TEMPORARY INTRA VASCULAR SHUNT FOR VASCULAR TRAUMA

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ABSTRACT

Objective: To highlight the efficacy of temporary vascular shunts in saving life and limb.
Study Design: Case series.
Place and Duration of Study: Combined Military Hospital Rawalpindi, Lahore and Combined Military Hospital Quetta, from May 2006 to Jul 2014.
Methodology: The data of those patients who had temporary intra vascular shunts were analyzed for the demography, location of hospital for shunt placement, material used as shunt, time of vascular repair after shunt placement, shunt patency and limb survival.
Results: A total of 21 (All male, mean age 32 ± 17 years) patients of arterial trauma were included. 16 (76.1%) shunts were placed in peripheral hospitals for transportation while 5 (23.8%) were placed in tertiary care hospital, out of which 2 (9.5%) were for vascular damage control while 3 (14.2%) were for orthopedic surgery before definite vascular repair. Mean time to definite vascular intervention was 8 ± 6 hours. Prior to placing vascular shunt, distal embolectomy was done in 8 (38%) cases; while distal compression, back bleed and irrigation with heparinized saline were done in 13 (62%) cases. Nineteen (90%) shunts were patent at the time of definite vascular repair while 1 (5%) patient had amputation and 1 (5%) died before definite vascular repair.
Conclusion: Temporary vascular shunt is an effective adjunct in the management of extremity vascular trauma for gaining time before definite vascular repair and in saving limb and life.

Keywords: Arterial trauma, Temporary vascular shunt, Vascular damage control, Vascular Repair.

INTRODUCTION

Being the front-line state in the war on terror, both civil and military population of Pakistan has suffered huge damage in bomb blasts in the last decade. That's why the overall incidence of vascular trauma has increased[1,2]. Temporary vascular shunt has a very important life & limb saving role as it decrease the ischemia time in a peripheral vascular injury[3]. French surgeon Professor Tuffier in 1915 first described the use of temporary vascular shunts by using paraffin coated silver tubes. These shunts kept on evolving until the recent technique of shunting was described by Eger *et al* in 1971[4]. Since then many studies support the use of these shunts in vascular trauma.

Temporary vascular shunts are indicated in mass casualty scenario, damage control surgery, Gustilo III C orthopedic injuries with associated vascular injury, perfusion prior to limb replantation, complex zone III neck injuries and in transportation of a patient with vascular injury from peripheral to tertiary care hospital[5]. The damaged artery is exposed, ante grade and retrograde bleeding from both ends is confirmed and any tube of matching caliber with the injured vessel is used as temporary vascular shunt. It is then secured with sutures on both ends[6].

The idea of presenting this series of 21 patients of vascular trauma managed with temporary vascular shunts is to highlight the efficacy of its use in reducing ischemia time and saving life and limb. Considering the health care situation of a country like Pakistan where facility of vascular surgeon is not frequently available even in most of district headquarter hospitals, use of temporary vascular shunts in managing vascular trauma becomes even more important.

METHODOLOGY

This case series study was conductd at Combined Military Hospital Rawalpindi, Lahore and Quetta, from May 2006 to July 2014. The data of the patients of extremity arterial injury, who had temporary vascular shunts were collected and analyzed for demography, location of hospital for shunt placement, material used as shunt, time of vascular repair after shunt placement, shunt patency and limb survival, after taking hospital ethical review board permission. We had 21 patients during our study duration so we included all of them[7]. Patients were recruited through non-probability consecutive sampling technique after taking informed consent. All the patients of either gender managed with vascular shunt were included in the study excluding

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the patients with unsalvageable extremity. In orthopedic cases the temporary intravascular shunt was used to reduce ischemia time before fixation of the bone, similarly shunts were placed in mass casualty scenario and performing damage control surgery. After doing embolectomy of proximal and distal site with Fogarty catheter (4Fr for upper limb and 5Fr for lower limb), ensuring proximal and distal flow and irrigating both columns with heparinized saline solution, either Javed's carotid shunt, Bard Brenner shunt or matching caliber Redivac tube (after cutting its holes) were placed in the defect to bridge the injured part as shown in fig-1 & 2. It is then secured to the artery using heavy

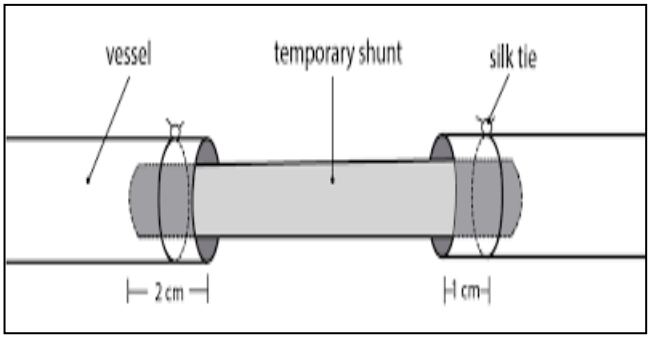

Figure-1: Temporary intravascular shunt.

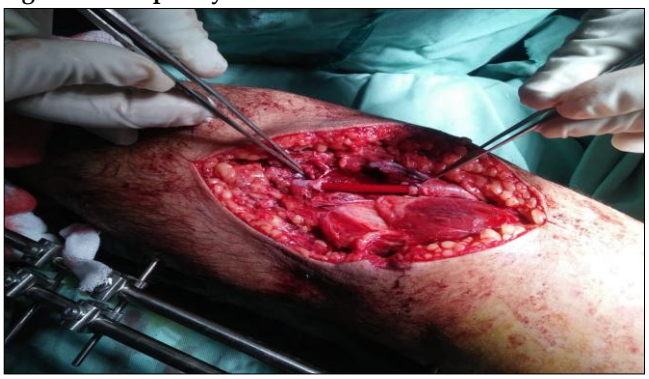

Figure-2: Temporary intravascular shunt in brachial artery.

silk suture on both ends. A third suture can also be tied in the mid portion of the shunt tube as a marker to see whether the shunt has migrated distally or not. If embolectomy catheter is not available then by manual compression of proximal and distal parts of extremity one can ensure the ante grade and retrograde flow.

SPSS-23 was used for data analysis. Mean and standard deviation were recorded for quantitative variables like age, time of placement of shunt in hours; while qualitative variables like type of shunt used, place of application of shunt, drains used, distal embolectomy procedure and limb patency were expressed as frequency and percentage.

RESULTS

A total of 21 (All male, mean age 32 ± 17 years) patients underwent temporary vascular shunts. Out of which 16 (76.1%) were placed in peripheral hospitals for transportation while 5 (23.8%) were placed in tertiary care hospital, out of which 2 (9.5%) were for damage control surgery while 3 (14.2%) were for orthopedic surgery before vascular repair. Time of placement of the shunt after injury was <2 hours in 5 (23.8%), 2 to 4 hours in 14 (66.6%) and 4 to 5 hours in 2 (9.5%) cases. Javid's carotid shunt was used in 2 (9.5%), Bard-Brenner carotid shunt in 3 (14.2%), Redivac Tube (after cutting holes) in 14 (66.6%) and Intravenous set tube in 2 (9.5%) cases as shown in fig-3. Time to definite vascular intervention was from 1 hour 15 minutes to 14 hours (mean time 8 ± 6 hours). Prior to placing vascular shunt, distal embolectomy was done in 8 (38%) cases; while distal compression, back bleed and irrigation with heparinized saline were done in 13 (62%) cases. Nineteen (90%) shunts were patent at the time of definite vascular repair while 1 (5%) patient had amputation and 1 (5%) died before definite vascular repair as shown in fig-4.

DISCUSSION

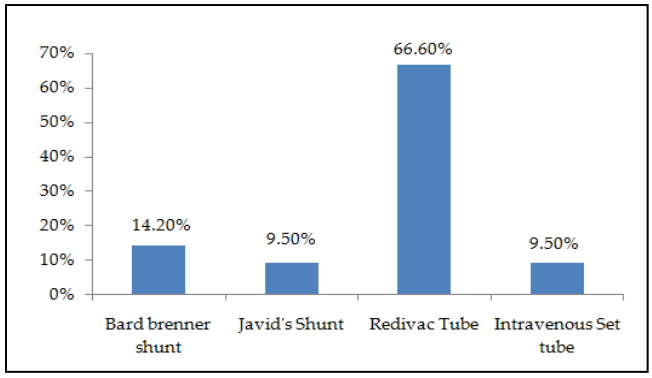

Figure-3: Percentage of material used as shunt.

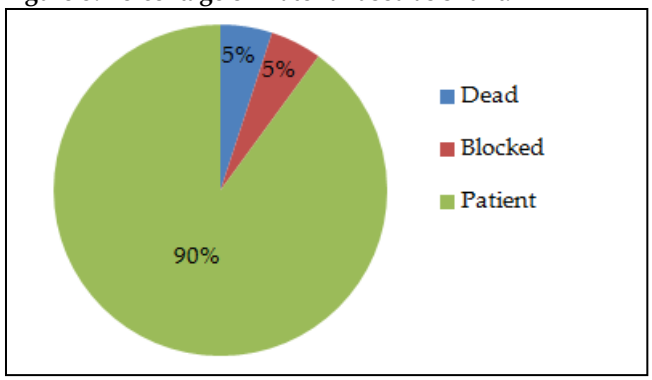

Figure-4: Percentage of shunt patency.

Vascular injury occurs as a result of iatrogenic, penetrating, or blunt injuries to the extremity; Majority are secondary to penetrating injuries[8]. Debakey and Simeone reported the amputation rate after vascular injuries during World War II to be >40%. Fortunately, the recent advancement in health care has greatly reduced this rate now[5].

A general surgeon in an emergency scenario may encounter a vascular injury and he will have to treat it when specialized vascular facility is not available. In many cases it will not be possible to transfer the patient to specialized center because of ongoing hemorrhage and delaying limb ischemia. In such situations, hemostasis and revascularization rely mainly on damage control techniques and the use of temporary vascular shunts (TVS. The long-term limb salvage results after a TVS are similar to those obtained when initial revascularization is performed[9,10,11]. The shunt time should be kept to the minimum in order to avoid complications and possible limb loss[12]. In our series the mean shunt time (time to definite vascular repair) was 8 ± 6 hours which is comparable to the international literature.

In the largest multicenter review study of temporary vascular shunt to date, by Inaba *et al*, published in March 2016, a total of 213 vascular injuries were temporarily shunted out of 7,385 patients. Gunshot wound (62.7%) was the commonest mechanism of vascular injury, followed by road traffic accidents. Both damage control (63.4%) and staged repair for combined orthopedic and vascular injuries (36.1%) were done. Superficial femoral was the commonest artery shunted (23.9%), followed by popliteal (18.8%) and brachial artery (13.2%), 81.6% patients survived till the definitive vascular repair, while the overall survival rate was 79.6%, 5.6% of the shunts thrombosed while 1.4% dislodged. The limb salvage rate was 96.3%. No deaths occurred due to shunt complication in this study[7] in our series the limb salvage rate was 90% while we have no deaths attributable to shunt complications.

Zhu *et al* shared their experience of managing 8 patients with temporary vascular shunts. These included both vascular trauma and tumor resections. In this series one patient ended up in limb amputation due to distal thrombosis. Rest of the seven patients had definite vascular repair after the completion of the initial procedure. All the patient had good limb vascularity on follow up[3].

Another study by Subramanian *et al*[13], regarding experience of temporary intravascular shunts in civilian trauma reveals 786 treated vascular injuries. Out of them 67 (9%) patients had 101 (72 arterial, 29 venous) temporary vascular shunts placed for reconstruction of Gustillo IIIC fractures, limb replantation and damage control surgery. Their study showed a shunt thrombosis rate of 5%, amputation rate 18%, overall survival 88%, and combination limb/patient survival rate of 73%. This study concluded that TVS is a reasonable bridging option to a definite vascular repair and this fact was also proved by our study.

Taller *et al*[14] published their data on temporary vascular shunts as initial mode of treatment in vascular trauma. A total of 610 patients were treated out of which 37 (6.1%) patients sustained 73 vascular injuries. Twenty-three vascular shunts were used in 16 patients. Twenty-two (95.6%) of 23 shunts were patent till the patients were received in the tertiary care facility for definite vascular repair. All shunt patients survived with 100% limb salvage. Again, the results of our series are comparable to this study as well.

Oliver *et al*[15] reported in his study that they have placed 35 TVS: 22 were part of a damage control procedure, 7 were inserted at a peripheral hospital without vascular surgical expertise prior to transfer, and 6 were used during fixation of a lower limb fracture with an associated vascular injury. There were 7 amputations and 5 deaths, 4 of the TIVSs thrombosed, and a further 3 dislodged or migrated. Twenty five patients underwent definitive repair with an interposition graft. They concluded that a TVS in the damage control setting is both life- and limb-saving.

Ayala-Hillman *et al* published their experience of vascular injury management in trauma patients with temporary vascular shunts, in Peurto Rico trauma hospital, in 2018. Out of 32 vascular trauma patients 13 needed temporary shunts. Mean shunt time was 6-96 hours. Eleven (86.5%) shunts were patent at the time of definite repair in their experience while 19 (90%) shunts were patent at the time of definite vascular repair in our study. They performed 4 (30.7%) amputations while we had 1 (5%) amputations in our study. Their 4 (30.7%) patients died of unrelated causes while only 1 (5%) death was recorded in our study. They concluded that temporary vascular shunt is an effective adjunct of damage control surgery in vascular injuries in both civil and military trauma[16].

Wlodarczyk *et al* published a multi centre review study in 2018, of 10 years data, comparing the outcome of combined vascular and orthopedic injuries in which either temporary shunts were used or not used. Out of total 291 patients, 72 had temporary vascular shunt

placement while 97 had definitive initial vascular repair. The shunted group had significantly lower rate of compartment syndrome (15% vs. 34%) as compared to non shunt group. They concluded that morbidity like compartment syndrome significantly improves with the use of temporary vascular shunt which increases the rate of limb salvage. Similar to our study results, their conclusion also favors the use of temporary vascular shunt in the management of extremity vascular trauma[17].

Van Dongen *et al* published their experience of management of major vascular injuries in Dutch role 2 medical facility in Afghanistan war in 2016. They noted that survival was better in peripheral vascular injury group as compared to central vascular injury group (96% versus 72%). Vascular shunts were used in 19/84 cases in the lower, and 7/15 in the upper limb, with a success rate of 69.2%. Amputation rate ranged from 5-60%. Similar to our study, They concluded that vascular damage control surgery with the use of temporary vascular shunts seems effective in initial limb saving[18].

CONCLUSION

Temporary intra vascular shunt is a simple and effective method of reducing ischemia time before definite vascular repair in cases of vascular trauma in special conditions like mass casualty scenario, damage control surgery, complex orthopedic fractures with associated vascular injury and inter hospital transportation of the patient.

CONFLICT OF INTEREST

This study has no conflict of interest to be declared by any author.

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