after any therapy, the optimum treatment for lymphedema has remained a debatable issue.¹⁵ Medical treatment with diethylcarbamazine is very effective in the early stages before the gross deformities of elephantiasis have developed. In the early stages of limb swelling, intermittent pneumatic compression helps, but the treatment has to be repeated over a prolonged period.¹³ These conservative approaches only minimize the progression of the disease but are often impractical. The stage-3 disease is dominated by fibrosis and seems particularly resistant to conservative therapy. Staged subcutaneous excisions, described by Homans in 1935 are a common procedure of choice.^{16, 17} The disadvantage of this procedure is that it is staged, usually 3 to 6 months apart. Although the recovery is more rapid for each stage, the ultimate recovery time is significant for this multistage procedure. In a Swiss roll operation, one flap is buried after

shaving off the epidermis under the opposite flap, deep to the deep fascia. But the procedure has complications like epidermal cysts and sinus formation. Microsurgical techniques for creating an alternative outflow of lymph by lymph-venous, nodo-venous anastomosis have shown good long-term results in lymphedema.^{1,14,15} The results seem to be better in the early stages of lymphedema (stage I, 2). Long-standing lymphedema with marked hypertrophic skin changes, induration,⁸ nodularity, and functional problems related to excessive weight are indications for the Charles procedure. The original Charles procedure is effective but immediately after debulking surgery, there is a continuous ooze of lymphatic fluid and blood. That's why graft take is poor, postoperative infection is common, extensive re-grafting is usual, and recovery is prolonged. This often leads to unstable areas with chronic wounds. Utilizing full-thickness skin results in more durable graft quality, but skin graft take is often compromised. Split thickness grafts are prone to hypertrophic skin changes although take is better. These skin changes sometimes become more troublesome than the original pathology.^{8,9} The possibility of "losing" the full-thickness graft or decreasing the quality of the skin by using split-thickness grafts from the surgical specimen is a major concern. When the preoperative skin quality is poor, the thickness of the skin is increased, obviously utilizing full-thickness skin grafts from surgical specimens would be disastrous.⁹ Therefore, a compromise needs to be reached between conventional split-thickness and full-thickness grafts. In a study, modification of the original Charles procedure was done by using negative pressure dressing immediately after excision followed by skin grafting after 5 to 7 days.⁹ We modified the Charles procedure by delaying skin grafting after 2-3 weeks of normal dressing from initial surgery until healthy granulation tissue appeared and leakage of fluid decreased. Instead of a surgical specimen, we harvested split skin grafts from normal skin of the same or opposite limb. This technique improved skin graft take in all cases and reduces

wound complications. All cases (11) in our study were secondary lymphedema patients who had progressed to end-stage lymphedema (stage-3). Patients presented with discomfort, infections, ulceration, nodularity, warty lesion, loss of movement, and the inability to wear conventional clothing and shoes. Because of the fibrotic nature of their tissues, they were not candidates for liposuction or microsurgical physiologic rebuilding, or other procedures. Therefore, the Charles procedure was the only surgical choice for this group of patients. Modification of the Charles technique in our study improved skin graft take and reduces wound complications. Minor complications like wound infection occurred in 18.18% of cases. Small area ulceration occurred only in 2 (18.18%) cases where re-grafting was needed. The hypertrophic scar was a problem of this procedure and it developed in 100% of cases. The use of pressure garments improved this scar. Finally, all the patients were able to resume normal function and ambulation, and they all reported considerable improvements in their quality of life. Patients' satisfaction after surgery was assessed. All patients were so satisfied that they were even ready to accept further surgery if any complications developed. All the patients recovered from depressive illness. Although all patients had a positive outcome with this modification, it is important to warn the patients about the likelihood of prolonged hospitalization. Patients should realize that this is not a curative procedure and even though every effort is made to ensure a good outcome, they will be left with a substantial deformity and complications. This was a hospital-based small study and does not give a complete scenario of the community. A long-term follow-up study is needed for a better understanding of the outcome of this technique.

CONCLUSION AND RECOMMENDATIONS

The Charles procedure, despite being one of the oldest known treatment methods for advanced lymphedema, continues to have clinical utility. Despite potential risks, Charles's procedure can be done successfully with proper planning and careful attention. Modification can reduce the potential risk of the original procedure. This modified technique is a procedure that can be life-changing for patients suffering from the most extreme lymphedema.

Ethical approval: The study was approved by the Institutional Ethics Committee.

REFERENCES

1. Stollendorf DP, Dietrich MS, Ridner SH. A comparison of

- the quality of life in patients with primary and secondary lower-limb lymphedema: A mixed-methods study. *West J Nurs Res.* 2016; 38(10):1313–1334.
2. Karri V, Yang MC, Lee JJ, Chen S-H, Hong JP., Xu E-S, et al. Optimizing Outcome of Charles Procedure for Chronic Lower Extremity Lymphoedema. *Ann Plast Surg.* 2011; 66:393–402.
3. Venkatramani H, Shanmugakrishnan RR, Kumaran MS, Sabapathy SR. Surgical debulking, lymphatic venous anastomosis, vascularised lymph node transfer in lower limb lymphoedema. *PlastAesthet Res.* 2020; 7:19
4. Bowman C, Piedalue K-A, Baydoun M, Carlson LE. The Quality of Life and Psychosocial Implications of Cancer-Related Lower Extremity Lymphedema: A Systematic Review of the Literature. *J Clin Med.* 2020;9(10):3200
5. Chakraborty S, Gurusamy M, Zawieja DC, Muthuchamy M. Lymphatic filariasis: Perspectives on lymphatic remodeling and contractile dysfunction in filarial disease pathogenesis. *Microcirculation.* 2013;20(5):349–364.
6. Park KE, Allam O, Chandler L, Mozzafari MA, Ly C, Lu X, et al. Surgical management of lymphedema: a review of current literature. *Gland Sur.* 2020;9(2):503-511.
7. Mousavi SR, Mehdikhah Z. Surgical Management of Chronic Lymphedema; Introducing an Innovative Procedure. *Iran J Pediatr.* 2008;18(3):257-262.
8. Schaverien MV, Coroneos CJ. Surgical Treatment of Lymphedema. *Plast. Reconstr. Surg.* 2019; 144:738-744.
9. Johannes C van der Walt¹, Timothy J Perks, Barend J vR Zeeman, Andrew J Bruce-Chwatt, Frank R Graewe. Modified Charles procedure using negative pressure dressings for primary lymphedema: a functional assessment. *Ann Plast Surg.* 2009 Jun; 62: 669-75.
10. Mehrara BJ, Zampell JC, Suami H, Chang DW. Surgical Management of Lymphedema: Past, Present, and Future. *Lymphatic Research and Biology.* 2011;9(3):159-167.
11. Rockson SG, Rivera KK. Estimating the population burden of lymphedema. *Annals of the New York Academy of Sciences.* 2008 May;1131(1):147-54.
12. Maruccia M, Chen HC, Chen SH. Modified Charles' procedure and its combination with lymph node flap transfer for advanced lymphedema. In *Lymphedema 2015* (pp. 289-299). Springer, Cham.
13. Williams NS, Bulstrode CJK, O'Connell PR. *Bailey and Love's short practice of surgery.* 26th edition. Newyork: CRC Press; 2013. 74.
14. Lymph node transfer: Planning and recovery: Medstar health [Internet]. *Planning and Recovery | MedStar Health.* [cited 2022Mar18]. Available from: <https://www.medstarhealth.org/services/lymph-node-transfer>
15. Dellon AL, Hoopes JE. The Charles procedure for primary lymphedema. Long-term clinical results. *Plastic and reconstructive surgery.* 1977 Oct 1;60(4):589-95.
16. Homans J. The treatment of elephantiasis of the legs: a preliminary report. *N Eng. J Med.* 1935; 215:1099.
17. Miller TA, Harper JD, Longmire WP Jr. The management of lymphedema by staged subcutaneous excision. *Surg Gynecol Obstet.* 1973; 136:1.

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