Regional Anaesthesia in a Combat Setting
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Abstract

Background: Recent advances in combat casualty care have contributed significantly to higher survival rates in previously fatal injuries from military trauma. However, most of the literature comes from international data during Operation Enduring Freedom and Operation Iraqi Freedom. Despite having conflicts, counter insurgency operations spanning over decades, very few studies in Indian scenario have analyzed injuries related to Combat and Military Trauma. Method: A retrospective observational study was done based on the records of management of military trauma cases in a zonal hospital deployed in an operational area. All trauma/combat casualties over a one year period from Oct 2018 to Oct 2019 were included and data was segregated based on type of mechanism of trauma, limb injuries involved, and choice of anaesthesia given based on type of surgery. Results: Total 371 combat casualties were included in the study, maximum patients had splinter injuries with grenade blast (43.4%), followed by gunshot wounds (39.9%). Other injuries included mine blast (11.3%) and miscellaneous including road traffic accidents (5.4%). Due to predominant involvement of limbs, regional anaesthesia was used most commonly (78%) and general anaesthesia was used only in 23.7% of cases. Conclusion: In our study maximum casualties were peripheral limb injuries both upper and lower limbs. Regional anaesthesia, peripheral nerve blocks for upper limb injuries and sub arachnoid block for lower limb injuries, were more commonly used in comparison to general anaesthesia (GA), while injuries involving body regions other than limbs were performed exclusively under GA. Keywords: anaesthesia, combat, military, injury.

INTRODUCTION

There is an ongoing worldwide epidemic, with respect to the use of opioids for pain management in the setting of trauma, to which military and combat trauma is also not excluded. Opioids are generally the first choice of analgesics in patients with multiple injuries, but they are associated with multiple adverse effects, including nausea, vomiting, constipation, delirium, vasodilation and hypotension (especially in hypovolemia), respiratory depression, pruritis and immunosuppression and hence there is an increased requirement for nursing care to monitor the patient. In various studies opioid use has also been associated with increased length of hospital stay. Presently, multimodal approach for pain relief using regional anaesthesia instead of single drug opioid therapy is becoming the standard of care in routine elective surgeries. This has resulted in a significant decrease in opioid-related adverse effects. Similar multimodal approach is required to be adopted for better pain management of the combat casualties and improving their long term outcomes.

Mechanism of injury is an important consideration factor in epidemiological analysis of combat and military trauma. Due to improvements in battlefield equipment including cataphract and continued advances in trauma medicine, modern military combatants have a
A retrospective observational study was taken up to establish pattern of military trauma cases / combat casualties in operational area and type of anaesthesia employed for surgical management of the same cases (primary objective). This study was also aimed to compare the type of anaesthesia used as per the region of body involved, RA vs GA for management of peripheral limb injuries and the type of surgeries being done in military trauma.

MATERIALS AND METHODS

A retrospective observational study was done of all military trauma cases in a peripheral zonal hospital deployed in operational area. All trauma/ combat casualties were included over a period of one year from Oct 2018 to Oct 2019 and data was segregated based on type of mechanism of trauma, limb injuries involved, and choice of anaesthesia given based on type of surgery. A total of 371 patients were included in this study over a period of one year and data was summarised in terms of percentage using MS-Excel software. Institutional and Ethics committee clearance was taken before beginning of the study. The data was collected from hospital records including admissions register, operation theatre register and surgical ward records. Fatal casualties were excluded from the study (these are the cases which were brought in dead to the hospital). This was a retrospective study aimed to establish pattern of trauma and type of anaesthesia employed for its surgical management. The outcomes of the type of each type of anaesthesia is out of bound to this study. Outcomes of the anaesthesia is not the objective of the study. However, this study can be a way forward for the interventional studies on the efficacy of the techniques.

RESULTS

Demographic profile

A total of 371 soldiers were considered in this study. The age ranged from 19 yrs to 53 yrs with an average of 31.76 yrs. No specific regiment or geographical belt was specified while analysing the subjects.

Cause of Injuries

Of the total 371 combat casualties, 161 patients (43.4%) had splinter injuries with grenade blast being the most common type of injury, followed by gunshot wounds, 148 cases (39.9%). Other injuries included mine blast, 42 (11.3%) and miscellaneous including road traffic accidents comprised remaining 20 cases (5.4%) (Figure 1).
Type of surgery and anaesthesia used

Of all the surgeries, wound debridement was the most common type of surgery being performed, 144 cases (38.8%), followed by orthopaedic procedures like ORIF & plating 110 (29.7%), CRIF 53 (14.3%) and implant removal 23 (6.2%). Other cases included exploratory laprotomy 11 (2.9%), amputation 6 (1.6%) and miscellaneous remaining surgeries were 24 (6.5%). Majority of the patients belonged to either ASA1, 173 patients (46.7%) or ASA 2, 138 (37.2%). Due to nature of injuries and predominant involvement of limbs, regional anaesthesia was used most commonly, 174 cases (46.9%), regional anaesthesia was supplemented with TIVA in 19 (5.1%) cases, sub arachnoid block in

Body region involved in combat trauma

As expected, limb injuries dominated the body regions involved, upper and lower limbs both having almost equal involvement; 175 upper limb and 176 lower limb cases. Of the 175 upper limb cases, maximum injuries involved were of forearm, 72 (19.4%) cases. Hand injuries and those involving above elbow were again similar, 50 (13.5%) and 53 (14.3%) respectively. For the lower limb out of 176 cases, maximum injuries were of legs 93 (25.1%), followed by 62 (16.7%) cases of above knee injury. Only 21 cases (5.7%) involved injury to feet. Remaining 20 (5.4%) cases involved head trauma, facial injuries, thoracic and abdominal injuries (Figure 2).
Complications

There were minimum procedural complications associated with Regional Anaesthesia techniques. No incidence of Pneumothorax or vascular injury was reported in upper limb blocks, however, there were 4 cases (1.07%) of unilateral ptosis associated with interscalene block, which resolved spontaneously. For lower limb

Type of anaesthesia as per body region

Type of anaesthesia used as per body region is shown in Table 1 and Figure 4. As is evident from the table maximum upper limb injuries were operated under Regional anaesthesia (78.8%), and maximum lower limb injuries were performed under sub arachnoid block (50%), while injuries involving body regions other than limbs were performed exclusively under GA (Table 1, Figure 4).

Type of regional anaesthesia used

Of the various RA techniques, Supra-clavicular Block was most commonly used in upper limb injuries (40.5%), followed by Interscalene block (6.45%). SAB was the most common technique used for lower limb injuries (31.5%), followed by femoral and sciatic block (15.05%) (Table 2, Figure 5).

Table 1. Type of anaesthesia as per body region

| Body Region       | Number | RA     | GA     | RA+TIVA | SAB |
|-------------------|--------|--------|--------|---------|-----|
| Upper Limb        | 175(47.2) | 138(78.8) | 28(16) | 9(5.2)  |
| Above Elbow       | 53(14.3)  | 40(23.4)  | 11(11.9) | 2(10)   |
| Forearm           | 72(19.4)  | 55(32.2)  | 14(15.2) | 3(15)   |
| Hands             | 50(3.5)   | 43(25.1)  | 3(3.3)  | 4(20)   |
| Lower Limb        | 176(47.4) | 33(18.7)  | 44(25)  | 11(6.3) | 88(50) |
| Above Knee        | 62 (1.6)  | 2 (1.2)   | 25 (27.2) | 1 (5)  | 34 (38.6) |
| Legs              | 93 (25.1) | 29 (16.9) | 14 (15.2) | 6 (30) | 44 (50) |
| Feet              | 21 (5.6)  | 2 (1.2)   | 5 (5.4)  | 4 (20)  | 10 (11.4) |
| Others            | 20 (5.4)  | 20 (100)  |        |        |      |
| Head Injury/Facial Trauma | 6 (1.6) | 6 (6.5) |        |        |      |
| Abdominal Injuries| 8 (2.2)   | 8 (8.7)   |        |        |      |
| Misc              | 6 (1.6)   | 6 (6.5)   |        |        |      |

Table 2. Type of regional anaesthesia

| Type of RA                      | Number | Percentage (%) |
|--------------------------------|--------|----------------|
| Supraclavicular Block           | 113    | 40.5           |
| Infraclavicular Block           | 9      | 3.23           |
| Interscalene Block              | 18     | 6.45           |
| Axillary Block                  | 3      | 1.08           |
| Wrist Block                     | 4      | 1.43           |
| Ankle Block                     | 2      | 0.72           |
| Femoral + Sciatic Block         | 42     | 15.05          |
| SAB                             | 88     | 31.54          |
| Total                           | 279    | 100            |

Figure 4. Percentage of type of anaesthesia as per body region.

Figure 5. Percentage of various regional anaesthesia blocks.
injuries 42 patients (23.8%) had associated hypotension following SAB, which was managed effectively with fluid resuscitation and vasopressors. Five patients had failed spinal and had to be converted to GA and ten patients had urinary retention managed with bladder catheterisation. There was a single case of accidental Dural tap while placing Epidural catheter and two cases reported to have PDPH which were managed conservatively. There was nil incidence of Compartment Syndrome, permanent nerve damage or death reported following regional anaesthesia in trauma in our study.

**DISCUSSION**

Most of the literature available on combat trauma comes from international data during Operation Enduring Freedom and Operation Iraqi Freedom. Despite having conflicts and counterinsurgency operations spanning over decades, very few studies in Indian scenario have analysed injuries related to military trauma. There is further scarcity of Indian literature reviewing anaesthesia techniques in the management of trauma and to the best of our knowledge no study has so far evaluated anaesthesia techniques in combat and military trauma of Indian Armed Forces scenario. Our study is a retrospective observational study which analyses the type of injuries suffered by military personnel admitted to a tertiary care hospital of the Indian Armed Forces in the setting of intense counter insurgency operations. It also evaluates the use of various Anaesthesia techniques according to the injury and body part involved. Being a retrospective study, there is an inherent risk of error in data collection from various sources. Sincere effort has been made to cross check all the records to avoid any discrepancy.

In our study, of the total 371 combat casualties maximum patients had splinter injuries with grenade blast being the most common type of injury (43.4%), followed by gunshot wounds (39.9%). Other injuries included mine blast (11.3%) and miscellaneous including road traffic accidents (5.4%). Our study has findings similar to those of various other authors, namely Rai et al.\(^{16}\), Belmont PJ Jr\(^{17}\) and Owens BD\(^{18}\), which mention majority of combat injuries due to explosive devices including grenades, IEDs, mortar fire and other fragmentation devices in their literature.

Due to nature of injuries and predominant involvement of limbs, regional anaesthesia was used most commonly (46.9%), regional anaesthesia was supplemented with TIVA in 19 (5.1%) cases, sub arachnoid block was used in in 90 (24.25%) cases of lower limb injuries and general anaesthesia was used in 88 (23.7%) cases involving thoracic-abdominal injuries and head injuries.

A study by Gallagher and colleagues emphasises on the utility of RA for acute pain management in combat related extremity injuries. A retrospective study by Stojadinovic included 126 military trauma patients and reported significant reduction in pain intensity over prolonged duration with use of RA. Buckenmaier CC mentions role of RA throughout the various stages of management of combat casualties, including initial pain management, evacuation to tertiary centre and even rehabilitation\(^{11}\).

Our study also reported significantly higher use of regional anaesthesia in case of combat related trauma to extremities. It is therefore in accordance to the existing literature and current guidelines meeting the standards of combat casualty care.

**RECOMMENDATIONS**

This is a case sheet review retrospective study. In further studies prospective intervention can be done to study the patient outcomes based on type of regional anaesthesia technique used.

**Compliance with ethics requirements:** The authors declare no conflict of interest regarding this article. The authors declare that all the procedures and experiments of this study respect the ethical standards in the Helsinki Declaration of 1975, as revised in 2008(5), as well as the national law. Informed consent was obtained from all the patients included in the study.
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