Regional Block Anaesthesia - How Effective is it for Extremity Trauma?

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Abstract

Regional block anaesthesia (RBA) techniques are eclipsed by the widespread use of general anaesthesia (GA), especially in trauma surgery. This is despite the numerous advantages that regional blocks have to offer. We conducted a study to evaluate efficacy, safety and feasibility of RBA in isolated extremity trauma in war scenario. A prospective study was carried out over a period of eight months. There were a total of 96 patients with splinter, mine blast and gun shot wounds. Supraclavicular or axillary brachial block was employed for upper extremity surgery. 3 in 1 femoral block with classical sciatic block at hip or popliteal fossa was administered for lower limb operations. All patients were stabilized prior to the procedure. A combination of lignocaine 3 mg/kg of 2% and bupivacaine 1.5 mg/kg of 0.5% with dilution to make a volume of 0.75 ml/kg was employed. Assessment was made for onset, duration and degree of anaesthesia. Haemodynamic parameters and oxygen saturation were measured during the peritraumatic period. 92.5% cases had good motor and sensory anaesthesia and permitted unhindered surgery without supplementation. The rest required GA/dissociative anaesthesia (DA). Post operative pain relief lasted for an average of 4-5 hours. No patient had derangement of haemodynamic parameters or oxygen saturation. There was no systemic drug toxicity, local complications or mortality in our series. We found RBA for isolated extremity trauma to be simple, safe and effective with consistent results.

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Key Words : Isolated extremity trauma; Regional block anaesthesia.

Introduction

Regional or general anaesthesia? This debate of ideal anaesthesia for war casualties can be discussed in the backdrop of safety and success as also appropriateness and patient acceptance. There is no consensus on whether certain types of patients benefit more from a regional, general or mixture of the two types. Different generations of anaesthesiologists have different priorities and preferences [1]. Despite numerous advantages of RBA techniques over GA, its scope and efficacy is understated and underutilized. Its role in trauma is even lesser, which happens to be the leading disease entity of modern times and occupies the highest priority in national statistics. A retrospective analysis of three service hospitals dealing predominantly with trauma victims revealed that RBA was employed in less than 5% of all isolated extremity injuries. In war/counter insurgency scenario the role of regional block techniques therefore needs to be reviewed. Expert field block techniques and skills, resuscitation, anaesthesia of battle casualties is possible, contrary to the belief, in forward mobile medical units on the war front [2]. The earliest description of regional block has been associated with military medicine. We have evaluated the efficacy and feasibility of regional blocks in isolated extremity trauma in war scenario and studied its effect on various aspects of patient care.

Material and Methods

The study was carried out in a 49 bedded hospital in a remote border area of northern sector. Over a period of 8 months from November 99 to June 2000 we managed a total of 80 patients of isolated extremity trauma in this forward surgical centre. This area being on the line of control is subjected to heavy enemy shelling. As a result, splinter injuries form the predominant mode of trauma. Our aim was to attempt a successful and safe conduct of surgery with RBA. We planned a prospective study in all isolated extremity trauma victims. Children below 6 years were excluded from the study.

On reception, patients were received with a standard life saving drill protocol. This included airway management, resuscitation with parenteral fluids and other supportive measures as required. For upper extremity surgery we employed a brachial plexus block using the supraclavicular plumb bob technique for injuries in the proximal arm. Alternately, we used a periarthral axillary block for distal injuries. In lower extremity trauma, a femoral 3 in 1 block (Winnie's technique) was combined with a classical sciatic nerve block. For injuries limited to below knee, sciatic nerve block was performed at the popliteal fossa. We employed a combination of lignocaine 3 mg/kg and bupivacaine 1.5 mg/kg with normal saline to make a volume of 0.75 ml/kg body weight. Verification of correct needle placement was judged by elicitation of paraesthesia. We have employed cold anaesthetic solution to enhance the subjective feeling of paraesthesia in a few patients. We did not employ a nerve stimulator or use any pressure to promote drug spread. Patchy block was supplemented by local infiltration. Administration of GA/DA was considered as

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inadequacy of regional block. Assessment was made for onset, duration and degree of anaesthesia as well as haemodynamic stability or other side effects. Continuous pulse oximetry with haemodynamic monitoring every 10 minutes, was done during the procedure and half hourly thereafter for 2 hours. Quality of analgesia was assessed and graded by four point scale.

Grade I - Excellent - complete sensory and motor block.

Grade II - Good - complete loss of touch and pain except deep pressure sense with adequate muscle relaxation.

Grade III - Moderate - mild pain or discomfort from operative procedure with good muscle relaxation.

Grade IV - Poor - Supplemental GA/DA given.

Onset time was recorded as time for establishment of analgesia checked by pinprick. Duration of analgesia was from onset till reappearance of pain requiring analgesics. Post operatively all patients were asked about pain relief and complaints if any were recorded.

Results

A total of 96 patients were studied over a period of 8 months. Of these, there were 80 (83.3%) cases of major isolated extremity trauma. In this subgroup 69 (86.3%) patients were males and 11 (13.7%) were females with a M:F ratio of 6.3:1. The age of the patients ranged from 6-67 years with a mean of 28.3 years for males and 34.7 years for females. The distribution of injuries is depicted in Table 1. There were predominantly splinter injuries due to enemy artillery shelling constituting more than half the casualties. Mine blast injuries were present in about one third of cases whereas gunshot wounds due to small arms firing were in a minority. The surgical procedures done were essentially wound debridement and amputations as shown in Table 2.

TABLE 1
Cause and distribution of injuries

	%	GSW	Splinter	Mines
Upper limb	(19.2)	2	17	1
Lower limb	(57.6)	7	24	29
Chest	(4.8)	2	3	-
Abdomen	(6.7)	1	6	-
Head and neck	(3.8)	-	4	-
Total		12 (12.5)*	54 (56.3)	30 (31.2)

* Figures in parenthesis indicate percentage; GSW - Gun shot wound

The anaesthesia administered to the patients is depicted in Table III. For upper limb injuries we employed either a supraclavicular or an axillary brachial plexus block. For lower extremity trauma, a combination of 3 in 1 femoral and sciatic nerve block was used. Lower extremity injuries constituted the majority of cases. Of 60 patients in this group regional block alone was successful in 51 (85%) cases. Wound infiltration locally was needed in 9 (15%) cases of patchy block, dissociative / GA was required for 5 (8.3%) of these patients. In upper extremity trauma comprising 20 cases, supplemental local infiltration was given

TABLE 2
Surgical procedures

	Upper limb	Lower limb
Debridements (58.8)*	13 (16.3)	34 (42.5)
Amputations (41.2)	7 (8.8)	26 (32.4)
Arm	1	
Forearm	5	
Hand	1	
AK		3
BK		3
Foot		9

* Figures in parenthesis indicate percentages; AK - Above knee, BK - Below knee

TABLE 3
Anaesthesia techniques

	Regional block	Supplementation	
		Localanaes	DA/GA
Supraclavicular	6	1	1
Axillary	14	1	0
Femoral + Classical sciatic	21	4	2
Femoral + POP sciatic ("FEMPOP")	39	5	3

TABLE 4
Parameters of effectiveness

	Upper limb	Lower limb
Onset*	15-27	14-35
Degree		
I	13	49
II	5	7
III	1	2
IV	1	2
Duration*	138-490	210-540
Average*	(266)	(318)

* Time in minutes

in 2 (10%) patients of which 1 (5%) required GA (Table 3).

The onset of surgical anaesthesia occurred within 14-35 minutes. Average duration of analgesia was about 4 hours for upper and 5 hours for lower limbs. Of all 80 cases, the regional block alone was successful in 69 (86.3%). The remaining patients needed supplemental anaesthesia. Quality of regional block was assessed by a four point scale (Table 4). Monitoring did not reveal any notable change in haemodynamic parameters or oxygen saturation during or subsequent to the operation. Two cases had cough during supraclavicular brachial block but there was no evidence of pneumothorax. There was no systemic drug toxicity or local complication encountered. There was no mortality in our series.

Discussion

The mode of anaesthesia for any procedure should be tailored to meet the demands of the procedure, patient acceptance and proficiency of anaesthesiologist. The era of regional anaesthesia was initiated following Karl 7Kollar's report of use of cocaine for ophthalmological procedures. Soon thereafter, William Halsted and Richard Hall in Dec 1884 described sensory nerve block at the face and arm. Subsequently, every peripheral somatic nerve and the plexuses were blocked [3]. Like other medical developments, the popularity of regional anaesthesia since its inception has waxed and waned. There seems to be a general reluctance to use nerve block techniques though these have much to offer to patients, surgeons and anaesthesiologists.

Trauma is the greatest killer in the young age group and is responsible for maximum loss of productive man-hours. GA continues to be preferred in trauma surgery because of usage of better and safer drugs, availability of advanced equipment and intensive patient monitoring. This is despite the fact that GA disrupts the sympathetic compensation and delicate physiological balance in traumatised patients and thereby courts disaster [4]. The issue of GA versus RBA has been much discussed and debated over the years [5]. RBA has been gaining acceptance and popularity mainly due to its simplicity, safety and efficacy.

Our field hospital is located on the line of control (LOC) and subjected to heavy artillery shelling. Retrospective review in our sector over a three year period revealed that extremity trauma constituted 84.5% of major and 77.7% of minor injuries. These high figures are apparently due to the fact that shell splinters and land mine blasts are the major cause of wounds in our sector. Trauma cases limited to the extremities are best suited for regional blocks. A study done by Regnier et al who evaluated spinal and nerve block anaesthesia in an emergency traumatology operating room revealed a success rate of 85% [6]. In our series, RBA without supplemental GA/DA was successful in 92.5% of cases. RBA preserves consciousness and patient protective reflexes. This is an asset in the usual scenario of multiple trauma victims with limited staff. An additional benefit is the decrease of stress response to trauma and surgery thereby reducing the morbidity and mortality [3]. We did not have any mortality in our study.

Upper extremity injuries constituted 25% of our cases. The fortuitous localization of nerves in a single anatomical area makes it ideal for plexus anaesthesia.

There are three basic approaches to brachial plexus block, the supraclavicular, the infraclavicular and the axillary. The supraclavicular technique is associated with radiological evidence of pneumothorax in as many as 25% of cases [7]. The incidence of drug toxicity is higher when this technique is used mainly because of rich vascularity. An axillary perivascular approach is safe and effective despite frequent sparing of musculocutaneous nerve. The overall incidence of complications with brachial plexus anaesthesia (BPA) appears to be higher with supraclavicular approach, which is advisable, only when there are clear indications [8]. A single injection technique is advocated based on the anatomical premise of envelopment of the plexus by a single fibrous sheath. Though not one uniform space, multiple connections within the sheath offer no impediment to the flow of drug [9]. For proximal upper limb injuries we used supraclavicular brachial plexus block. Axillary block was given in 70% of upper limb injuries, which were beyond mid arm. Positioning was not a problem in most cases except a few with mutilated limbs. In these, retraction of the pectoralis in a semiabducted arm was found to be helpful. We did not employ any specific positioning or pressure to promote spread of local anaesthetic (LA). We have instead relied on using liberal volume of 0.75 ml/kg to achieve good results.

Lower limb injuries formed three fourth of our cases. Technical problems are faced due to different anatomical positions of the four major trunks supplying the limb. Though known for decades, the combined sciatic and 3 in 1 technique is rarely used. The mechanism of Winnie's technique of blocking femoral, lateral femoral cutaneous and obturator nerve by a single injection was described in 1973. It was suggested that action occurred due to cephalad spread and lumbar plexus block by the LA. Magnetic resonance imaging of distribution of LA has demonstrated that the mechanism is blockade of the aforesaid somatic nerves and not cephalad spread [10]. Combined classical sciatic and femoral block at the hip in lower leg injuries had low success rate [11]. Difficulty is faced in administering classical sciatic block due to greater depth, need of specialised 15 cm needle and cumbersome patient positioning. We employed a 3 in 1 femoral with classical sciatic nerve block only for extensive thigh injuries. For most land mine injuries and cases having below knee trauma the sciatic block was given at the popliteal fossa along with the femoral block. We employed the "fempop" in two thirds of all lower extremity injuries with consistently good results. However, this useful technique is employed in very few

hospitals and only few publications exist in this area [12].

Methods to verify correct needle placement vary from the time-tested elicitation of paraesthesia to use of peripheral nerve stimulator. The click method of loss of resistance in entering the sheath is least reliable. Broadman has demonstrated the utility of ultrasound but this is unlikely to be of practical use [13].

Fears of serious permanent nerve damage are unfounded and rarely occur as demonstrated in a study from France [14]. A comparison of 3 methods of axillary brachial plexus anaesthesia using catheter insertion, elicitation of paraesthesia or use of nerve stimulator did not demonstrate a statistically significant difference in success rate [15]. In the absence of a peripheral nerve stimulator, we have found the elicitation of paraesthesia as a reliable means of judging correct needle placement. We employed cold anaesthetic solutions in a few patients. This appears to give a distinctive paraesthesia. Smith has demonstrated that stimulator is not a useful adjunct except in uncooperative patients where it permits a comparable success rate to paraesthesia elicitation [16].

Schnorr did a study on 131 anaesthesiologists routinely employing regional anaesthesia. It addressed their preferences regarding use of drug mixtures and reasons thereof. As many as 70% of respondents employed LA mixtures. The rationale for use was to avoid toxicity by not exceeding the dose of the parent compound. Unpredictable interactions may however occur limiting their overall utility [17]. We used a mixture of lignocaine and bupivacaine in our study and found a relatively early onset of action with prolonged effect. The average time of onset was 19 minutes with analgesic effect lasting for 4-5 hours. In our patients, the resulting quality of anaesthesia was generally dense. Higher drug concentration with smaller volumes is advocated for regional blocks by some authors which can result in local and systemic toxicity [18]. Inaccurate needle placement often results in unsatisfactory block due to minimal drug spread. We have relied on using larger volumes by dilution with normal saline to offset the need for very accurate needle placement. This may prolong the onset of block but the dense quality and duration of analgesia negates this apparent disadvantage. The same can be judged by the fact that we conducted 12 below and 1 above knee amputation without any supplementation. There was no clinically discernible alteration in the vital parameters of the patients in the study group.

The most important prerequisite for giving nerve blocks according to McConchie is a thorough knowl-

edge of anatomy [1]. Surgeons are therefore equally suited to giving regional blocks in this regard. Porter also claims RBA to be suitable for use by members of surgical staff but success was only assured by meticulous attention to detail and by careful safety precautions. The above notwithstanding, regional block techniques should not be attempted by inexperienced, unsupervised operators [19].

RBA has come a long way since its inauspicious beginning in trauma surgery and is established justly for trauma victim management in the present scenario. Advances in RBA have to date made it one of the safest modalities in surgical anaesthesia and pain management. Continued refinement and development of new block techniques and approaches enhance the potential for success, rapid postoperative recovery and patient safety [20]. In an emergency setting where patients are often full stomach, RBA is invaluable in permitting life saving operations since no starving or special preparation is required [21]. The benefits of RA are self-evident with drug effect limited to the part of body operated, fewer complications and high quality post operative pain relief. RBA decreases circulating catabolic hormones and catecholamines, thereby limiting the negative nitrogen balance associated with trauma. There is an additional advantage of safety in severe respiratory and cardiac disease. Early resumption of oral intake minimizes the catabolic phase associated with starvation [22]. Unexpected influence on outcome like reduction in the incidence of postoperative thrombotic episode and vascular graft occlusion is beneficial in limb trauma with vascular involvement [23].

In frontline military operations faced with numerous constraints, this form of anaesthesia offers comprehensive management of battle casualties with efficiency, safety and high quality of patient care. The simplicity of administration of nerve blocks have ensured and will continue to ensure their popularity for trauma surgery. These procedures can be easily performed in war scenario and primitive field conditions by a trained battle field anaesthesiologist. In third world countries with constraints of money, material and manpower, these techniques can also be used under supervision by surgeons with safety, speed and precision. We feel that RBA should be employed more not only in field but larger centres as well. The apparent disadvantage of prolonging the operation list can be easily offset by a judicious rotation of cases. The reduction in stress of anaesthesia and surgery with minimal peritraumatic physiological changes translates to reduced morbidity and mortality.

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