A 48-year-old man with drug addiction presented with gangrene of the right hand following an inadvertent intra-arterial administration of crushed dihydrocodeine tartrate (DF 118) tablets (GlaxoSmithKline S.A.) dissolved in water; the solution was injected into his right antecubital fossa. After 3 weeks of pain, paresthesia, and cyanosis, his right hand became gangrenous. We performed a right forearm amputation by use of the wide-awake local anesthesia no tourniquet technique. After surgery, his wound healed well, and he was successfully fitted with a hand prosthesis.

Case Report

A 48-year-old man with drug addiction presented to our hospital with gangrene of the right hand following inadvertent intra-arterial administration of crushed dihydrocodeine tartrate (DF 118) tablets (GlaxoSmithKline S.A.) dissolved in water; the solution was injected into his right antecubital fossa. Over a 3-week period after the injection, he initially experienced mild discomfort that worsened, progressively associated with paresthesia, swelling, skin mottling, and cyanosis of the right hand and distal part of the forearm. Eventually, this resulted in gangrene of the right hand. He presented to his district hospital when the hand began to appear mottled and underwent a computed tomography angiography. His radial artery was thrombosed, with only 2.1 cm of the proximal radial artery opacified, whereas approximately 11.4 cm of the ulnar artery was opacified. A trial of intravenous heparin therapy showed no improvement, and he was counseled for amputation. He was not satisfied with the decision and sought a second opinion from our center. Examination of his upper limb showed a clear line of demarcation of the gangrenous zone with no palpable radial or ulnar pulses (Fig. 1). No signs of infection existed at the level of the wrist joint. Together with a vascular consultation, we deemed the right hand unsalvageable, and he consented for a transradial amputation of the right forearm.

He initially consented for general anesthesia; however, owing to the limited operating time due to the COVID-19 pandemic, we instead discussed with the patient about performing the WALANT procedure, and he agreed.

Gangrene of the extremities after an accidental intra-arterial injection has frequently been described, including cases involving people with intravenous drug addiction and iatrogenic cannulation by health care professionals. It can lead to distal gangrene of the upper extremity that often requires surgical amputation. Traditionally, surgical amputation is performed under general anesthesia or regional block. However, here, we report a case of transradial forearm amputation performed by use of the wide-awake local anesthesia no tourniquet (WALANT) technique for right hand gangrene due to inadvertent intra-arterial injection. The amputation was performed by use of the WALANT technique owing to the limited general anesthesia operating time during the coronavirus disease 2019 (COVID-19) pandemic.3

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Procedure

We proceeded with right transradial forearm amputation by use of the WALANT technique after discussing the procedure with the patient. We obtained complete written consent from the patient for all contents of this report, including the pictures and videos.

We prepared the solution for tumescent anesthesia by mixing 50 mL of 2% lignocaine with 50 mL of normal saline, 1 mL of 1:1,000 adrenaline, and 10 mL of 8.4% sodium bicarbonate. The final dilution was 1% lignocaine with 1:100,000 adrenaline. We adhered to the safe dose of 7 mg/kg for lignocaine with epinephrine mixture.

The patient was positioned supine with the right upper limb placed on a hand table. The skin was cleaned and prepared with povidone-iodine solution. The schematic diagram of our WALANT injection is shown in Figure 2 (superficial) and Figure 3 (deep) along with the total volume (Table). A fish-mouth incision was marked out over the healthy skin 5 cm proximal to the line of demarcation of the gangrenous zone at the midforearm level (Fig. 4).

The WALANT injection technique is clearly outlined in our video (Video 1). We began with a circumferential injection of the WALANT solution into the skin and subcutaneous tissue. Using a 27-gauge needle, 10 mL of the solution was injected into the volar aspect and another 10 mL into the dorsal aspect. We subsequently focused on administering subperiosteally 2 cm proximal to the skin incision at the proposed region of bony transection. Beginning with the radius, on the radial side of the radius, we injected 2 mL of the solution straight down into the bone, followed by 4 mL angled volarly and 4 mL dorsally. Moving to the ulnar side of the ulna, this was repeated with 2 mL of the solution injected straight down into the bone, 4 mL angled volarly, and 4 mL dorsally. Hence, a total of 40 mL of the solution was injected before beginning the procedure. We waited for 30 minutes to allow the vasoconstriction to take effect before proceeding with the incision.

We incised the volar aspect initially through the skin and muscles to arrive at the median nerve (Video 2). A further 5 mL of the solution...
was injected immediately around the median nerve and a further 5 mL around the ulnar nerve. In total, 50 mL of the solution was injected. While waiting for the local anesthesia to take effect around the nerves, we proceeded to diathermize the muscle bulk. Both the radial and ulnar arteries were identified and ligated. Returning to the median and ulnar nerves, we informed our patient that there may be an electrical sensation during the transection of these nerves (Fig. 5). We transected the nerves as proximally as possible with a sharp blade, allowing them to retract into the muscle bulk. The radial nerve did not require extra anesthetic infiltration.

We subsequently moved to the dorsal side of the forearm and incised the skin, followed by the extensor muscles. Next, we removed the periosteum of the radius and ulna, clearing away all muscles. The patient was informed about the feeling of a slight shaking sensation as we cut both bones with a sharp saw and rasped the edges. The muscles were sutured over the bone ends in a myoplast fashion, and the skin was enclosed with nonabsorbable sutures.

The patient was well and stable throughout the procedure, with a pain score of 0, except during transection of the median, ulnar, and radial nerves regarding which he mentioned a sharp, electrical sensation (Fig. 6). We interviewed him the next day (Video 3) regarding his experience. His stump healed well, and he was fitted with a myoelectric prosthesis 3 months after the surgery (Video 3).

**Discussion**

The antecubital fossa is a common site for unintentional intra-arterial injection because of the anatomy of arteries and veins that are in close proximity as well as any possible pre-existing vascular anomaly. This can lead to gangrene of the fingers or hand. Common treatment modalities used in these injuries are analgesics, vasodilators, anticoagulants or thrombolytic therapy, sympathetic block, steroids, and surgical intervention such as bypass. When these fail, amputation is often required, as in the case of our patient. Regenerative peripheral nerve interface along with targeted muscle reinnervation would be the standard adjuncts in amputation surgery; however, this procedure can be prohibitively expensive; because our patient did not have insurance coverage, he was not able to access this within the parameters of our health care system.

The COVID-19 crisis has created unique limitations in performing urgent surgeries due to the diversion of anesthetists, operating room staff, and anesthetic equipment, including ventilators, to manage the patients with COVID-19. The WALANT technique can be useful in overcoming these limitations in performing upper-limb surgeries during the COVID-19 pandemic, as in our patient. Neither did we require an anesthesiologist nor any preoperative

### Table

| Anatomical Structure | Anatomical Part | Layer of Forearm | Volume (mL) |
|----------------------|----------------|-----------------|-------------|
| Subcutaneous         | Midforearm     | Dorsal          | 5           |
|                      |               | Volar           | 5           |
|                      | Ulnar side of the forearm | Superficial dorsal | 2.5         |
|                      |               | Superficial volar | 2.5         |
|                      | Radial side of the forearm | Superficial dorsal | 2.5         |
|                      |               | Superficial volar | 2.5         |
|                      | Bone          | Directly down to the radius | 2           |
|                      |               | Deep volar      | 4           |
|                      |               | Deep dorsal     | 4           |
|                      | Ulna          | Directly down to the ulna | 2           |
|                      |               | Deep volar      | 4           |
|                      |               | Deep dorsal     | 4           |
| Nerve                | Median nerve  |                 | 5           |
|                      | Ulnar nerve   |                 | 5           |
| Total                |               |                 | 50          |
investigations (e.g., laboratory work-up, chest radiographs, electrocardiograms); moreover, there was no postoperative observation period; postoperative sedative effects, nausea, and vomiting were absent; better pain management was possible with this technique than that with general anesthesia (WALANT pain relief lasts up to 8–12 hours similar to that with regional block); and it was economically more viable (lower financial requirements/staff usage).

The WALANT technique is gaining popularity worldwide for soft tissue and bony procedures in the upper and lower limbs. It is a local anesthesia technique in which lignocaine and adrenaline are injected in a tumescent fashion directly into the surgical site for anesthetic and hemostatic effects, respectively.6-7 A recent, updated review by Kurtzman et al.8 mentioned up to 80 articles; however, extensive bony procedures by use of the WALANT technique remain somewhat limited. By region, the bony procedures performed are for fracture management of the distal end of the radius, clavicle, olecranon, and foot and ankle.6-18

In most cases, the patient has no pain or very low pain scores. However, it has been recommended that the WALANT technique is especially not suitable for anxious patients.7 Our patient with drug addiction is a commando in the armed forces. He was not fearful of needles and prides himself as being tough. Therefore, we considered him a suitable candidate for undergoing the WALANT technique.

In summary, transradial forearm amputation surgery by use of the WALANT technique is an effective and readily available option during the pandemic and in resource-limited circumstances.

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