Management of Arterial Complications in Patients with Inadvertent Arterial Injection

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Authors’ contributions

This work was carried out in collaboration among all authors. All authors read and approved the final manuscript.

ABSTRACT

Aim: The aim of this study is to assess complications in inadvertent arterial injection and their management.

Methods: From June 2018 to May 2020 in Tanta University Hospitals vascular and endovascular surgery department, this study was conducted on 30 patients with inadvertent intra-arterial drug injection complications, including femoral artery pseudoaneurysm, acute ischemia, and compartment syndrome. In 20 patients with femoral artery pseudoaneurysm, proximal control to external iliac artery and assessment of the vascularity was done intra-operatively for distal arterial Doppler flow. If the distal arterial flow was present, ligation of the common femoral artery was done, While if it was absent, iliofemoral bypass was done. Brachio-ulnar bypass was done for brachial artery pseudoaneurysm. Fasciotomy was done for compartment syndrome.

Results: The mean age of patients was 27.4 years ranged from 1 year to 64 years. The femoral artery was affected in 20 cases. The brachial artery was involved in 6 cases, radial artery in 2 cases, and ulnar artery in 2 cases. In 20 patients, ligations of the common femoral artery CFA with...
debridement of necrotic were done for all cases. Twelve patients had good Doppler flow, eight patients had no Doppler flow, and iliofemoral bypass was done. In the upper limb cases, one case presented by severe edema in hand necessitating fasciotomy. Four cases presented with fixed color changes and gangrene in fingers after one brachial, one radial, and two ulnar arteries injections and required minor amputation. Two cases were presented with neglected ischemia and extensive infection, and above the elbow, amputation was done. In three cases with brachial pseudoaneurysm, we ligated the brachial artery, and no bypass was done with the preserved distal flow in one case; in the other two cases of brachial artery pseudoaneurysm, we did brachio-ulnar bypass.

**Conclusion:** Inadvertent IA injection of medications has no appropriate therapeutic guidelines. The actual incidence rates, natural history, and pathophysiologic factors surrounding these complications are unclear. For prevention, the best tools are the assessment of the risk factors and consequences. The treatment options are immediate recognition of the situation, disease progress, pain control, anticoagulation, specific therapy.

**Keywords:** Inadvertent; intra-arterial; pseudoaneurysm; injection.

### 1. INTRODUCTION

Accidental intra-arterial drug injections may occur as an iatrogenic complication or as a result of attempted intravenous injections in drug abusers [1]. The true incidence in today's practice is difficult to evaluate because of significant underreporting due to lack of recognition (especially in anesthetized or sedated patients who may not verbalize a painful injection) and the fear of potential professional and medicolegal consequences [2]. Unintentional intra-arterial (IA) injection of medications can lead to clinically important sequelae, including paresthesia, severe pain, motor dysfunction, compartment syndrome, gangrene, and limb loss [3]. The advent of ischemia in an extremity, however, has a multifactorial origin and can depend on the injection site, the physicochemical drug properties, and volume of the injected drug. Furthermore, on the patient side, various different pathophysiological responses, ranging from vasospasm, thrombosis, acral embolism due to non-dissolvable drug components, or thromboembolism, can be encountered [4]. This reflects the difficulty in treating this group of patients due to lack of evidence-based guidelines regarding the management of inadvertent intra-arterial drug injections [5].

### 2. PATIENTS AND METHODS

This study was a prospective study that was carried out on 30 patients with drug administration by injectable route with an arterial lesion due to this injection.

### 2.1 Clinical Assessment

1. Material injected by the patient himself in case of addiction and history of bright red colored blood at the time of injection, a drug injected in iatrogenic cases.
2. Recording time passed from injection till presentation in case of intravenous (iv) drug addict and cases of iatrogenic injection.
3. Site of the needle as regard sinus or discharge, bleeding, history of bleeding from this site.

### 2.2 Investigations

#### 2.2.1 Laboratory investigation

- Complete blood count (CBC), Haematocrite value (using DIRUI BCC-3600 hematology analyzer) blood grouping and cross matching.
- Clotting profile (prothrombin time, partial thromboplastin time, international normalization ratio INR).
- Liver and renal functions tests (using MYRA Chem).
- Virology markers for hepatitis C virus (HCV), hepatitis B virus (HBV), human immunodeficiency virus (HIV) using Elisa Plate Reader statfax Chromate 4300.

#### 2.2.2 Investigations to assess the arterial system of the affected limb

- Duplex U/S ((using Philips Affinity 50G ultrasound machine) was performed as a first-line diagnostic tool. It helps to show the following:-
- Haematoma or abscess connected to the artery.
- Aneurysm formation true or false aneurysm.
- Arterio-venous fistula presence or not.
- Distal flow pattern if triphasic or biphasic or absent.
  - CT angiography (using Toshiba aquilion 320 slice).

2.2.3 Angiography served three purposes

- Diagnosis was confirmed
- Exact location and number of the pseudoaneurysms were detected, thereby enabling us to better plan the surgical management
- The distal run-off vessels were imaged in case a bypass graft had to be performed.

2.3 Management

2.3.1 Medical treatment

- Anticoagulation: was given enoxaparin in therapeutic dose according to the bodyweight 1 mg/kg SC q12h for one week, and then we shifted to prophylactic dose for one week.
- Antibiotic: empirically (especially in those who abuse IV drugs) then according to culture and sensitivity Ceftriaxone 1 gm twice daily or imipenem (Meronam)1 gm every 8 hours daily for at least seven days according to the severity of infection.
- Corticosteroids: to reduce inflammatory response was given as dexamethasone 4 mg twice daily.
- Vasodilators: Prostaglandin E1 alprostadil (PGE1) 20.0 mcg, diluted with ten ccs normal saline, then one cc was given as intravenous infusion with 100 cc saline every 12 hours
- Antiplatelets: aspirin 75 mg daily and cilostazol 50 mg twice daily.

2.3.2 Surgical technique

2.3.2.1 In lower limb cases

- They presented with an infected pseudoaneurysm over the common femoral artery.
- Proximal control through suprainguinal approach to external iliac artery retroperitoneally.
- Distal control by exposure of superficial femoral artery distal to the pseudoaneurysm.
- Assessment of the vascularity was done intraoperatively with handheld Doppler and capillary refilling.
- Cases with preserved distal arterial flow ligation of the common femoral artery only were done.
- Cases with absent distal arterial flow extra-anatomical iliofemoral bypass were done using PTFE ringed graft 8 mm*80 cm synthetic graft.

2.3.2.2 In upper limb cases

- Cases with infected pseudoaneurysm over the brachial artery.
- Proximal control of the brachial artery in the arm was obtained then distal control of both ulnar and radial arteries was done.
- Clamping of the brachial artery and assessment of vascularity by handheld Doppler.
- If no distal flow was heard, extra anatomical brachio-ulnar bypass was done using PTFE graft 6mm*60 cm.
- If the distal flow was heard by handheld Doppler, ligation was done with debridement of the infected hematoma.
- Cases presented with fixed color changes in fingers minor amputation was done.
- The case presented with compartment syndrome fasciotomy was done.

2.4 Follow Up

Intervals of follow-up were weekly for one month, then every month for three months, patients were evaluated in our outpatient clinic.

- Imaging: by duplex study for graft patency, distal circulation.
- Socially: by referral to social services for follow-up of addiction status.

3. RESULTS

The mean age of patients was 27.4 years ranged from 1 year to 64 years. In this study, 86.7% of patients were IV drug abusers (26 of 30) and...
13.3% (4 of 30) were not, and (60%) of the patients had HCV-positive antibody (18 of 30).

### 3.1 Affected Artery in this Study

- The femoral artery was the most commonly affected artery in 66.7% (20 of 30 cases)
- Then the brachial artery 6 cases (20%)
- Radial and ulnar arteries 2 cases each (6.6% for each).

#### 3.1.1 Management of Cases of Lower Limb Intra-Arterial Injection

They were 20 cases with femoral artery pseudoaneurysm.

- In (12 of 20 cases) (60% of lower limb cases) we did ligation of common femoral, superficial femoral, and profunda femoris arteries. Doppler flow was present after this ligation, so no revascularization was done and the patient continued on medical treatment.
- In (8 of 20 cases) (40% of lower limb cases) iliofemoral bypass was done due to absent Doppler arterial flow after clamping the femoral artery.

#### 3.1.2 The Outcome of Cases of Lower Limb Intra-Arterial Injection

- Patients who did ligation presented in follow-up with mild claudication (60% of lower limb cases).
- Patients who did bypass, within the first two weeks, only one patient from the bypass group developed a massive infection, toxemia, and irreversible ischemia due to graft thrombosis and needed above-knee amputation.
- After 3-18 months, six cases (6 of 8) (75% of the bypass group) of the iliofemoral extra anatomical bypass came with an infected graft.
- The graft was removed in all of them with no need for reconstruction except only one patient presented with neglected ischemia and infection of the graft and needed above-knee amputation.

### 4. DISCUSSION

The exact incidence of inadvertent intra-arterial cannulation and a subsequent injection is unknown. It has been estimated that the frequencies may range from as low as 1:56000 to as high as 1:3440 [6]. so, awareness to prevent and manage similar occurrences in the future is essential. Non-iatrogenic accidental IA injections have been reported in illicit drug users and addicts. Early clinical manifestations may offer clues before irreversible damage has taken place. Early symptoms may include pain and flushing at injection, followed by nail bed pallor and a decreased capillary refill [7]. In this study, there were 30 patients with inadvertent intra-arterial drug injection, 26 cases were intravenous drug addicts, and 4 cases occurred in intensive care units (ICU).

**Presentation of intra-arterial drug injection in this study**

<table>
<thead>
<tr>
<th>Presentation of intra-arterial injection</th>
<th>No. (30)</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ruptured femoral pseudoaneurysm</td>
<td>10</td>
<td>33.3%</td>
</tr>
<tr>
<td>Impending rupture femoral pseudoaneurysm</td>
<td>10</td>
<td>33.3%</td>
</tr>
<tr>
<td>Pulsating mass in cubital fossa</td>
<td>3</td>
<td>10%</td>
</tr>
<tr>
<td>Necrotizing fasciitis in forearm</td>
<td>2</td>
<td>6.7%</td>
</tr>
<tr>
<td>Fixed colour changes in fingers</td>
<td>3</td>
<td>10%</td>
</tr>
<tr>
<td>Sever edema in hand</td>
<td>1</td>
<td>3.3%</td>
</tr>
<tr>
<td>Cyanosis in hand</td>
<td>1</td>
<td>3.3%</td>
</tr>
</tbody>
</table>

**Management of cases of upper limb intra-arterial injection**

<table>
<thead>
<tr>
<th>Management of upper limb intra-arterial drug injection</th>
<th>No. (10)</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Brachio ulnar bypass</td>
<td>2</td>
<td>20%</td>
</tr>
<tr>
<td>Ligation of brachial artery</td>
<td>1</td>
<td>10%</td>
</tr>
<tr>
<td>Fasciotomy</td>
<td>1</td>
<td>10%</td>
</tr>
<tr>
<td>Conservative, minor amputation</td>
<td>4</td>
<td>40%</td>
</tr>
<tr>
<td>Above elbow amputation</td>
<td>2</td>
<td>20%</td>
</tr>
</tbody>
</table>
Intravenous drug users carry a high risk of contracting blood-borne infections such as HIV, Hepatitis B, and C. Disease transmission from these patients to their treating healthcare professionals is a small but real risk [8]. In this study, presentation of patients with lower limb intra-arterial drug injection (20 cases) was bleeding from ruptured femoral artery pseudoaneurysm (50%) while groin swelling that was impending rupture femoral artery pseudoaneurysm (50%). Presentations in upper limb IADI were severe pain, and profound ischemia of the hand typically occurs almost immediately. This was clinically obvious on physical examination with mottling, cyanosis, swelling, and numbness of the fingers and palm. The radial pulse may remain palpable since most of the injury is in small distal vessels [9,10].

The debate regarding reconstruction is of particular interest in the subset of patients with infected pseudoaneurysm of the femoral artery (IFAP), which is the result of IV drug abuse. Most of the authors have advocated simple arterial ligation and resection of the infected tissues [11,12]. The management options include excision and debridement of the IFAP with routine revascularization or excision and debridement of the IFAP with ligation of the CFA without arterial revascularization. The use of synthetic or autologous conduits is complicated because of the presence of infection and the unavailability of autologous conduits from repeated drug abuse or deep venous thrombosis (DVT). In our study, 12 cases underwent ligation of common femoral, superficial femoral, and profunda femoris arteries, and 8 cases underwent iliofemoral bypass that presented later on with infection and was removed. Synthetic bypass grafts carry the risk of disease because the patient injects themselves with addictive substances, even when they are placed deep and away from the infected site, usually in the form of an obturator bypass graft because of groin infection. We found that routine ligation of the common femoral artery (CFA) along with local drainage and debridement of the IFAP in patients with a Doppler scan signal over a pedal artery on test clamping was a safe treatment option.

5. CONCLUSION

Inadvertent injection of medications intra-arterially has various case reports, physiochemical hypotheses. No appropriate therapeutic guidelines have been formed because of the difficulties in obtaining a large sample size of patients and collecting prospective data on this topic. Furthermore, the true incidence rates, natural history, and pathophysiologic factors surrounding these complications are unclear. For prevention, the best tools available to health care practitioners are assessing risk factors and appreciating the devastating consequences associated with inadvertent IA injection of drugs. Simple ligation-debridement of infected groin pseudoaneurysms in IV drug abusers is usually a sufficient management line, and revascularization is not warranted in most cases.

CONSENT

Informed (oral and written) consent was taken from all patients before initiating the study. Privacy was maintained by identifying the patients by coded numbers to identify research participants, and all the private data of the patient such as name, phone number, and address will not appear in the research.

ETHICAL APPROVAL

It was approved by ethical committee no 23757-12-19.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

REFERENCES


