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The Versatility of Reversed Turn-Over Latissimus Dorsi Muscle Flap for Reconstruction of Meningomyelocele Defects

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ABSTRACT

Closure of large thoracolumbar or lumbosacral meningomyeloceles closure poses a great challenge to the neurosurgeon and the plastic surgeon. Obtaining good coverage of the meninges is a lifesaving measure that prevents major complications and preserves maximum function. Attempts at direct closure are associated with problems of wound breakdown, skin necrosis, and infective complications. In an effort to overcome these problems, a variety of reconstructive procedures have been described. We present a technique for reconstruction of the meningomyelocele defects using reversed latissimus dorsi muscle flap covered by split-thickness skin graft. Thirteen neonates with large meningomyeloceles were operated upon between June 2009 and July 2011. Our patients operated in the first days of life; (2-9 days) and had medium birth weight 2.3kg (range 1.9kg-3.3kg). Defect size ranged from 7x5 to 9.5x8cm. We did not encounter any major wound complications apart from 2 patients with partial loss of the skin graft over the muscle flap treated conservatively until complete healing, seroma formation in the donor site of the flap in 3 patients managed by repeated aspiration and compressive dressing, and 3 patients with CSF leak from between the sutures which controlled after insertion of ventriculoperitoneal shunt within the first 5 days post-operatively. All patients followed post-operatively for a period from 3-12 months. In addition, all patients had stable and reliable wound coverage and none of them showed any morbidity related to the procedure.

INTRODUCTION

The main challenge presented by meningomyelocele defect is to repair the dura adequately and to create a durable surface cover without functional loss and without excessive traumatization of the very small, newborn infants. Due to the thin and vulnerable skin, an emergency closure is required because this is the best way to avoid meningitis originating from the ascending infection. In addition, placing the neural elements back in the spinal canal and closing it with dura protects the working neural elements and helps to keep mobility **[1]**. The dural sac should be covered with good skin without tension at the edges of the wound. Primary wound closure in such cases is impossible. A variety of reconstructive procedures have been described for the closure of broad-based myelomeningocele defects **[2,3]**. The efficient redistribution of available tissue by the combined use of transposition and advancement principles resulted in the repair of relatively large skin defects with reduced tension along the closure **[4]**. As for closure of the large thoracolumbar or lumbosacral defects, the literature suggests a number of convincing, clever, and effective bipedicled and island flap procedures using surrounding skin, subcutis, and most frequently muscle, but periosteum and muscle turnover methods as well as musculocutaneous advancement and the use of tissue expansion have also been proposed, bilateral modified V-Y advancement flap **[5-9]**. The reversed Latissimus dorsi muscle flap is a versatile modality for the reconstruction of large meningo-myelocele defects which will be discussed.

PATIENTS AND METHODS

Thirteen neonates with large meningo–myeloceles were operated upon between June 2009 and July 2011. In all cases the lower limbs showed paraplegia, hypotonia, areflexia, and complete anesthesia; in addition there was rectal and urine incontinence. All patients were operated in the first days of life; (2-9 days), had medium birth weight 2.3kg (range 1.9kg-3.3kg), and defect size ranged from 7x5-9.5x8cm. After stabilization, thorough examination and documentation of any deficit or other congenital anomalies of the baby by NICU staff, patient taken to operating theatre.

Operative details:

After induction and positioning (prone position), the neurosurgeon started exploration, lysis of the tethered cord, repositioning of neurofilaments and

closure of the dural sac (Fig. 1b). The reversed Latissimus Dorsi muscle flap is designed for transposition. The superficial surface of the muscle is identified through an oblique incision extending from the posterior axillary fold to the loin (not connected with the meningocele defect). The muscle insertion is divided within the axilla, after elevation of the fibres of insertion, the thoracodorsal artery, paired venae comitantes, and nerve are identified and divided (Fig. 1c). As the deep lateral surface of the muscle is visualized, dissection proceeds toward the posterior trunk midline. At a distance of 4-6cm from the midline, the segmental pedicle from the posterior intercostals and lumbar arteries are visualized and preserved. The superior Latissimus dorsi muscle fibers of origin are divided as required to obtain an adequate arc of rotation to the defect, the flap is then based on two large perforating vessels. A wide subcutaneous tunnel created between the flap harvesting site and the meningo-myelocele defect site, then the muscle is turned over through the tunnel and insetted over the defect (Fig. 1d,e). A split thickness skin graft harvested from the the thigh applied over the outer surface of the muscle and fixed by tie-over dressing (Fig. 1f). The donor site of the flap closed directly with suction drain (Fig. 2e,f).

The operative time ranged from 1.5 to 2.5 hours and all cases were done under general anaesthesia. Postoperatively, all patients were maintained in a prone or lateral position in NICU for few days, drainage tube was removed on the 3rd postoperative day, and stitches usually removed after 10 days. Patients stayed in NICU from 5-13 days. After discharge, the patients followed in neurosurgery and plastic surgery outpatient departments.

Case presentation:

Two cases are presented showing the different surgical steps; planning, positioning, harvesting the reverse latissimus dorsi muscle flap, turning over and insetting the flap to fill the meningomyelocele defect, applying split-thickness skin graft to cover the muscle, the immediate postoperative and late results. Case I and Case II, (Figs. a,b,c, d,e,f,g) are examples.

RESULTS

Thirteen neonates with large meningo–myelocoeles, 7 females and 6 males, operated during the period from June 2009 to July 2011, all the patients tolerated the procedure without major risks, we did not encounter any major wound complications apart from 2 patient with partial loss of the skin graft over the muscle flap which treated conservatively until complete healing, seroma formation in the donor site of the flap in 3 patients which managed by repeated aspiration and compressive dressing, and 3 patient with CSF leak in between the sutures which controlled after insertion of ventriculo-peritoneal shunt within the first 5 days post operatively. None of our patients received intra or postoperative blood transfusion. All patients showed very satisfactory results on discharge and on follow-up. All patients followed post-operatively for a period from 3-12 months. In addition, all patients had stable and reliable wound coverage and none of them showed any morbidity related to the procedure.

DISCUSSION

One of every 800 infants is born with spina bifida cystic. The disease includes a number of conditions in which epithelium-lined sacs filled with cerebrospinal fluid are in free communication with the spinal subarachnoid space. There is usually associated mal-development of the spinal cord, some paralysis of the lower limbs and sphincter and a variable sensory deficit **[10]**. Much of the discussion regarding patients with myelomeningoceles has focused on the long-term sequelae and survival, but the focal point of controversy is the decision when to operate and how to close the defect **[11]**. The proper defect closure maximizes the neurological salvage by preventing both infection and neural desiccation **[12,13]**. Primary closure in cases of meningocele and myelomeningoceles has been reported at rates of 75-95%. This primary wound healing can be attained in small myelomeningocele defects with wide undermining of the wound edges and direct closure of the wound **[14,15]**.

Patterson and Till **[16]**, in a series of 130 infants with myelomeningoceles observed that only 25% required more elaborate closure techniques than primary closure. Defects larger than 5x8cm in diameter require close co-operation between the neurosurgeon and the plastic surgeon **[17,18]**. Several variations of skin flaps have been described to close larger myelomeningocele defects.

Advancement flaps **[14]**, bipedicle flaps **[15]** local transposition flaps **[16]**, rotation flaps **[19,20]**, and Limberg type flaps **[21,22]** have all been utilized successfully in achieving closure of large myelomeningocele defects. These flaps, however, have random blood supply, require extensive skin undermining and involve a 20% risk of necrosis with an inherently greater incidence of wound edge failure **[2,23,24]**.

CASE I

Fig. (1A): Meningomyelocele of the back.

Fig. (1B): Opening of the sac and closure of the neural defect.

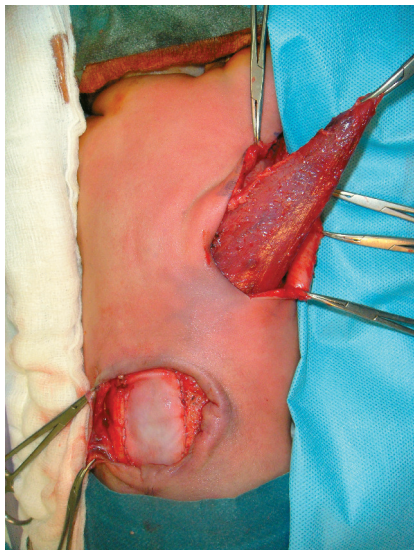

Fig. (1C): Harvesting reverse latissimus dorsi ms. flap.

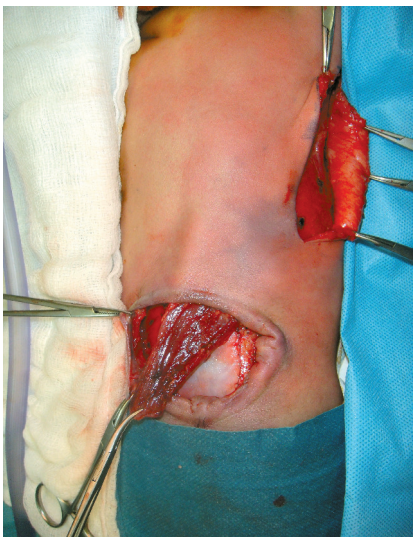

Fig. (1D): Transfer of the flap to the defect.

Fig. (1E): Insetting of reversed latissimus dorsi muscle flap over the defect.

Fig. (1F): Split thickness skin graft covering the muscle flap.

Fig. (1G): Post operative result, complete healing of the flap and the donor site.

CASE II

Fig. (2A): Meningomyelocele of the back.

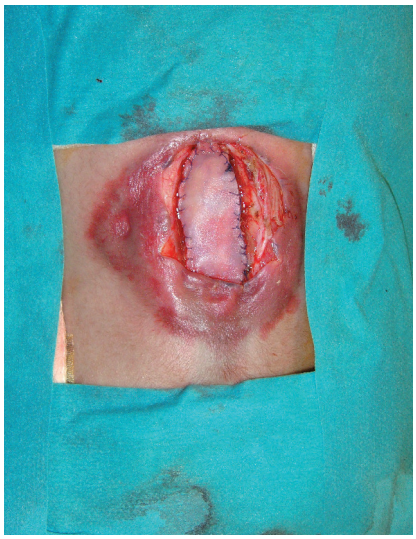

Fig. (2B): Opening of the sac and closure of the neural defect.

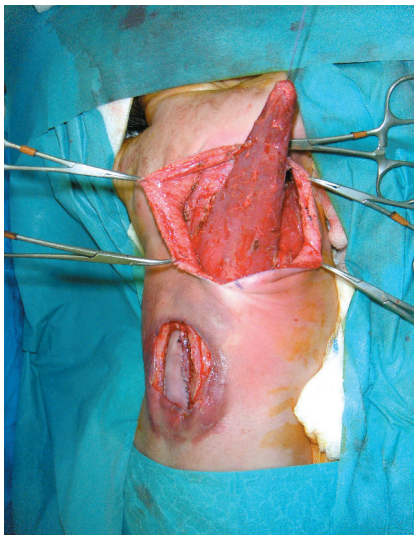

Fig. (2C): Harvesting of Rt. Reversed Latissimus dorsi muscle flap.

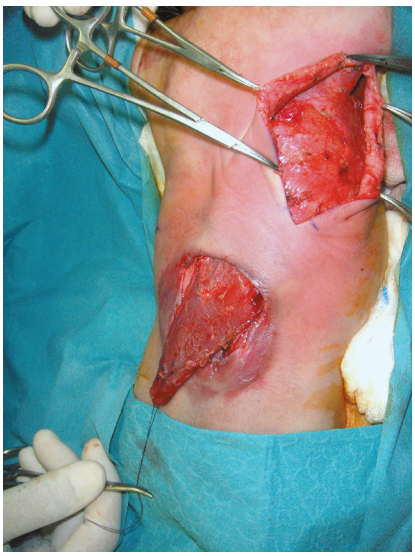

Fig. (2D): Transfer of the reversed flap to the meningomyelocele defect.

Fig. (2E): Insetting of the reversed LD muscle flap over the defect.

Fig. (2F): Application of the split-thickness skin graft over the muscle flap.

Fig. (2G): Complete healing of the flap and the donor site.

Luce and Walsh **[25]** reported satisfactory results with the use of split thickness skin grafts with low morbidity and mortality. However, a long-term follow-up by the same authors revealed a 23% incidence of chronic and/or severe skin ulceration requiring secondary surgery **[26]**. The advent of myocutaneous flaps has allowed for the use of compound tissue flaps with dependable blood supply to promote early and predictable healing. Utilization of muscle tissue provides additional padding in the repair of large defects **[27,28].**

There are several descriptions of bilateral latissimus dorsi musculocutaneous flaps for the reconstruction of thoracolumbar defects **[29]**. McCraw et al. **[28]** used bilateral bipedicled flaps without lateral relaxing incisions. On the other hand, Moore et al. **[30]** stated that relaxing flank incisions were necessary for primary closure without creating undue tension on the midline wound in the majority of their cases. Bilateral latissimus dorsi V-Y musculocutaneous flaps described for closure of large meningomyelocele defects **[17,31]**. Clark et al. **[32]** and Scheflan et al. **[33]** reported on the use of "reversed" or distally based latissimus dorsi muscle flaps, employing the deep paraspinous perforators for their blood supply. The procedure is associated with destroying the insertion of the latissimus dorsi muscle which is valuable in the paraplegic patients **[34]**.

There are many techniques available in the armamentarium of the plastic surgeon that can be useful for coverage of myelomeningocele defects. Whatever the technique used, it should be tension free, provide good soft tissue padding of the neural tube, prevent CSF leakage and should also provide stable and durable wound healing, especially for large defects. The technique used in this study meets with these criteria and, in addition, the muscle helps to obliterate any dead space and seals the dural repair. It has good blood supply, so it helps to deliver antibiotics and improve leucocyte function in the recipient site, thus preventing infection. The muscle flap also provides good padding of the back defect, which helps in wound stability and durability, and this is very important for these patients who might be wheelchair bound for most of their time in the future **[18,35,36]**.

Some authors **[17,37]** do not like sacrificing the latissimus dorsi muscle for fear of the functional deficit of the upper limb that might affect the use of wheelchairs by paraplegic patients. However, others **[38,39]** reported that removal of the latissimus dorsi muscle does not functionally impair strength or range of motion in the upper extremity. Longer follow-up of the patients should be available to detect any functional disability related to the procedure. In this technique, we used unilateral latissimus dorsi muscle for closure of large defects and we totally preserved the other muscle. Using the reverse pedicle flaps in this conventional manner could make the arc of flap rotation markedly restricted if more than two secondary pedicles are included **[40]**. Therefore, it is difficult for this flap to cover the contralateral side of the midline in cases of large lower defects. Many authors **[17,41,42]** overcome this problem by using bilateral reversed latissimus dorsi musculocutaneous flaps. On the other hand, transferring the flap as a muscle flap in a turnover manner gives a larger arc of rotation, especially after division of the superior muscle fibres of origin, allowing the flap to easily reach the contralateral side of the midline, providing big amount of tissues to cover large lower defects **[36,40,43]**.

The most frequently reported complication of latissimus dorsi flap harvest has been seroma formation at the donor site **[44,45]**. Friction of the wound layers and fat necrosis from the liberal use of electrocautery were reported as major causative factors in the formation of seroma after latissimus dorsi harvest **[46]**. In conclusion, large myelomeningocele defects represent a major challenge for the plastic surgeon. The use of the reversed turnover latissimus dorsi muscle flap is versatile in reconstruction of these complex large defects. This technique has the following advantages: (1) it provides a large amount of well-vascularised tissue to fill these large defects, obliterate any dead space and cover the exposed neural elements, (2) it seals the dural repair preventing CSF leakage and subsequent infection, (3) it provides good amount of tissue padding over the neural tube, (4) it allows for tension-free, durable and reliable primary skin closure, and (5) low donor-site morbidity.

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