CASE REPORT

FOREARM COMPARTMENT SYNDROME DUE TO TRANSRADIAL PCI IN STEMI: CASE SERIES OF WHAT CAN GO WRONG AND LESSON LEARNED

Rismarini Asanti[1], Sidhi Laksono[2]

[1]Department of Emergency Medicine, Siloam Diagram Heart Center, Depok City, West Java, Indonesia, [2]Department of Cardiology and Vascular Medicine, Siloam Diagram Heart Center, Depok city, West Java, Indonesia

Abstract: The trans-radial approach (TRA) is shown to be superior in reducing bleeding complications and associated with lower mortality with a similar procedural success rate in ST-Elevated Myocardial Infarction (STEMI) patients compared to the trans-femoral approach. Nevertheless, complications such as forearm hematoma and, in rare cases, acute compartment syndrome (ACS) may develop, thus requiring a prompt surgical procedure. Here, we present two successful emergency fasciotomy cases as ACS treatment following primary percutaneous coronary intervention after STEMI. Both patients show normal neurological and muscular function and normal artery flow on both hands afterward.

Keywords: Compartment syndrome, Complication, Percutaneous Coronary Intervention (PCI), Transradial approach (TRA)

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INTRODUCTION

In the 1990s, the trans-radial approach (TRA) for percutaneous coronary intervention (PCI) was first introduced by Campeau and Kiemeneij as an alternative to the already established transfemoral approach (TFA). The evidence from multiple trials and meta-analysis showed the trans-radial approach to be superior in terms of reducing bleeding complications (including major bleeding and local vascular complication) and associated with lower 30-day-mortality with similar Thrombolysis in Myocardial Infarction (TIMI) 3 flow and procedural success rate in ST-Elevated Myocardial Infarction (STEMI) patient.[1-4] TRA is also strongly recommended by Canadian and European Society guidelines for managing STEMI.[5,6]

Even though TRA has lower local vascular events than TFA, complications such as forearm hematoma and, in rare cases, acute compartment syndrome (ACS) may develop, thus requiring a prompt surgical approach. The incidence of vascular complications in TRA is very rare and mainly published in case reports.[7,8] As rare as it is, if compartment syndrome does develop, is unidentified, and is not treated promptly, it may cause catastrophic injury. Early recognition and intervention from a multidisciplinary team become essential to ensure a better prognosis for the patients. Here, we present 2 cases of successfully managed ACS following primary PCI after STEMI.

CASE 1

A 42-year-old male with a history of hypertension and smoking was referred with anterior STEMI with onset of symptoms 6 hours before admission to our hospital. He denied any history of chronic kidney disease, chronic liver disease, cancer, cerebrovascular disease, or spontaneous bleeding. His ECG showed ST elevation in lead V1-V4 with inverted T wave in lead V5-V6, I, aVL, and Q wave in lead III, V3R-V4R. His hemoglobin level was 11.7 g/dl, thrombocyte 225 10^3/µl, creatinine 1.09 mg/dl with estimated glomerular filtration rate (eGFR) of 80.4 ml/min/1.73 m^2, and troponin T value was increased at 306 ng/L. He was given a loading dose of Aspilet 320 mg, Clopidogrel 600 mg, Enoxaparin 30 mg IV and 60 mg SC, and Atorvastatin 80 mg and proceeded to primary PCI. At the beginning of the procedure, he received 7500 IU of unfractionated heparin and 8 mg intracoronary of Eptifibatide. His angiography showed 50-60% tubular stenosis in proximal, 80-90% diffuse in mid, 60% stenosis in the distal right coronary artery (RCA), and total occlusion in mid left anterior descending (LAD).

We placed Biomatrix Alpha 2.5 x 19 mm drug-eluting stent (DES) on his mid-LAD with a good result of TIMI 3 flow. 2000IU of heparin was given about 20 minutes before the finishing of the procedure. When the procedure was finished, the radial introducer sheath was removed, and a radial compressing device was used on the puncture site. One hour later, he

complained of progressive pain and worsening edema on his volar antebrachial area with EASY hematoma classification grade III. We also started to apply pressure by using blood pressure (BP) cuff inflation for 15 minutes with pressure of 15 mmHg below systolic pressure and repeated the procedure thrice. He was given 1000 mg of intravenous Paracetamol and compressed with a cold pack between the cuff inflation, and multiple bullae appeared progressively. The compartment syndrome is still progressing despite initial management. The surgeon was immediately contacted, and an emergency fasciotomy was scheduled. In the operating room, his radial artery was lacerated 2 cm from the puncture site. We proceeded to ligate the artery and conduct arthroplasty to repair the artery and control the bleeding. The wound was left open for two days and then closed after two days. His recovery was good, with no sign of neurologic or muscular dysfunction. After three months, during follow-up, a Doppler was used to assess blood flow and found normal artery flow in both hands.

Figure 1: Right forearm compartment syndrome with multiple bullae

CASE 1

A 62-year-old male presented to our emergency department with anterior extensive STEMI onset of symptoms 13 hours prior to admission to our hospital. The patient is an active cigarette smoker (1 pack per day) with no history of chronic diseases. His ECG showed right bundle branch block (RBBB) and ST elevation in lead V2-V6, I, aVL. His hemoglobin level was 13 g/dl, thrombocyte 306 10^3/µl, creatinine 0.59 mg/dl with eGFR of 108.5 ml/min/1.73 m^2, and troponin T value is increased at 984 ng/L. He was given a loading dose of Aspilet 160 mg, Ticagrelor 180 mg, and Enoxaparin 60 mg SC and proceeded to primary PCI. He received 3000 IU of unfractionated heparin and 9.75 mg of Eptifibatide. During the procedure, the patient's BP dropped (cardiogenic shock), so we titrated intravenous norepinephrine with a dose of 0.05 mcg/kg/min until mean arterial pressure (MAP) was above 65 mmHg. During angiography, the patient was found to have a total occlusion in proximal LAD, and there is also the presence of 60-70% stenosis in the proximal left circumflex artery (LCx). We placed Biofreedom Ultra 3.0 x 19 mm DES to his proximal LAD, resulting in TIMI 3 flow (good flow) to distal LAD.

2000IU of heparin was given about 20 minutes before the procedure was finished. When the procedure was finished, the radial introducer sheath was removed, and the radial compressing device was worn slightly above the puncture site. Two hours later, he developed progressive edema on his right antebrachial area extending to 2 cm above antecubital fossa, with EASY Hematoma Classification Grade V. He also complained of paraesthesia and inability to move his fingers due to unbearable pain. Multiple petechiae and signs of low blood flow (cyanotic skin, capillary refill time of more than 2 seconds, and blood oxygen saturation of 88%) are observed distal from the

puncture area. When the radial hemostatic band was loosened, perfusion to the distal area improved, but the puncture site was bleeding profusely. The catheter lab team was called to place a new hemostatic band. We also started to apply pressure by using BP cuff inflation for 15 minutes with pressure of 15 mmHg below systolic pressure and repeated the procedure thrice. Pain management was given using 2 mg of intravenous Morphine and 25 mg of intravenous Fentanyl with no resolution of pain. After some time, multiple bullae appeared on the forearm. The compartment syndrome was still progressing despite initial management. The surgeon was immediately contacted, and an emergency fasciotomy was scheduled. In the operating room, there was no laceration on his radial artery, but we found his artery puncture to be 3 cm proximal from its skin puncture. We proceeded to suture the puncture site; the wound was left open for three days, and wound closure was done after the third day. On follow-up, two weeks after the procedure, the patient showed no sign of neurologic or muscular dysfunction.

Figure 2: Right forearm hematoma with the sign of reduced distal perfusion

Figure 3: Fasciotomy

DISCUSSION

Sandoval et al. classified TRA complications into intra-procedural and post-procedural. In post-procedural, bleeding complications might manifest as forearm hematoma and compartment syndrome, which was found in both of our patients.[9] Garg et al. found the incidence of forearm hematoma to be 10,2%, and similar results are also documented by Dwivedi et al. who found the incidence to be 10,7%. Although both studies have 520 and 186 samples, none of their patients developed compartment syndrome.[10,11]

Compartment syndrome (CS) occurs when there is build-up pressure in the closed osteofascial compartment. Early identification of CS is crucial to prevent permanent extremity dysfunction. Therefore, suspicion and diagnosis of CS should mainly be based on clinical symptoms. Patients typically present with pain whose severity is disproportionate to the injury, as seen in both of our patients, where the pain

gradually builds up until it becomes incessant. Additional 5P symptoms of acute limb ischemia (pain, pallor, paraesthesia, pulselessness, poikilothermia) might be present. One crucial physical finding in CS is the presence of a firm, wood-like feel when performing deep palpation in the affected area. Incidentally, there might be the presence of cutaneous bullae.

In relation to TRA, some factors related to the development of CS can be divided into patient characteristics and procedural aspects. The Academic Research Consortium for High Bleeding Risk (ARC-HBR) proposed a definition of a high bleeding risk (HBR) population, where 20 clinical criteria were separated into major and minor criteria.[12] When patients fulfill one major and two minor criteria, they are at high bleeding risk.

From a procedural perspective, CS might occur due to bleeding caused by arterial laceration, excess anticoagulant pre or post-PCI, inappropriate arteriotomy compression band position, more distal puncture site of the radial artery, and multiple access attempts.[13,14]

In our first patient, only one minor criterion was fulfilled: hemoglobin of 11.7 g/dL. In contrast, on our second patient, we found no risk factor of bleeding risk according to ARC-HBR criteria. We were concerned about arterial laceration as the cause of CS in our first patient. In contrast, the inappropriate position of the compression band may cause CS in our second patient. Informed consent was obtained after fasciotomy for both patients.

Management of forearm hematoma becomes essential to prevent its progression to compartment syndrome. It should start with prevention by managing factors related to the incidence of CS, such as appropriate anticoagulant dose intra or after the procedure and properly positioned compression band. In cases with high suspicion of CS, we should monitor progressing clinical signs such as forearm hematoma incessantly with potent analgesia. Applying a 15 mmHg pressure to the impending CS site using a blood pressure cuff (BP cuff) may help reduce swelling and blood flow, resulting in decreased inter-compartmental pressure at the site. If swelling, pain, or induration persists after applying such pressure twice, consult a surgeon for further action.

CONCLUSION

Preventing compartment syndrome in a post-PCI patient with trans-radial access should begin before the PCI procedure by recognizing the patient's factors and procedural factors that might contribute to the development of forearm hematoma. Early recognition is essential to prevent neuro-muscular-vascular complications.

AUTHORS' CONTRIBUTION

RS and SL: Concept and design, data acquisition, interpretation, drafting, final approval, and agree to be accountable for all aspects of the work.

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Address for Correspondence:

Dr. Sidhi Laksono, Department of Cardiology and Vascular Medicine, Siloam Diagram Heart Center. Address: Jl. Cinere Raya No.19, Pangkalan Jati, Subdistrict Cinere, Depok city, West Java, Indonesia. Zip Code: 16514.
Email: sidhilaksono@uhamka.ac.id