Original Research Article

Modified intravenous regional Anaesthesia (Re-exsanguination before surgery)

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Abstract

Aim: This study was undertaken to assess if modified intravenous regional anaesthesia (re-IVRA) in which re-exsanguination of the arm before surgery offers an advantage over routine IVRA in patients operated for distal parts of upper extremity based on the quality of operative field, sensory and motor block, quality of surgical analgesia , tourniquet pain together with the efficacy and safety of the technique. **Method:** A total of 60 patients undergoing surgeries of the distal end of upper extremity with 30 in each group were randomized to receive either IVRA or re-IVRA technique. **Results:** The onset of sensory and motor block had no significant difference in either groups, with 3.48 minutes in IVRA and 3.49 minutes in re-IVRA. Quality of analgesia remained statistically same in both the groups. Quality of operative field was rated significantly better by the surgeons in patients with re-IVRA technique with 23 patients rated as excellent, good in 6 patients, fair in 1 patient and the surgeon never had a poor field in contrast to IVRA technique with 12 patients rated as excellent , good in 16 , fair in 1 patient and poor in 1 patient. There were no significant differences in tourniquet pain between the IVRA and the re-IVRA groups. There was no serious central nervous system or cardiovascular system toxicity in either the IVRA or the re-IVRA group. **Conclusion:** IVRA provides adequate surgical conditions in most cases, however re-exsanguination (re-IVRA) before surgery reduced oozing considerably and provided significantly drier surgical field especially in microsurgeries, without jeopardizing the quality of analgesia and safety.

Key Words: Lignocaine, intravenous regional anaesthesia, re-exsanguination

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INTRODUCTION

Mankind has always been torn between two spectra - one which holds that the toleration of pain shows great physical and spiritual fortitude and the other more compassionate view that suffering should be minimized .All through the early civilization we find attempts to decrease pain, often by altering levels of consciousness, together with painful rituals to prove maturity and strength of character. Pain is one of the commonest symptoms to lead a patient to seek medical advice and whatever the cause, it demands relief. The relief of pain during surgery is the raison d'etre of anaesthesia. Local analgesia made its appearance in 1884 when Carl Koller of Vienna demonstrated the use of cocaine for topical analgesia in the eye. William Stewart Halsted originated nerve block or regional analgesia and showed that a reduction in the circulation of a part of the body, as by an Esmarch bandage, would prolong the effects of local analgesia. In 1901 Harvey Cushing first used the term "Regional Anaesthesia" to describe the pain relief by nerve block. The Harveys studies of circulation enabled both Percival Christopher Wren and Daniel Johann Major to conceive the idea of injection of medicinal into the blood stream.[1] In 1846 Alms showed that the

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intravascular injection of local analgesic agent was associated with analgesia in the area supplied by the vessel. In 1904, Einhorn synthesized novocaine (procaine), a safer substitute to toxic cocaine which was popularised by Henrich Braun in 1905.2 In addition to his discovery of spinal anaesthesia, August Karl Gustav Bier put this knowledge to practical use and in 1908 published his account of Intravenous regional anaesthesia for limb surgery, using procaine.3 The technique did not gain any measure of popularity, however, until it was reintroduced by Holmes in 1963 using single tourniquet and lignocaine instead of prilocaine. Lignocaine, a tertiary amine was first introduced by Torsten Gordh in 1948 and synthesized by Lofgren and Lundquist in 1943 in sweden.4Lignocaine has numerous advantages over many of its predecessors. It is the local anaesthetic of moderate potency and duration with good neuronal uptake and rapid onset of action. Todays need is to provide anaesthesia which is simple, safe and easily applicable without jeopardizing the protective reflexes of patients. Also major nerve blocks such as Brachial plexus block and femoral sciatic block requires technical expertise. Conversely, the administration of IVRA requires only the skill necessary to perform a venipuncture. Thus the advantages of IVRA are that it is effective, simple to perform and may be used in cases that are unsuitable for general anaesthesia i.e, poor risk patients" as it does not abolish consciousness and does not obtund protective reflexes. It is also useful for outpatient surgery on limbs. The present study is done to,1.To determine whether a modification of the IVRA technique in which the arm is re-exsanguinated before surgery(re-IVRA) offers any advantage over routine IVRA. The comparison will be made by using the following parameters:

- Quality of operative field
- Sensory and motor block
- Quality of surgical analgesia
- Tourniquet pain

2. To determine whether modified technique is useful in particular situation like micro-surgery on hand where blood less field is required.
3. To assess the efficacy and safety of modified IVRA.

MATERIAL AND METHOD

This study was carried out in Department of Anaesthesiology, Byramjee Jeejeebhoy Medical College and Sassoon General Hospital, Pune. After ethical committee approval.

No. of cases: 60 Normotensive patients were included and randomly divided into two groups:

Group 1: 30 cases of routine Intravenous Regional Anaesthesia (IVRA)

Group 2: 30 cases of modified Intravenous Regional Anaesthesia (re-IVRA)

Selection of cases:

- ASA I-II , posted for both routine and emergency operations on distal parts of upper extremity
- Male – Female : 20 to 60 years
- Absence of any cardiac, respiratory, hepatic, renal or other pathologies that may affect the parameters for clinical evaluation of cardio-respiratory performance for the purpose of the trial
- Absence of hypersensitivity to local anaesthetic agents, nerve injuries, extensive crush-injuries with massive destruction of venous plexuses, peripheral vascular diseases.
- Absence of mental illness.
- Patient must not be on psychotropic drugs, analgesic, anti-inflammatory or other drugs likely to influence sensation of pain.

Equipment used included:

Scalp vein set No 21,Intracath No.18, Sterile syringes, lignocaine 2% vial, Esmarch bandage, Two pneumatic tourniquets, Normal saline, Ringer lactate, 5% Dextrose, Emergency resuscitation kit was kept ready. All patients were thoroughly examined during pre-operative check up and investigated to diagnose any systemic disorder. The investigation consisted of haemoglobin, bleeding time, clotting time, PT/INR, urine routine, blood sugar, RFT, LFT, ECG, X-ray.

Suitable cases were selected and patients were explained about the procedure and a written consent was taken, patients were divided into two groups of 30 each.

Before giving anaesthesia following points will be noted:

1. Pulse rate rhythm
2. Blood pressure
3. Respiratory rate
4. SpO_2

After shifting the patient to operation theatre, vital Parameters were recorded. Intravenous infusion was started. A solution of 0.5% lignocaine was prepared in the gallipot. A layer of wadding and a double cuff pneumatic tourniquet were applied to the upper arm. The pressure at which the radial pulse was no longer palpable was noted as "occlusion pressure" for each cuff and the cuff deflated.[5,6,7]

A cannula scalp vein set was introduced into a vein on the dorsum of the hand to be operated as distal as possible with usual aseptic precaution and with utmost care, avoiding counter puncture.[6,8] Another cannula - Intracath No. 18 was inserted into a vein in the opposite arm and intravenous drip was started. Thorough exsanguination was performed by a tightly applied rubber Esmarch bandage.[9,10] In case of painful conditions, Gravitational

method i.e elevation of arm above chest level for 3 minutes was used for exsanguination.[6,8,11,12]The upper (proximal cuff was inflated to a pressure 100 mm. Hg greater than the occlusion pressure of same cuff and Esmarch bandage was removed.[7] The drug was injected only when the arm distal to the cuff was ischaemic and pulseless, with a pale or mottled appearance and had no evidence of venous congestion.[5] 0.5% solution of lignocaine was injected with the dose of 3 mg/Kg over 90 seconds Scalp vein set was removed and the pressure was applied at site to prevent extravasation of the drug solution.[6,8]

Surgical preparation and draping were allowed to proceed about 5 minutes after injection of local anaesthetic. After 15 minutes, Surgeon was asked to cover arm with sterile drape and re-exsanguination was performed by firm re-application of a sterile Esmarch bandage followed by complete release and immediate re-inflation of the lower (distal) cuff tourniquet. Signs and symptoms of local anaesthetic toxicity were observed. Pulse, blood pressure and respiration were monitored for each patient every 2 minutes for first 15 minutes then every 15 minutes till end of procedure. Patients were sedated with 0.02 mg/kg IV Midazolam after 15 minutes of drug injection. All the parameters were assessed every 15 minutes and at the end of procedure tourniquet was deflated. The time of return of sensory and motor action was recorded and patient was observed in recovery room for 2-3 hours.

Sensory and motor functions were assessed before and every 2 minutes after injection of local anaesthetic until there was complete sensory and motor block. Sensory block was assessed by pinprick in the areas innervated by radial, median and ulnar nerves. Motor block was studied by Grip strength or by asking patient to compress balloon of blood pressure apparatus.

Surgical assessment of quality of the operative field was made every 10 minutes as a four-grade scale by surgeon. Surgical field was graded EXCELLENT when it was completely dry and POOR when the Surgeon was unable to perform surgery because of excessive oozing and general anaesthesia with repeat exsanguination were considered necessary. Surgical analgesia was graded by the patient as good, fair or poor. Analgesia was graded GOOD when the patient was pain free, comfortable; FAIR when the patient was pain free after injection of analgesic; POOR when the patient was restless and in pain inspite of repeated doses of analgesics or sedatives and general anaesthesia was considered necessary. Tourniquet pain was assessed.

OBSERVATION

This study was conducted in 60 patients undergoing operations on distal parts of upper extremity. The patients were randomly divided into two groups of 30 each. Group I patients were managed with routine Intravenous Regional Anaesthesia (IVRA). Group II patients were managed with modified Intravenous Regional Anaesthesia (re-IVRA).

TABLE 1: ONSET OF SURGICAL ANALGESIA

Type	Sensory	Motor
IVRA	3.48	9.28
RE-IVRA	3.49	9.19

No significant difference in both the groups ($p>0.05$ by unpaired t-test)

TABLE 2a: CHANGES IN PULSE IN RE-IVRA TECHNIQUE

Pulse(per minute)	Nf. Of cases
0-10	8
11-20	2
21-30	0
Total	**10**

TABLE 2b: CHANGES IN BLOOD PRESSURE IN RE-IVRA TECHNIQUE

Bloos Pressure(mmhg)	No.of cases
0-10	5
10-20	1
20-30	0
Total	**6**

TABLE 3: TORNIQUE PAIN

Type	Present	Absent	Total
IVRA	3(10%)	27(90%)	30
RE-IVRA	2(6.66)	28(93.34)	30
Total	**5**	**55**	**60**

There is no significant difference in both the group ($p>0.05$) by standard error of difference between two proportion.

TABLE 4: QUALITY OF SURGICAL ANALGESIA

Quality	IVRA	RE-IVRA	Total
Good	26(86.66%)	27(90%)	53
Fair	3(10%)	3(10%)	6
Poor	1(3.34%)	-	1
Total	**30**	**30**	**60**

No significant difference in both the groups ($P>0.05$) by standard error of difference between two proportion.

TABLE 5: QUALITY OF OPERATIVE FIELD

Quality	IVRA	RE-IVRA	Total
Excellent	12(40%)	23(76.66%)	35
Good	16(53.33%)	6(20%)	22
Fair	1(3.34%)	1(3.34%)	2
Poor	1(3.33%)	-	1
Total	**30**	**30**	**60**

There is significant difference between both groups regarding oozing at operation site (P<0.05) by standard error of difference between two proportion.

TABLE 6: CHAGES IN PULSE RATE AFTER TORNIQUE RELEASE AT THE END OF SURGERY

Pulse rate (per minute)	IVRA	RE-IVRA	Total
0-10	4	5	9
11-20	2	0	2
21-30	1	0	1
Total	**7**	**5**	**12**

TABLE 7: CHANGES IN BLOOD PRESSURE AFTER TORNIQUE RELEASE AT THE END OF SURGERY

Blood pressure (mmHg)	IVRA	RE-IVRA	Total
0-10	3	3	6
11-20	2	0	2
21-30	1	0	1
Total	**6**	**3**	**9**

DICUSSION

Intravenous regional anaesthesia (IVRA) is a safe and reliable technique in the hands of properly trained personnel. It is a well accepted regional block for upper extremity surgery. There are few disadvantages, apart from discomfort due to the cut, oozing at the site of operation and the theoretical hazard of toxic amounts of local anaesthetic agent reaching the general circulation in the event of cuff failure.[13,14] Oozing is an infrequent but irritating problem for surgeons. It seems to occur regardless of how meticulous the technique has been.[5,13,14] Poor exsanguination and incorrectly applied cuff naturally leads to oozing but in many cases it is due to inevitable engorgement caused by the large volume of the local anaesthetic solution injected, combined with continued blood flow through the non-compressible intramedullary vessels.[13,15] It has been suggested that IVRA is unsuitable for microsurgical procedures in which a totally "Bloodless field is mandatory. Leakage under the cuff may be prevented by thorough exsanguinations ,optimal tourniquet pressure and slow injection of local anaesthetic solution, at least over 90 seconds.[6,8] A chaser injection of normal saline 5-10 ml has been used by some to hasten the onset of block and this can be expected to enhance the problem.[11,16] P.Cox1989 described modification of IVRA to reduce engorgement, in which excess local anaesthetic was aspirated from veins of the isolated arm 15 minutes after injection of the local anesthetic once analgesia was established and the amount of prilocaine/blood mixture recovered from the arm by aspiration represented 12% of the initial dose injected.[13] Analgesia was not affected and was satisfactory in both the groups.[13] There was a significant difference between the groups with regards to oozing at the site of operation.[13] Another modification described by N Rawal *et al* (1993) to obtain a dry operative field is the Re-exsanguination before surgery in which the injected local anaesthetic solution is squeezed into the tissues and under the distal tourniquet and there was no influence of re-exsanguination on the quality or duration of sensory or motor block.[14] Surgical and tourniquet analgesia were superior in patients receiving re- exsanguination compared with those not receiving it.[14] Re-exsanguination was not associated with risk of local anaesthetic toxicity or deterioration of sensory or motor block, which has been proved with Lignocaine uptake studies using positron emission tomography showing maximum nerve, vascular and muscle uptake occuring within 5-10 minutes of administration of drug.[17]

ONSET OF SENSORY AND MOTOR BLOCK (Table No.1)

In the present series, the onset of sensory action from the time of injection of drug in IVRA group was 3.48 minutes and in Re-IVRA group 3.49 minutes .Similarly the onset of motor paralysis was 9.28 minutes in IVRA group and 9.19 minutes in R-IVRA group. Thus in present series there was no significant difference between the IVRA and Re-IVRA technique as far as onset of sensory and motor blocked was concerned (P >0.05). Our findings regarding onset of sensory and motor blockade are comparable with the S.A Mone *et al* (1974) in which onset of sensory blockade was 3.4 - 3.5 min and of motor blockade was 9.4 - 10.8 min.[12] Similar findings were reported by V.K. Mishra *et al* (1987) study which showed onset of sensory blockade within 3.9 +/- 1.56 min and motor blockade within 13.86 +/- 3.28.[18] Bell H.M. *et al* (1963) observed it to be 1-4 minutes.[19]Ted Gingirch found it to be 2-10 minutes.[20] Colbern C noted the analgesia to be complete within 3-5 minutes.[11] Toshio Fujita *et al* (1968) observed onset of analgesia in 3-5 minutes. [21] We observed that there is more rapid onset of analgesia in the area which is in the vicinity of the site of injection and it gradually spreads above and below. In one case there was inadequate analgesia at terminal phalanges because it was limited by the unidirectional valves in venous system. Thus we agree with the finding of K.H.EL Hassan (1984) to choose site of injection as distal as possible.[8] During momentary release of the proximal tourniquet in the Re-IVRA group signs and symptoms of lignocaine toxicity was looked for. In the present study, no patient showed significant lignocaine toxicity. Only few patients had slight fall in pulse rate and blood pressure, which was within normal limit, as follows. Table No.2 shows changes in pulse rate and blood pressure during momentary cuff deflation and re-exsanguination in the Re-IVRA group. In the Re-IVRA group 10 patients had slight fall in pulse rate during re-exsanguination out of

which only 2 patients had fall between 10-20 beats/min in pulse rate from initial level (Table 2-A). No treatment was required as pulse rate did not fall below 60 beats/min in any patient and pulse rate came to original level within 5-10 minutes slight fall in blood pressure occurred in 6 patients during re-exsanguination and the momentary cuff release out of which 5 patients had very slight fall in blood pressure < 10 mm. Hg, and one patient had a fall in blood pressure between 10-20 mm/Hg of initial level (Table No.2-B). No treatment was required in any patient and blood pressure came back to initial levels within 5 minutes. No patient developed central nervous system toxicity during re- exsanguinations. Similar study by N. Rawal *et al* (1993) had demonstrated that 15 minutes after injection of local anaesthetic, re-exsanguination was not associated with risk of local anaesthetic toxicity.[14] After confirming absence of signs and symptoms of toxicity all the patients from IVRA group and Re-IVRA group were sedated with 0.02 mg/Kg I.V midazolam. Tourniquet pain was looked for in both IVRA and Re-IVRA group (Table No.3) There was no significant difference in tourniquet pain between the IVRA and the Re-IVRA group. In the IVRA group, one patient complained of tourniquet pain after 30 minutes of drug injection and in 2 patients there was subjective mild discomfort at the tourniquet site 30 minutes after drug injection. In the Re-IVRA group there was subjective mild discomfort in 2 patients. In both the groups, no patient had tourniquet pain within 30 minutes of drug injection. Absence of tourniquet pain in most of the cases must be because of inflation of distal (lower) cuff which is placed over well-anaesthetized tissues. Our finding supports the study of Y.C. Tsai .*et al*, (1993) who had shown that double cuff technique is both effective and safe in the prevention of tourniquet pain as compared to local EMLA and subcutaneous ring anaesthesia.[22] S. Scott Reuben *et al* (1995) in their study on 60 patients reported the onset of tourniquet pain at 38 +/-9 mins.[23] In the present study tourniquet time varied from 30 minutes to 95 minutes with an average of 57.5 minutes in IVRA group and from 30 minutes to 90 minutes with an average of 60.83 minutes in Re-IVRA group

QUALITY OF SURGICAL ANALGESIA (Table 4)

In IVRA group surgical analgesia was GOOD in 26 patients (86.66%), FAIR in 3 patients (10%) and POOR in 1 patient (3.34%) where as in Re-IVRA group it was GOOD in 27 patients (90%), FAIR in 3 patients (10%) and no patient with POOR analgesia. Thus there was no significant difference between the IVRA and Re-IVRA groups in quality of analgesia (P >0.05). In all patients, sensory and motor block remained complete and unaffected after re- exsanguination and momentary deflation followed by re-inflation of tourniquet (re-IVRA group), except one patient of IVRA group where analgesia was POOR due to inadvertent release of tourniquet after drug injection. This patient was given general anesthesia for completion of Surgery. The findings of present study regarding quality of surgical analgesia co-relate with the study of N Rawal *et al* (1993) in which surgical analgesia was considered GOOD by (86%), FAIR by (10%) and POOR by (3.3%) patients in IVRA group and the corresponding numbers for the re-exsanguination IVRA group were GOOD in (86%), FAIR in (14%) and POOR in (0%) of patients.[14] Kennedy , *et al* (1965) have reported complete analgesia in 75% cases Good in 7% cases, Fair in 12% cases and Poor in only 3% cases in their series of IVRA study.[24] P. Cox (1989) in their comparative study of standard IVRA technique and modified IVRA technique reported excellent analgesia in both groups. 2 patients in the standard group and 1 patient in the modified group experienced pain at site of operation.[13]

QUALITY OF OPERATIVE FIELD (Table No.5)

There was a significant difference between the groups with regard to oozing at the site of operation. Since the only practical and clinically relevant way of assessing oozing was to ask the surgeon for his opinion one has to accept the limitations implied. Each type of operation and each surgeon has a different requirement with regard to bloodless field. By comparing two relatively large groups under normal clinical conditions, it was felt that the difference seen between the 2 groups represents a significant reduction in oozing at the site of operation. In the present series, in the IVRA group quality of field was EXCELLENT in 12 patients (40%), GOOD in 16 patients (53.34%), FAIR in 1 patient (3.34%) and POOR in one patient (3.33%), where as in the re-IVRA group it was EXCELLENT in 23 patients (76.66%), GOOD in 6 patients (20%) and FAIR in one patient (3.34%). There was no case of POOR field at operative site in re-IVRA group. Thus in the re-IVRA group, incidence of excellent quality of operative field was significantly higher as compared to IVRA group. (P <0.05) (Table No.5). Our results of comparison between IVRA group and Re-IVRA group regarding "quality of operative field were supported by studies of N Rawa ,*et al* (1993).[14] In this study routine IVRA technique was compared with re-exsanguination IVRA technique on 120 patients and in IVRA group they reported Excellent operative field in 38% of patients, Good operative field in 44% of patients, Fair operative field in 18% of patients and no patient showed Poor operative field whereas in re-exsanguination IVRA technique group, they reported Excellent operative field in 67.8% of patients, Good operative field in 27% of patients, Fair operative field in 5.1% of patients and no patients with Poor operative field.[14]

SAFETY OF THE RE-IVRA TECHNIQUE

In this study, after release of tourniquet at the end of surgery, 7 patients from the IVRA group and 5 patients from the re-IVRA group had slight fall in pulse rate. (Table No.6). Out of 7 patients from the IVRA group, 4 patients had a fall in pulse rate by less than '10 beats/min' of the initial level, 2 patients had a fall in pulse rate between 10-20 beats/min of the initial level and 1 patient had a fall in pulse rate between 20-30 beats/min of the initial level.In the re-IVRA group no patient had a fall in pulse rate more than 10 beats/min of the initial level. No treatment was required, as pulse rate did not fall below 60 beats/mins, in any patient and the pulse rate came to the original level within 10-15 minutes. A slight fall in blood pressure occured in 6 patients from the IVRA group and 3 patients from the re-IVRA group after release of the tourniquet (Table No.7). Out of 6 patients in the IVRA group only 2 patients had a fall in blood pressure between 10-20 mm Hg of the initial level and one patient had a fall in blood pressure between 20-30 mm Hg, of the initial level. In the re-IVER group no patient had a fall more than 10 mm/Hg in the blood pressure from the initial level. No treatment was required in any patient as the fall was very slight and the blood pressure came to initial levels within 5 minutes. No central nervous system toxicity was noted in any patient in the present series. In the re-IVRA group, although the cuff was deflated only momentarily, a bolus release of local anaesthetic into the circulation can be expected which may cause local anaesthetic toxicity and affect the quality of sensory and motor block. Some studies had recommended period of 20 minutes to allow fixation of the drug in the tissues and thus reduce the peak blood concentrations after tourniquet release. Others have recommended tourniquet time in the belief that as tourniquet time is increased local anaesthetic agents diffuse from the intravascular space and enter the extracellular fluid of muscle and skin. However, present study does not show any toxic reaction during momentary release of tourniquet during re-exsanguination after 15 minutes of drug injection. Also motor and sensory block was unaffected. J Hallen ,*et al* (1991) did lignocaine uptake studies using positron Emission Tomography and have shown that maximum nerve, vascular and muscle uptake occurs within 5-10 minutes of administration.[17] The lack of any toxic symptoms in patients receiving re-IVRA reinforce the belief that most of the injected drug is fixed to the tissues early. R.L. Hargrove, *et al* (1966) found that maximum concentrations did not exceed 2.0 ug/ml with a dose of lignocaine 2.5 mg/Kg, even if the tourniquet was released after 5 minutes.[25]According to Folder, *et al*, threshold of blood lignocaine levels for toxic symptom is 5 ug/ml and for convulsion is 10 ug/ml.[26] N. Rawal, *et al* (1993) found the peak concentrations of lignocaine after momentary cuff release in the re-IVRA group was 0.91 ug/ml.[14] Charles Sorbie and Pesi Chacha (1965) studied IVRA in 128 patients with 0.5% lignocaine in dose of 200 mg in arm. No serious toxic reaction was encountered in their study.[27]

INADVERTENT RELEASE OF TOURNIQUET

In the present series in IVRA group, one patient had a fall, in the pulse rate between 20-30 beats/min and a fall in the blood pressure between 20-30 mmHg after 5 minutes of drug injection. The tourniquet was checked and was found to be deflated. There was no dizziness, nausea, perioral numbness and other central nervous system toxicity. Patient was given 100% oxygen to breathe from the anaesthetic machine and the intravenous infusion rate was stepped up. After 5 minutes the pulse rate and the blood pressure came back to initial levels. There was poor surgical analgesia with patchy sensory and no motor at all. Alter a full neurological examination, the operation was completed under general anaesthesia. Aronson and Vatashsky (1980) have described a case where bupivacaine was used for intravenous regional analgesia for upper limb and tourniquet got released after 5 minutes. No toxic symptoms were reported.[28] From the present study it was observed that re-exsanguination was not associated with the risk of local anaesthetic toxicity and does not affect the quality of surgical analgesia but at the same time it gives an "Excellent" operative field. Thus it would definitely be the technique of choice when surgeon is not satisfied with the surgical field because of excessive oozing or if microsurgery is planned where dot less field is required.

SUMMARY AND CONCLUSION

IVRA provided adequate surgical conditions in most of the cases. However, re-exsanguination before surgery reduced oozing considerably and provided significantly drier surgical field. There was no significant difference between the IVRA and the re IVRA groups in quality of sensory or motor block. Re- exsanguination did not affect the quality or duration of sensory or motor block. There was no significant differences in tourniquet pain between the IVRA and the re-IVRA groups. There was no serious central nervous system or cardiovascular system toxicity in either the IVRA or the re-IVRA groups. Considering all these factors, it appears possible to reduce the problem of irritating oozing associated with IVRA by using re-exsanguination technique without jeopardising the quality of analgesia and safety. Along with the other outstanding features of IVRA like simplicity of technique, complete safety, almost nil failure rate, excellent analgesia and little pre-operative preparation with no post-operative starvation and hospitalisation, re-IVRA gives the additional advantage of a more drier surgical field. Thus

if the surgeon is not satisfied with the surgical conditions because of excessive oozing or if microsurgery is planned, re-IVRA technique has a definite place in the present day anaesthetic practice.

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