Case Report

BERAM Flap to the Rescue; Perioperative Journey from ER to OR to Recovery in a Three-year-old Child having Type 3c Compound Fracture with Vascular Involvement

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Abstract

Systematic approach to a paediatric trauma victim who has sustained life threatening injuries calls for good pre-hospital care, triaging in the emergency room and effective management consisting of primary survey along with skilled resuscitation followed by secondary survey. After stabilization, it is essential to know the severity of injury and soft tissue defect by vigilant clinical examination, coupled with assessment by established scoring systems, such as GANGA and MESS, in order to plan further management. Recent guidelines in polytrauma management stress on initial damage control surgery for achieving haemostasis and debridement, followed by definitive reconstructive procedure. The procedure involves essential management of type 3c compound fracture with vascular involvement by damage control surgery along with vascular repair by saphenous graft followed by unique method of BERAM flap in continuity with Lattismus dorsi myocutaneous flap subsequently. Because of its role in hemodynamic stability and regional blood flow, anaesthesia is an important determining factor in the success of microvascular free flap surgeries. Stabilizing haemodynamic and achieving normal metabolic and biochemical parameters is essential. Our case report is aimed at reviewing the relevant aspects of anaesthetic practice in a procedure involving microvascular flaps.

Key words: Anesthesia, BERAM flap, GANGA scoring system, microvascular surgery, vascular repair

Introduction

Primary survey with focus on airway, breathing and circulation, followed by secondary survey and serial assessment of general condition and haemodynamics of a child help in achieving favourable outcome and minimize morbidity associated with trauma. In addition to stabilizing haemodynamics and fractures, it is vital to ensure good coverage of soft tissue defects following trauma. Not many cases of BERAM flap has been reported in literature. This is first of its kind unique flap in pediatric age for covering large soft tissue defects being performed at our institute. Hence we would like to share our experience.

Case History

At 2:00 PM on 19th February 2016, a 3-year-old girl riding pillion on a two-wheeler was run over by a truck and sustained severe leg injury. On arrival, child was conscious, oriented and obeyed commands. Her blood pressure was 90/60 mmHg, heart rate was 140 beats per minute. The airway was patent and was breathing adequately. Her left leg was crushed from the medial aspect of the thigh to the medial aspect of the lower leg. Her GANGA score was found to be 11.

After an initial fluid resuscitation in the emergency department, blood samples were sent for relevant investigations. The child

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was wheeled to the operation theatre for debridement, external fixation, and vascular repair.

Anaesthetic management

Child was induced with sevoflurane fentanyl and 10 mg of propofol. Relaxation was done with atracuriun 7.5 mg, endotracheal intubation with 5.5 mm uncuffed endotracheal tube. B/L air entry checked, the left radial artery was cannulated with 22 g vasofix, and right internal jugular vein was cannulated using a 5.5 Fr. 8 cm triple lumen CVP catheter. Then, Foleys catheterization was done.

Anaesthesia was maintained with Gas O_2 (50:50) isoflurane 0.8 to 1.0 MAC, fentanyl, and atracurium supplemented as required. Core temperature was monitored using nasopharyngeal probe. Extensive measures were taken to prevent hypothermia by using warming blankets, and warm intravenous fluids [Figure 1].

Circumferential degloving of the skin, lower third of the thigh and knee and upper two-thirds of the leg. Along with fractured femur, tibia along with severed popliteal vessels was observed intraoperatively [Figure 2]. Fracture was stabilized with external fixator [Figure 3].

Femoropopliteal artery and vein was repaired with 7 cm vein graft. Foot vascularity was regained and haemostasis was achieved. After the procedure, the patient was shifted to the intensive care unit for ventilation.

Figure 1: Type 3C fracture femur and both bones of the left leg

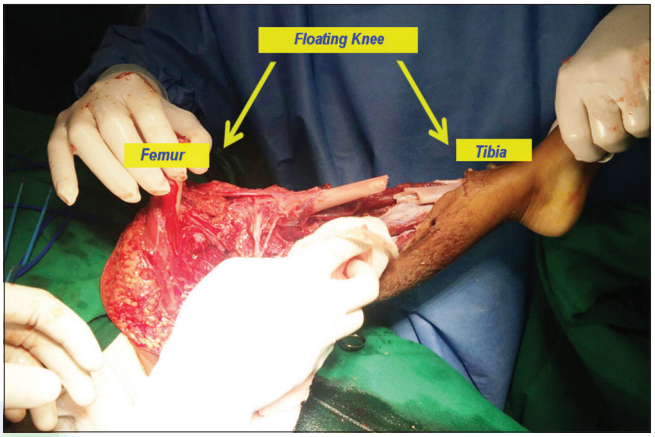

Figure 2: Floating knee, femur, and tibia

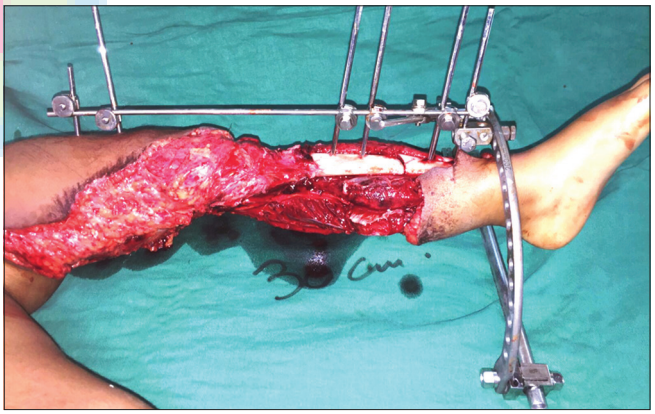

Figure 3: Post debridement defect with external fixation *in situ*

Discussion

Trauma is the leading cause of death and disability in children and adolescents.[1] On arrival in the emergency room, the child presented with type 3(c) compound fracture of left Leg and was in hypovolemic shock. Systematic assessment of the child was performed in accordance to the advanced trauma life support (ATLS) protocol.[2]

Detailed examination of the injured limb was performed by the surgical team to assess the severity of musculoskeletal damage and neurovascular status.[3] Considering early presentation following injury, child's age and a favourable GANGA Score,[4,5] a decision was taken to salvage the limb rather than amputate. The initial plan was damage control surgery followed by definitive reconstructive procedure.[6]

The child was rushed to the operation theatre for damage control surgery[7] consisting of haemostasis, debridement and external fixation with vascular repair. Popliteal artery and vein were reconstructed with 7 cm saphenous vein graft. In addition to warm crystalloid, the child also received 2 PRBC and 1 FFP. Intraoperatively, normothermia was maintained along with adequate intravascular volume and mean arterial pressure at >60 mmHg to ensure good arterial perfusion. It was decided to electively ventilate child at the end of surgery for normalization of metabolic parameters.

Blood samples were sent for ABG, serum lactate, and other relevant investigations. Fresh frozen plasma and platelets were transfused to correct deranged coagulation profile and thrombocytopenia. Acidosis normalized and normothermia was maintained.

Next morning, sedation was stopped to assess the child's neurological status. Child was following commands and moving extremities. Following damage control surgery with vascular repair[8] in a child, there is always a possibility of developing systemic inflammatory response syndrome (SIRS), acute respiratory distress syndrome (ARDS), etc. in view of extensive crush injury and multiple blood transfusion. Hence, it is vital to maintain adequate intravascular volume and oxygenation parameters within normal range and to keep lungs dry. Haemodynamic parameters were within normal

range without need of ionotropic support, urine output was adequate, serial lactate levels were normal, and blood gases were within normal range. Hence, it was decided to proceed with reconstructive surgery in the form of free flap cover for significant soft tissue defect. Conventional flap techniques of harvesting anterior lateral thigh or Gracilis or Lattismus dorsi flap were inadequate to cover the extensive defect. BERAM flap[9] in continuity with Lattismus dorsi was selected to cover the big defect [Figure 4]. Advantages with this free flap are that it provides longest skin paddles in body, it is easy to harvest, has long reliable vascular pedicle, and it causes minimal donor site morbidity [Figure 5].

We encountered obstacle during donor area defect closure or rectus sheath closure. There was consistent increase in airway pressure, tachycardia, and upsloping ET CO_2 pattern due to raised intra-abdominal pressure. Surgeons had to perform component separation of rectus, i.e., dividing it from the external oblique and then closing the rectus sheath.

Prolene mesh was used to augment rectus sheath repair. Skin-to-skin approximation was done to cover the exposed mesh and the rest of defect covered with skin graft [Figure 6]. The cornerstone for achieving success in microvascular free flap is to have an in-depth understanding of physiology of microcirculation.[10] Laminar blood flow in microcirculation is guided on basis of Hagen Poiseuille law.

$$Q = \frac{\Delta P\, r^4}{8nl}$$

'Q' : Laminar Flow

Delta P : Pressure Difference b/w 2 ends of Tube

'r : Radius of Vessel

'n' : Viscosity

'l' : Length of Vessel

Common reasons attributed to the failure of flap[11] are arterial and venous thrombosis, hypothermia and vasospasm, increased viscosity fluid overload leading onto flap edema, and systemic hypotension. Throughout the intraoperative period, ambient temperature in the operation theatre was maintained at approximately 25 and warming devices and warm fluids were used.

Adequate intravascular volume and mean arterial pressure was maintained by the judicious use of fluids/blood products. It was ensured that urine output was maintained at approximately 1 to 2 ml/kg/h. To aid in the rheology of microcirculation, NS 500 ml with 5000 U heparin was administered at 10 ml/h. ABG with lactate levels Hb/PCV at 2 hourly intervals were done. Judicious fluid management coupled with serial blood investigations, aided by serial trend in CVP, and quantifying

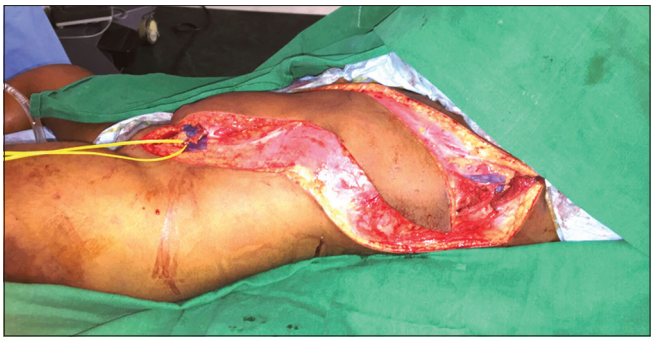

Figure 4: Proposed free flap cover (extended BERAM)

Figure 5: Extended BERAM Flap (after harvest)

Figure 6: Donor area closure (primary closure + skin graft)

hourly urine output helped in achieving optimal fluid balance vital for microvascular surgeries.[12]

In view of two major surgeries, raised intra-abdominal pressure in intraoperative period, significant fluid shifts, and prolonged surgery, it was decided to electively ventilate child at the end of surgery. Child was adequately warmed; all biochemical and metabolic parameters were optimized, gradually weaned off ventilatory support, and then extubated. Postoperative pain was managed with fentanyl infusion and intravenous Paracetamol. Child was monitored in the ICU to check flap viability, adequacy of arterial perfusion, and was subsequently shifted to High Dependency Unit (HDU) [Figure 7].

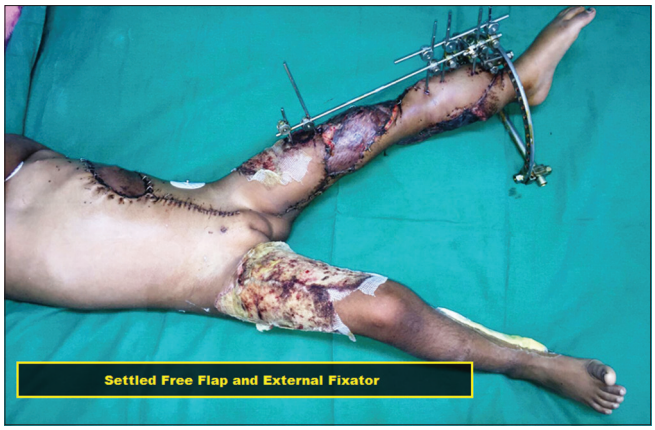

Figure 7: Two weeks post operation; settled free flap and external fixator

Conclusion

BERAM flap in continuity with Lattismus dorsi flap helped in achieving good soft tissue coverage in spite of a large area of defect. In addition to adhering to the basic principles of paediatric anaesthesia, it is vital for the anaesthesiologist to have a sound knowledge of microvascular circulation as well as about the various physiological aspects governing laminar flow in microcirculation.

Managing a paediatric case with compound fracture of extremities and extensive crush injuries is a challenge. However, a dedicated team involvement ensuring clear communication and close coordination between the surgeons and anaesthesiologists minimizes any morbidity associated with long operative times.

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Conflicts of interest

There are no conflicts of interest.

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