DIGITAL SUBTRACTION ANGIOGRAPHY: PROBLEM SOLVING TOOL IN DECISION MAKING IN EQUIVOCAL CASES OF POLYTRAUMA

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We are reporting a case of polytrauma having head injury and fracture in both bone lower limb, highlighting the importance of Digital Subtraction Angiography (DSA) in patient care and management and how important it is to be aware of normal anatomical variations. It can lead to an erroneous diagnosis and therefore change the entire management protocol of the patient. Polytrauma is an emergency , immediate and judicious intervention is the mainstay in patient's management.

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1. Introduction

Cases of poly-trauma usually admitted in emergency department (ED) require urgent and judicious selection of protocol. It requires selection of investigations which are of utmost importance and directly related to patient management, keeping in mind the time factor which is very crucial. Unnecessary investigations should be avoided giving preference to most urgent ones.

2. Case Study

Our patient case of road traffic accident (RTA) (young adult) sustained injuries in lower limbs and head injury. When brought to the emergency department was conscious but in severe pain and confused. He was hemo-dynamically stable. Obvious and severe injury was presented in his right lower limb in form of swelling, tenderness and hemorrhagic wound. He was immediately sent for a Non contrast CT (NCCT) of Brain and radiographs of Right thigh, antero-posterior/lateral (AP/LAT) view and leg AP/LAT view. A radiograph chest antero-posterior view was advised. NCCT Brain showed fracture of right parietal bone and a very small epidural hemorrhage (EDH) of parietal lobe. No mass effect or parenchymal contusion was present. Glasgow Coma Scale (GCS) was normal. Radiographs showed undisplaced fracture of proximal tibia and fibula right side. Chest radiograph was normal. Abdomen was soft with no distension. Bowel sounds were normally heard. On examination pulse was normal in femoral and popliteal. Due to edema and swelling posterior tibial and Dorsalis pedis could not be satisfactorily examined**.** He was advised a bed side Color flow Doppler to rule out vascular injury which would require immediate intervention. Doppler study by an experienced radiologist found normal flow in femoral and popliteal and its trifurcation. Posterior tibial could not be traced after mid calf region. Peroneal showed good flow. Anterior tibial could be seen only for a short segment after which it could not be traced. However Dorsalis pedis showed good flow. Keeping in mind of clinical setting and limitations of bed side Doppler, vascular injury could not be ruled out. After consultation with the surgeon an angiography was done before taking a final decision. Digital

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Subtraction Angiography showed what nobody could think of in a tense and emergency situation of poly-trauma. The flow in Right external iliac, femoral and popliteal was normal (Fig 1A), flow in posterior tibial was good but subjectively less in its distal most portion (Fig 1B), There was an anatomical variation of calf arteries. The predominant artery was peroneal artery which continued as dorsalis pedis artery (Fig 1C). The anterior tibial was hypoplastic (Fig 1D). It had a high origin (Fig 1E). The tibio peroneal trunk was prominent (Fig 1D & E). The peroneal gave prominent arteries to plantar arch. The flow was normal, angiography study was labeled as normal and ruled out any sort of vascular injury. The decision of operative intervention for vascular repair was averted. The patient was conservatively managed for his undisplaced fracture and head injury. The patient had an uneventful hospital stay with no major complaints.

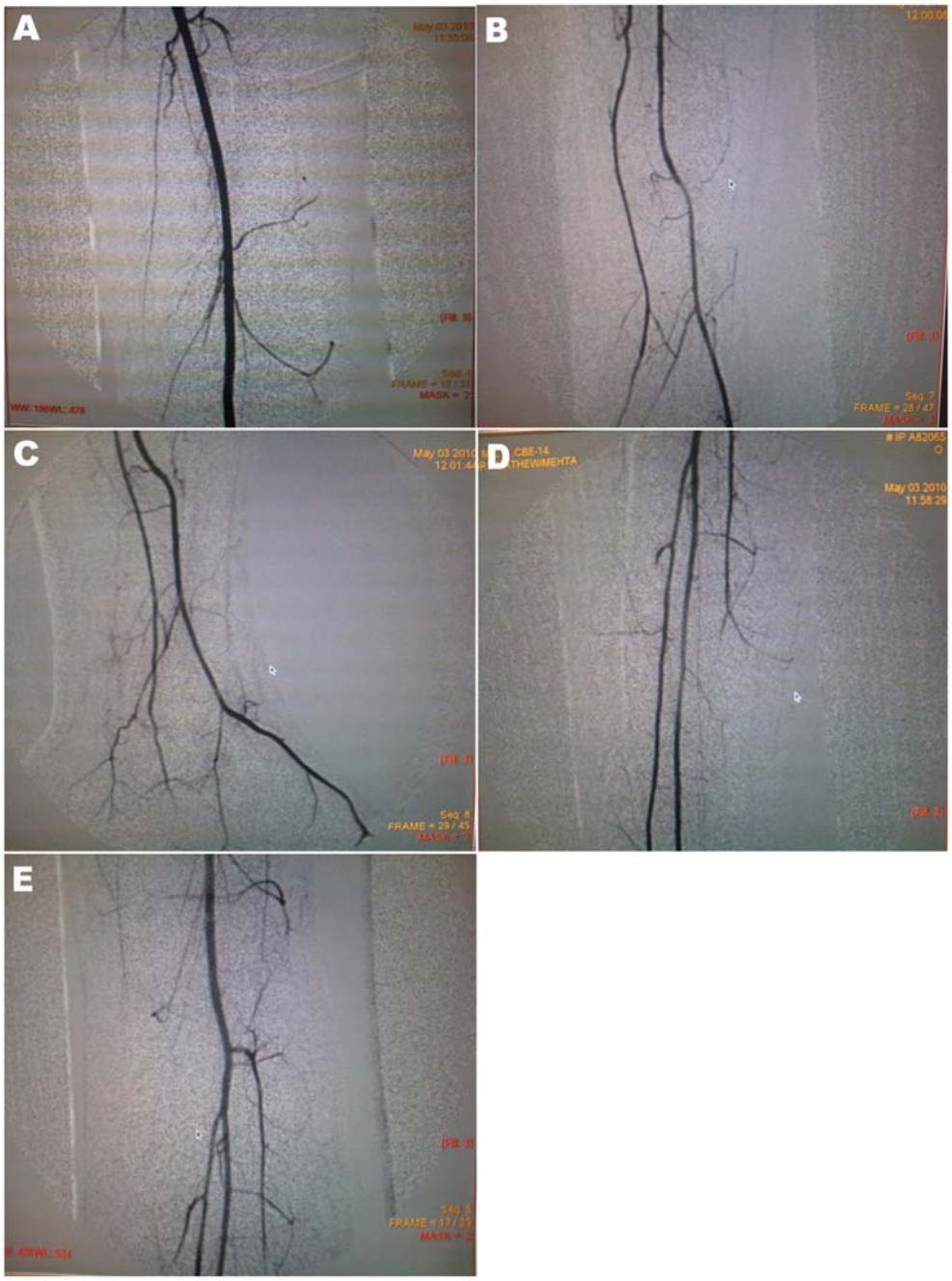

Fig. 1. [A]. The flow in Right external iliac, femoral and popliteal was normal, [B]. Flow in posterior tibial was good but subjectively less in its distal most portion, [C]. Predominant artery was peroneal artery which continued as dorsalis pedis artery, [D]. Anterior tibial artery is small and hypoplastic, [E]. High origin of Anterior tibial and prominent tibio-peroneal trunk.

3. Discussion

The distal runoff arteries the ATA (anterior tibial artery), PTA (posterior tibial artery) and PA (peroneal artery) are the three terminal branches of the popliteal artery. The ATA runs anteriorly through the interosseous membrane between the tibia and fibula. It is the only major artery in the anterior compartment of lower leg and continues into the foot as DP (dorsalis pedis) artery. The PTA is the direct continuation of POP (popliteal) artery and supplies the muscle of posterior compartment and nutrient artery to tibia. The peroneal artery is the third terminal branch and lies between the ATA and PTA. It provides branches to calf muscles and is the nutrient artery to fibula. Its most terminal branches can cross the ankle and anastomose with plantar arch. The medial and lateral plantar arteries are a continuation of PTA. The plantar arch is formed by a continuation of lateral plantar artery that joins the deep plantar branches of DP artery. The arterial anatomy of the lower extremity is fairly constant. However anatomic variations that may be encountered occasionally are [1]

1. Duplication of SFA (rare)
2. High bifurcation of popliteal artery (4%)
3. High bifurcation of PA with peroneal arising from ATA (2%)
4. Absent PTA; may have distal reconstitution at the level of ankle by way of peroneal artery (1-5%)
5. Hypoplasia or aplasia of ATA with resultant absence of DP pulse (4-12 %)
6. Anomalous location of DPA (8%)

Some patients of extremity trauma have clear evidence on examination of significant vascular injury and undergo surgical exploration without imaging. In some cases a vascular injury is suspected without hemodynamic compromise, based on location and nature of injury. Most of these patients undergo angiography, but some centres have investigated the utility of Duplex ultrasound for these cases seeking intimal injury, thrombosis, traumatic pseudo-aneurysms and AV fistulas. Bynoe and colleagues [2] used duplex scanning in 198 patients and achieved a sensitivity of 95% specificity of 98% and overall accuracy of 98% for identifying arterial injuries. In an experimental study Duplex was more accurate than angiography in identifying arterial lacerations [3]. The Duplex examination need not be performed immediately on admission to trauma room. However it should be done expeditiously to facilitate management especially in poly-trauma patients. Since the site of vessel injury is difficult to predict it should include the entire limb in question. Several factors can complicate performance of Duplex scanning in setting of trauma. Uncooperative patients may require sedation. Accoustic access may be limited due to wound dressings, orthopaedic immobilising devices, foreign bodies in soft tissues. Soft tissue hematoma can increase the depth of penetration needed to visualise the vessels. Arterial injuries detectable by Duplex scanning includes arterial stenosis /occlusion dissection or intimal flap formation, pseudo-aneurysm and AV fistula.

Arteriography can make a significant contribution to management of trauma patients [4, 5].Traumatic arterial injuries of the pelvis and lower extremity unless promptly recognised can cause severe hemorrhage or ischemia and thus carries a high risk of death or loss of limb [6]. It is generally impossible to determine clinically whether the source of bleeding is arterial or venous [7]. Surgical exploration has been the traditional technique used in attempts to establish the bleeding site but is usually unsuccessful in case of massive hemorrhage [8]. If the tamponading effect of hemorrhage is disturbed by surgical exploration, fatal hemorrhage and intraperitoneal rupture may be reactivated. Even when successful it can lead to sepsis. Arterial injury such as laceration or contusuion of lower extremity vessels is common especially after penetrating or blunt injuries or fractures [9]. Patient selection for arteriography may require that certain guidelines be followed [10]. Arteries near the surface, fixed in position or adjacent to bone are usually the ones most readily injured by the common mechanism of trauma [11].The distal SFA is a common site of injury after fracture femur. Another frequently injured vessel is popliteal artery [12, 13]. The anterior tibial artery is similarly prone to injury as it passes through the interosseous membrane in case of fracture proximal tibia. The close proximation of the artery to the bone makes this site vulnerable for arterial injury. The clinical diagnosis of arterial injury in the lower extremities

depends on recognising the signs of acute ischemia distal to the traumatised site [14]. The clinical signs are sufficient to give a strong suggestion to the diagnosis [15]. An arteriogram may be necessary to confirm and pinpoint the lesion before surgical repair as long as definitive therapy is not duly delayed. Arterial spasm can mimic the clinical and arteriogaphic findings of severe arterial trauma, the diagnosis must be established by surgical exploration. All potential mechanisms of arterial injury cause partial or total vessel obstruction and this threatens the viability of the extremity. The ischemic time refers to the time elapsed before definitive repair of the arterial injury is attempted. Greater the ischemic time more are chances of failure after reconstruction and increased chances of muscle contracture and atrophy [16]. Ischemic times or delay of more than 6 to 12 hours has been said to be critical [17, 18].

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