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CASE REPORT

Two Cases of Acute Compartment Syndrome as Complication of Transradial Approach in STEMI: What Can Go Wrong and Lesson Learnt

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Abstract

Background: Some studies showed the transradial approach (TRA) to be superior in terms of reducing bleeding complications and is related with lower 30-day mortality in patients with ST-elevation myocardial infarction (STEMI), while maintaining equal rates of TIMI 3 flow and procedural success. Nevertheless, TRA still present with a variety of complication, such as forearm hematoma and acute compartment syndrome, requiring a prompt surgical approach. Here, we present 2 cases of successfully managed acute compartment syndrome following primary Percutaneous Coronary Intervention (PCI) after STEMI.

Case Presentation: First patient, male, 42-year-old, transported to Siloam Diagram Heart Hospital with anterior STEMI with an onset of 6 hours. He has a history of hypertension and is an ex-smoker. Electrocardiography (ECG) shows elevation in ST segment leads V1-V4. The second patient, male, 62-year-old, came with an extensive STEMI with an onset of 13 hours. He is an active smoker with no history of chronic diseases. ECG shows RBBB and ST elevation in lead V2-V6, I, and aVL. Both underwent primary PCI procedures and developed forearm hematoma with compartment syndrome.

Management and Results: The first case was related to a laceration of the radial artery, and the second case was related to the compression band being positioned incorrectly in relation to the actual arteriotomy location. Both are successfully managed with a surgical approach with no neuromusculovascular sequelae.

Conclusion: CS might occur as a complication after the procedure caused by many conditions. Early recognition is essential to prevent neuromusculovascular complications.

Keywords

Compartment Syndrome, Complication, Percutaneous Coronary Intervention, Transradial Approach

Introduction

In the 1990s, the transradial approach (TRA) for percutaneous coronary intervention was first introduced by Campeau and Kiemeneij as an alternative to the already established transfemoral approach (TFA). The evidence from multiple trials and meta-analyses showed the transradial approach to be superior in terms of reducing complication of bleeding (including major bleeding and local vascular complication) and associated with lower 30-day mortality with similar TIMI 3 flow and procedural success rate in STEMI patient[s1-4]. TRA is also strongly recommended by Canadian and European Society guidelines in this population[5-6].

Even though it has lower local vascular event than TFA, the TRA approach still possess complication ranging from mild to severe, such as forearm hematoma and acute compartment syndrome, requiring a prompt surgical approach. The incidence of vascular complications in TRA is very rare and mainly published in case report[7,8]. Rare it was, but it poses a possible catastrophic injury to the neuromusculovascular system of the arm if not diagnosed and treated timely and properly. 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 acute compartment syndrome following primary PCI after STEMI.

First Case

Male, 42-year-old reffered to our emergency departement (ED) with anterior STEMI with onset of 6 hours prior to admission. He was previously diagnosed with hypertension and was an ex-smoker for 2 years. 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, 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/ml, creatinine 1.09 mg/dl with eGFR (estimated glomerular filtration rate) of 80.4 ml/min/1.73 m^2, and troponin T value was increased at 306 ng/L. Aspilet 320mg, Clopidogrel 600 mg, Enoxaparin 30 mg IV and 60 mg SC, and Atorvastatin 80 mg were given and proceeded to primary PCI.

At the beginning of the procedure, he received 7500 IU of unfractionated heparin and 8 mg of intracoronary eptifibatide. His angiography showed total occlusion in mid Left Anterior Descending (LAD) and 50-60% tubular stenosis in proximal, 80-90% diffuse in mid, 60% stenosis in distal Right Coronary Artery (RCA). We proceeded to place Biomatrix Alpha 2.5 x 19 mm drug-eluting stent (DES) on his mid-LAD with a good result of TIMI 3 flow. Twenty minutes before the end of the procedure, he received another 2000 IU of heparin. The radial introducer sheat was removed, and the radial compressing device was placed on the site of the puncture.

One hour later, he complained of progressive pain followed by worsening edema on his volar antebrachial area with EASY classification grade III. We proceeded with BP cuff inflation for 15 minutes with a pressure of 15 mmHg below systolic pressure and repeated the procedure thrice. He was given Paracetamol 1000 mg IV and compressed with a cold pack between the cuff inflation. Multiple bullae progressively appeared. Consultation with the surgeon was obtained, and he was diagnosed with compartment syndrome. And emergent fasciotomy was scheduled. At the table, he was found to have a laceration on his radial artery 2 cm from his puncture site, so we proceeded to do ligation and arthroplasty to repair the artery and control the bleeding. The wound was left exposed for a duration of 48 hours, after which it was later closed. His recovery was good, with no sign of neurologic or muscular dysfunction. A three-month follow-up using ultrasound Doppler showed normal artery flow in both hands.

Graphic 1. Right forearm compartment syndrome with multiple bullae.

Second Case

Male, 62-year-old, referred to our ED with anterior extensive STEMI with onset of 13 hours prior to admission. There is no history of chronic disease. He was an active cigarette smoker of 1 pack per day. His ECG was found to have RBBB and ST elevation in lead V2-V6, I, and aVL. His hemoglobin level was 13 g/dl, thrombocyte 306 10^3/ml, creatinine 0.59 mg/dl with eGFR of 108.5 ml/min/1.73 m^2, and troponin T value was increased at 984 ng/L. spilet 160 mg, Ticagrelor 180 mg, and Enoxaparin 60 mg SC were given and proceeded to primary PCI.

He received 3000 IU of unfractionated heparin with a total of 9.75 mg of Eptifibatide. During intraprocedural, he developed cardiogenic shock, which we proceeded to give him norepinephrine starting from 0.05 mcg/kg/min. Neab Arterial Pressure target are 65 mmHg. from angiography, proximal LAD were totally occluded and proximal circumflex artery (LCx) were at 60-70% stenosis. We proceeded to place Biofreedom Ultra 3.0 x 19 mm DES to his proximal LAD with TIMI 3 flow result to distal LAD. Twenty minutes before the end of the procedure, he received another 2000 IU of heparin. The radial introducer sheat was removed, and the placement of the radial compressing device was slightly above the site of the puncture.

Two hours later, he developed progressive edema on his right antebrachial area extending to 2 cm above antecubital fossa, with EASY Classification Grade V. He also complained of paresthesia and inability to move his fingers due to unbearable pain. Distal from the puncture area showed multiple petechiae and ischemic signs, with cyanotic skin, capillary refill time of more than 2 seconds, and SpO2 of only 88%. When we loosened up the radial hemostatic band, perfusion to the distal area was improved, but the puncture site was still bleeding profusely; the cath lab team was called to place a new hemostatic band. We also proceeded with BP cuff inflation for 15 minutes with a pressure of 15 mmHg below systolic pressure and repeated the procedure thrice.

Pain management was given using Morphine 2 mg IV and Fentanyl 25 mg IV with no reduction of pain quantity. Multiple bullae progressively appeared. Consultation with a surgeon was obtained, and with a working diagnosis of compartment syndrome, an emergent fasciotomy was scheduled. At the table, there's no laceration on his radial artery, but we found his artery puncture to be 3 cm proximal from its skin puncture. We proceeded to

do a suture at the puncture site. The wound was left exposed for a duration of 72 hours, after which it was later closed. At the 2nd 2-week follow-up, he showed no sign of neurological or muscular dysfunction.

Figure 2. Right forearm hematoma with signs of reduced distal perfusion

Graphic 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 were found in both of our patients[9]. Compartment syndrome (CS) occurs when there is build-up pressure in the closed osteofascial compartment. Early identification of CS is crucial to prevent permanent dysfunction of the extremity involved. Therefore, suspicion and diagnosis of CS should mainly be based on clinical symptoms. Patients commonly show pain that is unusually intense compared to the severity of their injury, as seen in both of our patients, where the pain gradually builds up until it becomes incessant. There may be additional signs of acute limb ischemia, such as pallor, pain, poikilothermia, pulselessness, and paresthesia. The primary diagnostic physical observation is the presence of a rigid, solid and firm as wood sensation upon deep examinatio. bullae may also be observed.

Regarding TRA, the factors that may be associated with the development of CS can be categorized into patient characteristics and procedural factors. The Academic Research Consortium for High Bleeding Risk (ARC-HBR) has established a definition for the group at high risk of bleeding (HBR), which consists of 20 clinical criteria categorized as major and minor criteria. Table 1 contains a list of both major and minor requirements. Patients are classified as being at high risk if they meet at least one main criterion and two minor ones.

Table 1. Major and Minor Criteria of HBR

Major Criteria	Minor Criteria
Age ≥75 y	
Anticipated use of long-term oral anticoagulation	
Severe or end-stage CKD (eGFR < 30 mL/min)	Moderate CKD (eGFR 30-59 mL/min)
Haemoglobin < 11 g/dL	Hemoglobin 11-12.9 g/dL for men and 11-11.9 g/dL for women
Spontaneous bleeding requiring hospitalization of transfusion in the past 6 mo or at any time, if recurrent	Spontaneous bleeding requiring hospitalization or transfusion within the past 12 mo not meeting the major criterion
Moderate or severe baseline thrombocytopenia (platelet count < 100 x10^9/L	
Chronic bleeding diathesis	
Liver cirrhosis with portal hypertension	
Long-term use of oral NSAIDs or steroids	
Active malignancy (excluding nonmelanoma skin cancer) within the past 12 mo	
Previous spontaneous ICH (at any time) Previous traumatic ICH within the past 12 mo Presence of bAVM Moderate or severe ischemic stroke within the past 6 mo	Any ischemic stroke at any time not meeting the major criterion
Nondeferrable major surgery on DAPT	
Recent major surgery or major trauma within 30 days before PCI	

From a procedural standpoint, CS may arise due to arterial laceration leading to bleeding, compression band being positioned incorrectly in relation to the actual arteriotomy location, excessive use of anticoagulant during or after to procedure, puncture of the radial artery at a distal location, and repeated access attempts.[11,,12].

Our first patient met only one minor criterion, which was a hemoglobin level of 11.7 g/dL. However, our second patient did not exhibit any risk factors for bleeding according to the ARC-HBR criteria. In our first patient, we suspect that artery laceration is the underlying cause of CS. In contrast, in our second patient, the improper placement of the compression band may be the reason for CS.

Effective management of a hematoma in the forearm is crucial in order to avoid it from developing into compartment syndrome. Prevention of CS should begin by effectively managing factors that may be associated with its occurrence, such as administering the correct dosage of anticoagulants before or after the surgery and ensuring the compression band is properly positioned.

When there is a strong suspicion of CS, it is important to continuously monitor the

development of clinical indicators, such as a hematoma in the forearm, and provide strong pain relief. First-line conservative measures involve placing a blood pressure cuff (BP cuff) at the location of induration for a duration of 15 minutes, applying a pressure that is 15 mmHg lower than the systolic blood pressure. The objective is to halt bleeding and decrease swelling in order to alleviate pressure in the volar compartment. If there is continued swelling, pain, or hardening of the tissue after two inflations, it is recommended to seek immediate surgical consultation.

Conclusion

From a procedural standpoint, CS may arise due to arterial laceration leading to bleeding, compression band being positioned incorrectly in relation to the actual arteriotomy location, excessive use of anticoagulant during or after to procedure, puncture of the radial artery at a distal location, and repeated access attempts. Preventing compartment syndrome in post-PCI patients with transracial 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 neuromusculovascular complications.

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References

1) Di Santo P, Simard T, Wells GA, Jung RG, Ramirez FD, Boland P, Marbach JA, Parlow S, Kyeremanteng K, Coyle D, Fergusson D. Transradial versus transfemoral access for percutaneous coronary intervention in ST-segment–elevation myocardial infarction: a systematic review and meta-analysis. Circulation: Cardiovascular Interventions. 2021;14(3):e009994..
2) Valgimigli M, Gagnor A, Calabró P, Frigoli E, Leonardi S, Zaro T, Rubartelli P, Briguori C, Andò G, Repetto A, Limbruno U. Radial versus femoral access in patients with acute coronary syndromes undergoing invasive management: a randomized multicentre trial. The Lancet. 2015;385(9986):2465-76..
3) Jolly SS, Yusuf S, Cairns J, Niemelä K, Xavier D, Widimsky P, Budaj A, Niemelä M, Valentin V, Lewis BS, Avezum A. Radial versus femoral access for coronary angiography and intervention in patients with acute coronary syndromes (RIVAL): a randomized, parallel-group, multicentre trial. The Lancet. 2011;377(9775):1409-20..
4) Ahsan MJ, Ahmad S, Latif A, Lateef N, Ahsan MZ, Abusnina W, Nathan S, Altin SE, Kolte DS, Messenger JC, Tannenbaum M. Transradial versus transfemoral approach for percutaneous coronary intervention in patients with ST-elevation myocardial infarction complicated by cardiogenic shock: a systematic review and meta-analysis. European Heart Journal-Quality of Care and Clinical Outcomes. 2022;8(6):640-50..
5) Wong GC, Welsford M, Ainsworth C, Abuzeid W, Fordyce CB, Greene J, Huynh T, Lambert L, Le May M, Lutchmedial S, Mehta SR. 2019 Canadian Cardiovascular Society/Canadian Association of Interventional Cardiology guidelines on the acute management of ST-elevation myocardial infarction: focused update on regionalization and reperfusion. Canadian Journal of Cardiology. 2019;35(2):107-32..
6) Ibánez B, James S, Agewall S, Antunes MJ, Bucciarelli-Ducci C, Bueno H, Caforio AL, Crea F, Goudevenos JA, Halvorsen S, Hindricks G. 2017 ESC Guidelines for the management of acute myocardial infarction in patients presenting with ST-segment elevation. Revista espanola de cardiologia (English ed.). 2017;70(12):1082..
7) TIZÓN - MARCOS HE, Barbeau GR. Incidence of compartment syndrome of the arm in a large series of transradial approaches for coronary procedures. Journal of Interventional Cardiology. 2008;21(5):380-4..
8) Hahalis G, Tsigkas G, Kakkos S, Panagopoulos A, Tsota I, Davlouros P, Xanthopoulou I, Koniari I, Grapsas N, Christodoulou I, Almpanis G. Vascular complications following transradial and transulnar coronary angiography in 1600 consecutive patients. Angiology. 2016;67(5):438-43..
9) Sandoval Y, Bell MR, Gulati R. Transradial artery access complications. Circulation: Cardiovascular Interventions. 2019;12(11):e007386..
10) Urban P, Mehran R, Colleran R, Angiolillo DJ, Byrne RA, Capodanno D, Cuisset T, Cutlip D, Eerdmans P, Eikelboom J, Farb A. Defining high bleeding risk in patients undergoing percutaneous coronary intervention: a consensus document from the Academic Research Consortium for High Bleeding Risk. Circulation. 2019;140(3):240-61..
11) Jue J, Karam JA, Mejia A, Shroff A. Compartment syndrome of the hand: a rare sequela of transradial

cardiac catheterization. Texas Heart Institute Journal. 2017;44(1):73-6..

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Chugh SK, Chugh Y, Chugh S. How to tackle complications in radial procedures: tip and tricks. Indian heart journal. 2015;67(3):275-81