

Dorsal intercostal artery flap; A reliable option for coverage of myelomeningocele defects: A case series

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Abstract

Meningomyelocele is a common congenital condition and its reconstruction poses a challenge for surgeons. The dorsal intercostal artery (DICA) flap offers a one-stage tension-free closure with adequate results. This study, spanning from January 2019 to September 2022, analyses the outcome of nine DICA flaps for meningomyelocele reconstruction, where the average size of the DICA flap was 6.8 x 4.6 cm for an average defect of 6.33 x 4 cm. Notably, no post-operative blood transfusion was required, nor any complications occurred except for one patient's septic shock-related death. Two had post-operative cerebrospinal fluid (CSF) leak, repaired primarily with one requiring VP shunt. Based on our experience, the DICA flap, with its consistent anatomy, is a reliable option for the reconstruction of meningomyelocele defects.

Keywords: Dorsal intercostal artery flap (DICA), Meningomyelocele, Neural tube defects, Reconstructive surgery, Fasciocutaneous flap.

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Introduction

Myelomeningocele (MMC) is a commonly seen congenital anomaly. It is a defect caused as a result of the failure of closure of neural plate edges. It is characterised as a pouch containing neural elements floored by meninges through a defect in vertebral column. Lumbosacral region is involved in approximately 66% of the cases.¹

Taylor and Palmer explained the concept of angiosome in 1987, which formed the foundation for perforator flaps.² Koshima and Soeda, introduced the use of perforator flaps in various soft tissue defects throughout the body, including MMC repairs, with promising results.³ Several methods have been reported for the coverage of MMC defect including rhomboid, rotation, and bilateral random

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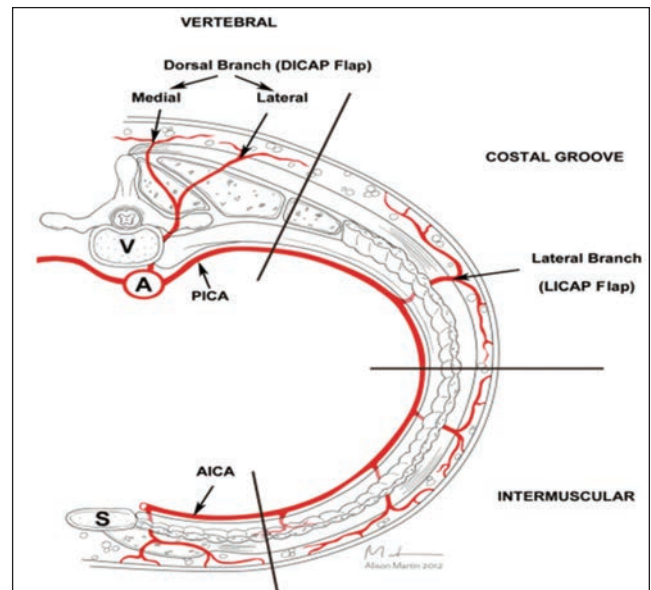


Figure: Showing anatomy of Posterior intercostal artery (PICA) and its dorsal branches.

pattern flaps. Among them DICA flap is a single stage procedure which provides tension-free closure of MMC and allows good coverage.⁴⁻⁶

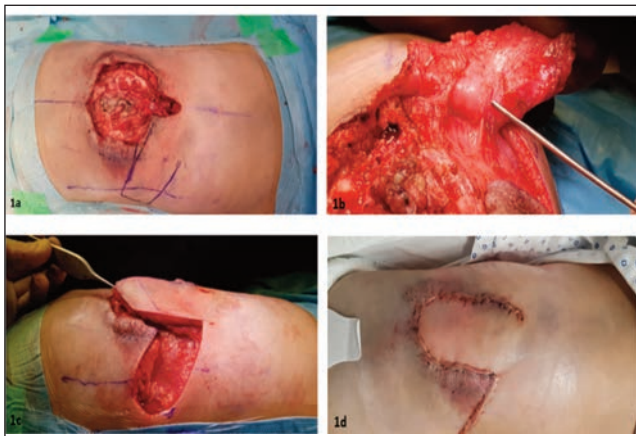
DICA is based on the dorsal branches of posterior intercostal artery (Figure) and provides an advantage of preventing an overlap between the suture lines of the skin and suture line of the underlying reconstructed neural tube.⁷ There is no mobilisation of the neighbouring fascia or muscles and the closure is tension free, with no pressure on the thecal sac. DICA flap provides coverage with tissue thickness similar to that of the surrounding tissue, and is associated with shorter operative time, less blood loss, more freedom of flap design, less morbidity at donor site, and can be used to cover MMC defects at any location.⁸ In addition to the above, it has also shown to reduce complications such as fistula formation, wound dehiscence, and flap necrosis.⁹

DICA flaps has recently been adopted as the standard skin coverage technique for MMC repairs at our centre. The purpose of this study is to explore the initial results with this technique.

Case Series

The retrospective study was conducted from January 2019 till September 2022, at the section of Plastic Surgery and Neurosurgery, Aga Khan University Hospital, Karachi, after approval from the ethics review committee. Nine patients were included in this study. Intraoperatively, once the neural repair was done by a neurosurgeon, the marking of the DICA flap was drawn on the patient. A vertical line was drawn on the midline of the back and posterior axillary line. Two more vertical lines were drawn to divide that part into three equal columns (case 3a). Then, hand held Doppler was used to identify the location of the perforator which most of the time is around the junction of the medial and central columns (case 1a). The DICA flap was then designed in horizontal orientation. The length of the flap was usually kept slightly longer than the defect but did not cross the posterior axillary line (case 2a). Pinch test was used to determine the width of the flap to utilise maximum width for adequate coverage of the defect along with a primary closure of the donor area. After markings, an incision was made, and fasciocutaneous flap raised at deep fascia plane in lateral to medial direction. The Dorsal intercostal artery perforator, often present at the junction of medial and central columns, should be identified without extensive dissection (case1b). Although visible during dissection, the flap isn't fully islanded on it, hence not termed a perforator flap. Three-sided (superior, inferior, and lateral) incisions were usually enough for the flap to reach the defect but, if needed, medial incision was also made to facilitate the rotation/transpositions of the flap (case1c). The flap was sutured at defect, in two layers (skin and subcutaneous) without any tension, followed by primary closure of the flap donor site (case1d, 2b, 3b).

Among the nine patients, six were males and three were



Case-1: (1a) Meningomyelocele defect and marking of DICA flap. (1b) DICA flap harvested and perforator identified. (1c) DICA flap after transposition. (1d) Postop picture of DICA flap covering the defect, outcome of flap after 10 days.



Case-2: (2a) Defect after repair of Meningomyelocele and marking of DICA flap. (2b) 2 weeks after DICA flap reconstruction of the defect.

Case 3: (3a) Preoperative marking of DICA flap on both sides (3b) 10 days After closure of defect with DICA flap

females with male to female ratio of 2:1. Two patients presented late at the age of 10 months and two years, respectively, as both of them were paraplegic, while others were operated at an average age of 10 days (range 2 – 30). The defects were either lumbosacral or lumbar, with a mean defect size of (6.33±2.77) x (4±0.94) and a mean flap size of (6.8±3.04) x (4.6±0.82).

All the patients were daily followed-up until discharge, with follow-ups at the clinic averaging five months and the longest for 12 months. One patient died of septic shock on the third post-operative day. Two had post-operative CSF leakage which were repaired primarily. No blood transfusions were required, and no complications (haematomas, infections, fistulae, and partial or total flap loss) occurred. Two patients had minor wound dehiscence at the donor site, which was managed with dressings and eventually healed with secondary intentions. Table presents the demographics and flap outcomes.

Table: Demographics and flap outcomes.

Age in days/ Gender	Aetiology	Location of defect	Size of defect (cm)	Size of flap (cm)	Flap Outcome
300/M	Meningomyelocele+ hydrocephalus	Lumbosacral	9 x 4	10 x 5	Survived
4/F	Meningomyelocele	Lumbosacral	12 x 4	13 x 5	Survived
2/M	Meningomyelocele+ hydrocephalus	Lumbosacral	7 x 5	8 x 5	Survived
15/F	Meningomyelocele+ hydrocephalus	Lumbar	8 x 4	8 x 5	Survived
19/M	Meningomyelocel+ hydrocephalus	Lumbosacral	6 x 6	7 x 6	Survived
10/M	Meningomyelocele+ hydrocephalus	Lumbar	4 x 3	4 x 4	Survived
425/M	Meningomyelocele	Lumbosacral	4 x 3	4 x 4	Survived
02/M	Meningomyelocele	Lumbosacral	3 x 3	4 x 3	Survived
30/F	Meningomyelocele+ hydrocephalus	Lumbar	4 x 4	4 x 5	Survived

Discussion

Surgical repair is the standard treatment method for meningomyelocele. Foetal surgery for meningomyelocele has been practiced with fewer neurological deficits at the expense of foetal complications but currently, early postnatal repair procedure is being routinely done.¹⁰ The goal of surgical repair for meningomyelocele is to give an adequate coverage to the exposed spinal cord and neural structures, that would help to prevent CSF leakage and reduce the chances of infection.¹¹

A variety of surgical techniques have been introduced to repair meningomyelocele.⁶ Small defects can be closed primarily after dural repair if it can be achieved without any skin tension. It needs thorough monitoring to observe signs of ischaemia, such as skin discoloration. For defects larger than 5 cm, it is recommended that it should be covered with one of the following after dural repair: (i) larger cutaneous skin flaps, (ii) fasciocutaneous skin flaps, or (iii) muscle flaps.¹² Several methods such as Z-plasties, V-Y advancement flaps, muscle flaps, random-pattern fasciocutaneous flaps (rotational flaps), have been used as surgical closures of meningomyelocele defects. Out of these, DICA flap⁴ gives an additional benefit by providing a one-stage, tension-free closure of meningomyelocele defects.^{5,6}

Lobo et al. (2018) demonstrated a primary closure for meningomyelocele defects under 3cm in nine patients, resulting in CSF leakage in all cases and wound dehiscence in six patients. Consequently, a recommended intervention was fasciocutaneous skin flaps. In cases where defects were larger than 3 cm, a V-Y fasciocutaneous flap was employed, showing fewer complications than primary skin closure in the same study.¹¹

Luce et al. who used rotation skin flaps for meningomyelocele defects, reported its efficacy in covering large mid-line defects with minimal CSF leakage and low skin tension. However, this technique led to prolonged operating times, increased blood loss, longer anaesthesia, and more cautery use, elevating the risk of surgical site infections.¹³

Muscles and its innervations remain intact in case of fasciocutaneous skin flaps as compared to muscle-cutaneous flaps; therefore, they maintain their functions.

Successful closures of myelomeningocele defects were reported by some authors using a muscle flap.¹⁴ However, prolonged operating time, increased blood loss, and loss of major muscles are disadvantages of this procedure.¹⁵ Strong back muscles are important to maintain the trunk posture, pelvic stability and for activity in patients who are

bed-ridden or on wheelchair and at risk of paraplegia.¹¹

In a study of 27 patients with myelomeningocele defects undergoing DICA flap, the fasciocutaneous skin flap provided ample coverage with a good blood supply, ensuring no overlap between the suture line and dura. Although the defect size was large, none of the patients needed blood transfusion. Flap donor site was closed primarily in all patients. Two patients presented with marginal necrosis of the distal part of the flap.⁶ The advantage lies in the intact surrounding skin on three sides, offering multiple secondary flap options in case of complications. Bilateral flaps can be utilised for wider defects, allowing primary closure of both donor sites.

Conclusion

DICA flaps are optimal for myelomeningocele defects, offering excellent soft tissue coverage, blood supply, and seamless neural line repair. With no scar line overlap, intact surrounding skin, and minimal donor-site morbidity, DICA flaps stand out with fewer post-operative complications.

Consent: Verbal consent has been taken from all the parents/guardians of the patients for the publication of this case report.

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Author Contribution:

MK: Writing and data collection.

FS: Data interpretation and results.

MT: Worked primarily on statistics.

MSS: Operated these cases and provided data.

SAS: Provided all data, pictures, patients details and writing.