# MODIFIED INTRAVENOUS REGIONAL ANAESTHESIA FOR MANAGEMENT OF CLAW DISEASES IN BUFFALO

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## ABSTRACT

In the present study, the buffalo having surgical affections of claw were divided randomly in to two groups having six animals in each group. Tourniquet was placed circumferentially at the middle of the metacarpus in Group I (standard IVRA) and just below dewclaw in Group II (modified IVRA) animals. In Group I animals, lignocaine hydrochloride and dexmedetomidine mixture was injected 4 mg/kg and 5 µg/kg b.wt in the radial vein. However, in Group II above drugs were injected in half doses in the axial digital vein. Heart rate and respiration rate decreased significantly in both group of animals. In Group I pulse rate decreased significantly ($P<0.05$). After removal of tourniquet no significant changes in HR, PR and RR was observed in both groups of animals. Peripheral oxygen saturation (%) decreased significantly in both groups of animals even after removal of tourniquet. Systolic and diastolic pressure significantly ($P<0.05$) decreased in both group of animals. Mean arterial pressure decreased significantly ($P<0.05$) in both groups at 5 and 10 minutes interval. In Group II animals, the value increased significantly at 20 and 40 minutes interval. Sensory and motor block onset time was lower in Group II as compared to Group I animals. SBRT was more in Group II animals and MBRT was more or less similar in both groups. None of the animal of both group showed sign of toxicity except stumbling in 4 animals of group I just after release of tourniquet.

**Keywords**: *Bubalus bubalis*, buffaloes, hoof disorders, lignocaine, dexmedetomidine, modified IVRA

## INTRODUCTION

The ruminants are unsuitable subjects for the routine general anesthesia because of various complications associated with administration of general anesthesia *viz*. tympany, regurgitation, aspiration of ruminal contents, bed sore, radial nerve paralysis, etc. Further, facilities of general

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anesthesia are not available generally in field conditions and we have to rely on other anesthetic techniques. Therefore, regional anesthesia is more common for the management of surgical affections of buffalo. Intravenous regional anesthesia (IVRA) is best technique for providing local anesthesia/ analgesia and can be performed effectively for short surgical procedures of extremities in bovines (Lumb and Jones, 1984). This technique can be used easily to obtain anesthesia of the limbs in field condition with minimum facility available. However, there are certain disadvantages of bier's block like tourniquet pain, local anesthetic toxicity, poor muscle relaxation and minimal analgesia during postoperative periods (Muhammad and Muhammad, 2012). The ideal IVRA solution should have rapid onset of anesthesia, require reduced doses of local anesthetic, reduce tourniquet pain, and prolong analgesia after deflation of tourniquet. This may be achieved by addition of adjuncts to local anesthetic solution (Kognole *et al*., 2004). In standard technique of intravenous regional anesthesia, the tourniquet is placed at the mid metacarpal/ metatarsal region/ just proximal to carpal/ hock joint which require large amount of local anesthetic and sometimes may produce local anesthetic toxicity just after deflation of tourniquet (Skarda, 1987). The common clinical signs of local anesthetic toxicity are profuse salivation, drowsiness, minor convulsions, trembling and hypotension (Weaver *et al*., 2005).

Lidocaine is the most frequently used local anesthetic agent for producing IVRA in human as well as veterinary patients. Dexmedetomidine, is a potent selective alpha2-adrenoceptor agonist and used as preanesthetic in buffaloes (Singh *et al*., 2013). Dexmedetomidine-lignocaine mixture produces good IVRA with improved quality of anesthesia, tourniquet pain and reduces post operative analgesic requirement in human beings (Esmaoglu *et al*., 2005)

Keeping in view of certain limitations of standard IVRA technique the present study was designed to overcome the problem of local anesthetic toxicity by decreasing dose of local anesthetic and to improve analgesia during intraoperative and postoperative periods in buffaloes. It was hypothesized that the dose of the local anesthetic can be reduced by applying tourniquet more distally just below the dew claws to produce IVRA. No study till date has been undertaken on this aspect in buffalo. Due to the paucity of literature, modified IVRA was performed and compared with the standard IVRA technique using dexmedetomidine as an adjunct to lignocaine hydrochloride for the management of hoof/ claw disorders in buffalo.

## MATERIALS AND METHODS

The present study was performed on the buffalo of either sex aged 6 months to 2 years having surgical affections of hoof or claw. The buffaloes having hoof abnormalities were divided randomly in to two groups having six animals in each group. All the animals were off fed for 24 hours and no premedication was given to any of the animal. Animals were casted and restrained in right lateral recumbency and the site was prepared aseptically. Intravenous regional anesthesia was induced as per the standard technique in Group I animals (Yavari *et al*., 2017). Briefly, tourniquet was placed circumferentially in the middle of the metacarpus (Figure 1). Radial vein was cannulated with the help of winged infusion set and the area was exsanguinated. However in Group II animals, tourniquet was placed distal to the dew claws and axial digital vein was venipunctured for infusion

of drugs (Figure 2). Lignocaine hydrochloride-dexmedetomidine mixture was injected 4 mg/kg and 5 µg/kg b.wt in Group I and 2 mg/kg and 2.5 µg/kg b.wt in Group II animals, respectively. The cannula was removed and injection site was pressed with antiseptic soaked cotton swab to avoid drainage of the local anesthetic or formation of a hematoma. After 50 minutes, the tourniquet of Group I animals was released in three stages with an interval of 3 minutes and the reading of different parameters was noted just after complete removal of tourniquet. However, tourniquet of Group II animals was released at once. The anesthetic potency was monitored by observing the following parameters at different time intervals.

**Heart rate (HR)**

Heart rate was measured by the number of heart contractions per minute. It was taken preoperatively, 5, 10, 15, 20, 30, 40, 50 minutes or till the recovery and after removal of tourniquet.

**Pulse rate (PR)**

Pulse rate represents the tactile arterial palpation of the heart beat and recorded by palpating middle coccygeal artery as beat per minute (bpm). Pulse rate of animals was taken preoperatively, 5, 10, 15, 20, 30, 40, 50 minutes or till the recovery and after removal of tourniquet.

**Respiration rate (RR)**

It is measurement of frequency of breathing. It is usually measure as breath per minute. For a healthy animal it should be 12 to 18 per minute. It was taken preoperatively, 5, 10, 15, 20, 30, 40, 50 minutes or till the recovery and after removal of tourniquet.

**Peripheral oxygen saturation (SPO2)**

It is percentage of hemoglobin binding site in the blood stream occupied by oxygen and measured by pulse oxymetry (*Marketed by- Dr. Trust, Model no. DR50D, Nectar Life science Limited Works, Saidabad, Mohali, Punjab*). The device was applied at the tip of the ear and the reading was taken preoperatively, 5, 10, 15, 20, 30, 40, 50 minutes or till the recovery and after removal of tourniquet.

**Systolic, diastolic and mean arterial pressure (MAP)**

Pressure within arteries in systolic and diastolic phase was measured by non invasive blood pressure monitoring unit (*Romsons BPX automatic BP monitor*) preoperatively, 5, 10, 15, 20, 30, 40, 50 minutes or till the recovery and after removal of tourniquet.

Mean arterial pressure is defined as the average pressure in a patient's arteries during one cardiac cycle. It is considered a better indicator of perfusion to vital organs than systolic blood pressure (SBP). It was calculated by the formula-

$$MAP = SBP + 2(DBP)/3$$

Where, MAP: Mean Arterial Pressure
SBP: Systolic blood pressure
DBP: Diastolic blood pressure

**Sensory block onset time (SBOT)**

It is the time from drug injection to sensory block achieved in all dermatomes. It was recorded preoperatively and at 5, 10, 15, 20, 30, 40, 50 or till the recovery after the administration of anesthesia as per method described by Kognole *et al.* (2004). Briefly, sequential loss of reflexes was recorded by making repeated pin pricks over the skin below the

tourniquet at specific time intervals (not more than 2 to 3 times at a given space).

**Motor block onset time (MBOT)**

It is measurement of motor block. It was taken preoperatively and at 5, 10, 15, 20, 30, 40, 50 or till the recovery after the administration of anesthesia as per method described by Kognole *et al.* (2004).

**Sensory (SBRT) and motor block recovery time (MBRT)**

SBRT and MBRT were measured after 30 minutes of administration of anesthesia till the recovery after the administration of anesthesia as per method suggested by Kognole *et al.* (2004).

**Complication**

Local anesthesia toxicity, if any, was observed by clinical sign and symptom like regurgitation, pain, skin rashes, bradycardia, tachycardia, hypotension and convulsion.

**Statistical analysis**

One way ANOVA (Analysis of variance) was used to compare the mean values at different intervals with their base values. Independent "t" test was used to compare the mean values between groups at different intervals.

## RESULTS AND DISCUSSION

Injuries of hoof and digits are very common in bovines and adversely affect the farmer's economy in the form of decreased production (Cook *et al*., 2016). Thus management of these conditions is of prime importance and sometimes digital or phalangeal amputation may be indicated in severe cases. Surgical management requires adequate intraoperative and postoperative pain management including local anesthesia (LA) and analgesic administration to control pain (Janssen *et al*., 2016). Intravenous regional anesthesia (IVRA) or Bier's block is useful for short surgical procedures of the extremities for an anticipated duration of 60 to 90 minutes (Brown *et al*., 1989). The dose of lignocaine hydrochloride and dexmedetomidine in Group II animals was decreased to half because the area to be desensitized is decreased in modified IVRA as compared to standard IVRA. Clinical parameters like PR, HR, RR should be monitored before, during and after IVRA in order to monitor cardiovascular system (Babalola and Oke, 1983). Mean ± SE of heart rate (per minute), pulse rate, respiration rate, peripheral oxygen saturation (%), systolic pressure (mm of Hg), diastolic pressure (mm of Hg) and mean arterial pressure (mm of Hg) of animals of different groups at different time intervals is presented in Table 1

**Heart rate**

In group I no definite trend in heart rate was observed but the heart rate decreased significantly ($P<0.05$) at 5, 10, 20, 30 and 50 minutes. In Group II animals, heart rate significantly decreased 5, 10, 15, 20, 30, 40 and 50 minutes. The decrease in heart rate values were within normal range in both groups of animals. Elramely and Elmontaz, (2016) also noted decrease in heart rate after dexmeditomidine as an analgesic additive to lignocaine in intravenous regional anesthesia in human beings. After release of tourniquet, the animals were returned from lateral recumbency to standing and no significant change in heart rate was observed in both groups of animals. However, the values were lower than the base value. A significant decrease in heart rate over time after removal of tourniquet from IVRA

using 2% procaine was also observed by Yavari *et al.* (2017). A decrease in heart rate is common in bovines after administration of alpha-2 agonists.

**Pulse rate**

In group I pulse rate decreased significantly (P<0.05) at 10 minutes (48.17±6.86). Thereafter, the value increased towards the base value. In Group II no significant change was noted at any time interval. After removal of tourniquet, no significant change in pulse rate was observed in none of the animals of different groups and pulse rate was within the normal range. Bhaumik *et al.* (2016) also noticed significant fall in mean pulse rate after IVRA using lignocaine and dexmeditomedine combination in human being.

**Respiration rate**

In group I, respiratory rate decreased significantly (P<0.05) at 20 minutes and 30 minutes. However, in Group II respiratory rate decreased significantly (P<0.05) at 5, 10, 15, 20 and 30 minutes and increased non significantly (P>0.05) at 50 minute interval. The respiration rate was within normal range in both groups of animals. Addition of dexmedetomidine with lignocaine in intravenous anesthesia causes minimal respiratory depression (Memis *et al*., 2004). After removal of tourniquet no significant changes in respiratory rate was observed in both groups of animals.

**Peripheral oxygen saturation**

Peripheral oxygen saturation (%) decreased significantly in both groups of animals at 5, 10, 15, 20, 30, 40, and 50 minutes of intervals. After removal of tourniquet peripheral oxygen saturation significantly lower than the base value in both the groups of animals. Significantly low peripheral oxygen saturation might be due to lateral recumbency as rumen pressed the lungs and diaphragm. Lateral recumbency also impairs respiration in cows leading to a moderate increase in arterial $pCO_2$ and a decrease in $pO_2$ (Yavari *et al*., 2017).

**Systolic, diastolic and mean arterial pressure**

Systolic pressure significantly decreased at 5 minutes in both Group I and II animals. Similarly, diastolic pressure was also decreased significantly at 5 and 10 minutes, and increased significantly at 20 minutes of intervals in Group I animals. However in Group II, diastolic pressure decreased at 5 and 10 minutes of interval. Flacke *et al*. (1993) also noticed significant fall in systolic and diastolic pressure using lignocaine and dexmeditomedine combination. There was no significant change in systolic and diastolic pressure after removal of tourniquet in both groups of animals. Mean arterial pressure decreased significantly (P<0.05) in Group I animals at 5 and 10 minutes interval. Memis *et al.* (2004) also noticed significant fall in mean arterial pressure using lignocaine and dexmeditomedine combination. In Group II animals, the value decreased significantly (P<0.05) at 5 and 10 minutes interval. Thereafter the value increased significantly at 20 and 40 minutes interval. The significantly higher MAP in the IVRA cows may indicate a stress response induced by tourniquet pain (Yavari *et al*., 2017) and subsequent release of catecholamines during restraining in lateral recumbency (Rizk et al., 2012). After release of tourniquet, MAP was slightly lower than the base value in both the groups. MAP significantly decreased over time after removal of tourniquet (Yavari *et al*., 2017).

Mean ± SE of sensory block onset time (SBOT), sensory block recovery time (SBRT), motor block onset time (MBOT) and motor block

recovery time (MBRT) (in minutes) of animals of different groups are presented in Table 2.

**Sensory block onset time (SBOT)**

Pin prick to the interdigital space is the common nociceptive test for foot desensitization after local anesthesia (Hudson *et al*., 2008). Sensory block onset time was more in Group I (4.50±0.60 minutes) as compared to Group II (3.08±0.42 minutes). These results were in accordance with the findings of Sheth *et al.* (2016). Lignocaine as a local anaesthetic agent has a rapid onset of action, excellent power of diffusion, low toxicity and good surface anaesthesia, but has a short duration of action (Shah *et al*., 1975). Nasr and Waly (2011) also reported significantly shorter sensory block onset time after using mixture of lignocaine and dexmeditomedine in human patients.

**Motor block onset time (MBOT)**

Motor block onset time was lower in Group II (6.00±1.04 minutes) as compared to Group I (7.58±1.19 minutes) even after halving the dose of lignocaine and dexmeditomidine in Group II animals. Bhaumik *et al.* (2016) also noticed shorter motor block onset time using lignocaine and dexmeditomedine combination in human being.

**Sensory block recovery time (SBRT)**

Sensory block recovery time was 48.17±2.72 minutes in Group I and 47.34±0.71 minutes in Group II animals. Nasr and Waly (2012) noticed longer sensory block recovery time using mixture of lignocaine and dexmeditomedine. These results were in accordance with the findings of the Kognole *et al.* (2004). Mixture of local anaesthetics agent for IVRA had more profound analgesia and successful block and low incidence of complication compared with patient who received individual drug only (Haider and Mahdi, 2013).

**Motor block recovery time (MBRT)**

Motor block recovery time was 51.83±2.68 minutes in Group I and 50.83±1.14 minutes in Group II. Nasr and Waly (2012) also noticed longer motor block recovery time using mixture of lignocaine and dexmeditomedine.

**Local anesthetic toxicity**

In the present study, none of the animal of both group showed sign of toxicity except stumbling in 4 animals of Group I just after release of tourniquet. It might be due to release of tourniquet in three stages at an interval of 3 minutes in Group I animals and lowering the dose of lignocaine and dexmedetomidine in Group II animals. Lumb and Jones (1984) reported cardiovascular and central nervous system toxicity when the local anesthetic enters the circulation at toxic level. Toxicity may be avoided if the tourniquet is loosened for 10 to 15 seconds and retightened for 2 to 3 minutes, and this procedure is repeated several times (Skarda, 1987). Local anesthetic toxicity during release of tourniquet may also be avoided by reducing the total dose of local anesthesia. Toxic symptoms can be avoided by reduction of total amount of local anesthetic (Babalola and Oke, 1983).

## CONCLUSION

Although both standard and modified techniques for producing IVRA using mixture of lignocaine hydrochloride and dexmedetomidine were found suitable but modified IVRA technique was safer as compared to standard IVRA because low doses of local anesthetic are required in this technique. Tourniquet may be released

Table 1. Mean ± SE of heart rate (per minute), pulse rate, respiration rate, peripheral oxygen saturation (%), systolic pressure (mm of Hg), diastolic pressure (mm of Hg) and mean arterial pressure (MAP) (mm of Hg) of animals of different groups at different time intervals.

| Time interval | Heart rate (per minute) | | pulse rate (per minute) | | Respiration rate (per minute) | | Peripheral oxygen saturation (%) | |
|---|---|---|---|---|---|---|---|---|
| | I | II | I | II | I | II | I | II |
| 0 | 67.50±4.71 | 72.50±1.96 | 59.17±4.49$^{a}$ | 71.50±0.85$^{b}$ | 24.17±0.54 | 23.00±1.29 | 93.84±1.05 | 91.67±0.76 |
| 5 | 62.50±5.29$^{*}$ | 44.67±4.87$^{*}$ | 50.67±6.37$^{a}$ | 68.17±0.30$^{b}$ | 21.34±2.54$^{a}$ | 16.17±0.60$^{b*}$ | 87.17±1.40$^{*}$ | 86.34±0.80$^{*}$ |
| 10 | 61.67±5.80$^{a*}$ | 49.17±1.07$^{b*}$ | 48.17±6.86$^{a*}$ | 68.34±0.67$^{b}$ | 21.50±2.03 | 18.34±1.40$^{*}$ | 85.17±1.11$^{*}$ | 81.50±0.76$^{*}$ |
| 15 | 65.00±6.15$^{a}$ | 47.67±0.72$^{b*}$ | 54.67±5.55$^{a}$ | 72.17±0.70$^{b}$ | 22.17±1.78 | 19.17±1.45$^{*}$ | 82.50±2.53$^{*}$ | 81.84±0.70$^{*}$ |
| 20 | 64.50±6.07$^{*}$ | 50.67±1.35$^{*}$ | 56.34±5.94$^{a}$ | 74.17±0.47$^{b}$ | 22.34±0.99$^{*}$ | 21.17±1.45$^{*}$ | 83.34±2.09$^{*}$ | 84.17±0.79$^{*}$ |
| 30 | 64.84±6.02$^{*}$ | 51.67±1.76$^{*}$ | 56.50±5.58$^{a}$ | 74.00±0.52$^{b}$ | 23.00±0.73$^{*}$ | 21.34±1.76$^{*}$ | 86.17±1.19$^{*}$ | 86.00±0.68$^{*}$ |
| 40 | 65.00±5.25 | 52.84±2.03$^{*}$ | 57.00±4.95$^{a}$ | 72.34±0.42$^{b}$ | 24.67±0.34 | 23.67±1.31 | 87.67±0.84$^{*}$ | 87.34±0.76$^{*}$ |
| 50 | 64.34±4.58$^{*}$ | 56.67±3.42$^{*}$ | 57.50±4.99$^{a}$ | 73.17±0.47$^{b}$ | 24.67±0.49 | 25.00±0.86 | 88.67±0.98$^{*}$ | 87.67±0.80$^{*}$ |
| After tourniquet removal | 66.67±4.51 | 61.33±3.49 | 58.17±4.03$^{a}$ | 71.84±0.54$^{b}$ | 24.67±1.26 | 25.50±1.12 | 90.50±0.85$^{*}$ | 88.84±0.79$^{*}$ |

Table 1. Mean ± SE of heart rate (per minute), pulse rate, respiration rate, peripheral oxygen saturation (%), systolic pressure (mm of Hg), diastolic pressure (mm of Hg) and mean arterial pressure (MAP) (mm of Hg) of animals of different groups at different time intervals. (Continue)

| Time interval | Systolic pressure (mm of Hg) | | Diastolic pressure (mm of Hg) | | MAP (mmHg) | |
|---|---|---|---|---|---|---|
| | I | II | I | II | I | II |
| 0 | 124.84±1.58 | 124.00±1.53 | 91.50±1.31 | 91.67±0.67 | 102.61±0.48 | 102.44±0.59 |
| 5 | 117.50±1.77* | 120.00±1.87* | 87.00±2.13* | 82.00±1.24* | 97.17±1.47* | 94.67±0.61* |
| 10 | 118.5±3.36 | 123.5±1.48 | 88.34±1.69* | 85.34±0.67* | 98.39±1.01* | 98.07±0.36* |
| 15 | 126.0±3.47 | 132.5±2.05* | 94.00±1.19 | 91.50±1.77 | 104.7±1.13 | 105.7±1.52 |
| 20 | 132.8±3.86[a] | 144.8±4.39 [b]* | 97.00±1.04* | 94.50±1.77 | 109.0±1.64* | 111.3±1.31* |
| 30 | 127.5±3.52[a] | 139.0±3.31[b]* | 95.50±1.44 | 90.84±2.49 | 106.2±1.38 | 106.9±1.42 |
| 40 | 125.7±3.76[a] | 135.0±2.27[b]* | 90.50±1.71 | 91.67±0.85 | 102.2±1.78 | 106.1±0.93* |
| 50 | 126.7±3.00 | 115.7±6.33 | 88.34±2.95 | 89.50±2.22 | 101.1±2.45 | 98.2±6.29 |
| After tourniquet removal | 124.0±2.07 | 127.8±2.97 | 87.00±2.98 | 86.67±2.80 | 99.3±2.33 | 100.4±1.48 |

*Differ significantly (P<0.05) from day 0 values.

[ab]Value with different alphabets differ significantly (P<0.05) between groups at particular time interval.

Table 2. Mean±SE of sensory block onset time (SBOT), sensory block recovery time (SBRT), motor block onset time (MBOT) and motor block recovery time (MBRT) (in minutes) of animals of different groups.

| Groups | Sensory block onset time (SBOT) | Sensory block recovery time (SBRT) | Motor block onset time (MBOT) | Motor block recovery time (MBRT) |
|---|---|---|---|---|
| I | 4.50±0.60 | 48.17±2.72 | 7.58±1.19 | 51.83±2.68 |
| II | 3.08±0.42 | 47.34±0.71 | 6.00±1.04 | 50.83±1.14 |

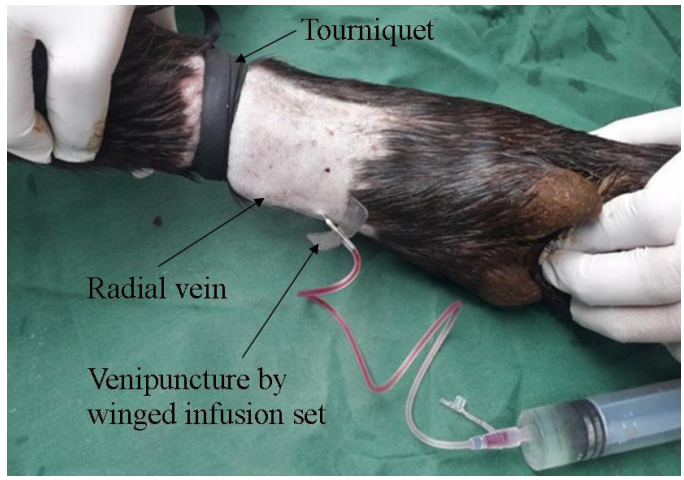


Figure 1. Placement of tourniquet at mid metacarpus and venipuncture of radial vein using winged infusion set (standard IVRA).

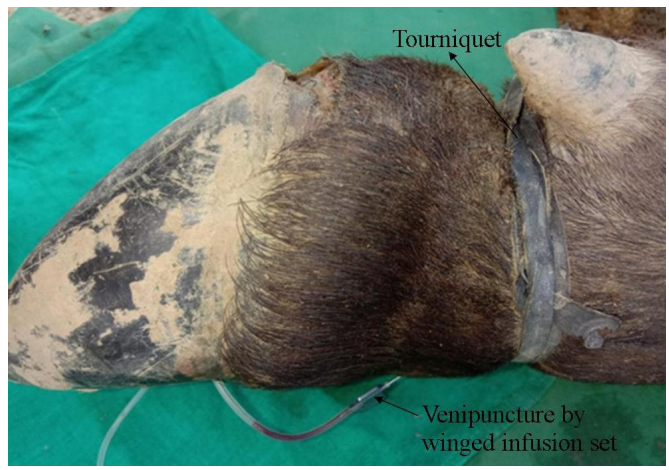


Figure 2. Placement of tourniquet distal to dew claws and venipuncture of axial digital vein using winged infusion set butterfly canula (modified IVRA).

at once without any local anesthetic toxicity symptoms. Digital or phalangeal amputation may be performed under modified IVRA.

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