



Acute compartment syndrome of the forearm after trans-radial approach to percutaneous coronary intervention: a case report

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ABSTRACT

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Percutaneous coronary intervention (PCI) through transradial pathway is associated with lower risk of severe vascular problems comparing to transfemoral. It is reported that the acute compartment syndrome (ACS) in forearm is significant lower comparing to leg. A 47 y.o. male with ACS following a transradial approach of PCI due to inferior myocardial infarction was reported. The patient experienced pain and swelling in his right forearm for 7 hr after the procedure and was later brought to hospital and treated with emergency of fasciotomy. The patient showed good post-fasciotomy recovery on the first 2 wk and showed good DASH score after 4 wk. Quick diagnosis with prompt treatment makes a better outcome for the patient. Consequently, a high level of awareness to make the diagnosis as quickly and accurately management as possible could prevent morbidity caused by late and unrecognized management compartment syndrome eventually could make a better clinical outcome.

ABSTRACT

*Percutaneous coronary intervention (PCI) melalui pendekatan transradial dikaitkan dengan risiko komplikasi vaskular yang lebih rendah di lokasi akses dibandingkan dengan pendekatan transfemoral. Insiden sindrom kompartemen akut di lengan bawah dilaporkan secara signifikan lebih rendah dibandingkan di kaki bawah. Seorang pria 47 tahun dengan sindrom kompartemen akut setelah dilakukan PCI transradial karena infark miokard inferior dipresentasikan dalam laporan kasus ini. Pasien mengalami nyeri dan bengkak pada lengan kanannya 7 jam setelah prosedur dan kemudian pasien dibawa ke rumah sakit kami dan segera dilakukan fasciotomi pada lengan kanan. Pasien menunjukkan pemulihan pasca fasciotomi yang baik pada 2 minggu pertama. Setelah 4 minggu pasca operasi, diperoleh skor *disabilities of arm, shoulder and hand* (DASH) yang memuaskan. Diagnosis cepat dengan pengobatan yang tepat dapat mencegah morbiditas yang disebabkan karena keterlambatan penanganan yang dapat memberikan hasil yang lebih baik bagi pasien.*

Keywords:
percutaneous coronary intervention;
acute compartment syndrome;
transradial approach;
clinical outcome

INTRODUCTION

Acute compartment syndrome (ACS) represents a limb-threatening condition that occurs due to increased pressure within a fibroosseous space and ends up in a decreased tissue perfusion condition. Time to diagnosis is a factor in outcome for ACS, which is still a diagnostic problem despite technology advancements.^{1,2}

Compartment syndrome is defined as the elevation of fascial compartment pressure, which surpasses perfusion pressure leading to irreversible tissue ischemia and necrosis. Other less common etiologies such as burns, emboli, and iatrogenic injuries can be equally troublesome and challenging to diagnose. The sequelae of a delayed diagnosis of compartment syndrome may be devastating. All care providers must understand the etiologies, high-risk situation, and the urgency of intervention. Questions/Purposes: This study was conducted to perform a comprehensive review of compartment syndrome discussing etiologies, risk stratification, clinical progression, noninvasive and invasive monitoring, documentation, medical-legal implication, and our step-by-step approach to compartment syndrome prevention, detection, and early intervention. Methods: A literature search was performed using the PubMed Database and the following search terms: "Compartment syndrome AND Extremity," "Compartment syndrome AND Gluteal," and "Compartment syndrome AND Paraspinal." A total of 2,068 articles were identified. Filters allowed for the exclusion of studies not printed in English (359

In situations of ACS, fractures account for 75% of cases.^{3,4} It occurs primarily because of trauma, especially in the lower leg. However, it can also be triggered by static patient positioning during long surgical procedures such as recreational

drugs injection, post-operative bleeding, tourniquet use, injury to blood vessels, rhabdomyolysis, and sports injuries.⁵ Compartment syndrome rarely happens as a sequela of trans-radial percutaneous coronary intervention (PCI).

In this case report and literature review, an uncommon case of ACS after PCI was reported. The CARE guidelines and checklist were followed in this study.⁶ Furthermore, our patients signed an informed consent form to the publication of their data and clinical photographs.

CASE

A 47 y.o. male arrived at the emergency room (ER) on April 28th, 2019 with the chief complaint of pain and swelling in his right forearm. The patient was referred to the orthopaedic division from another hospital after a transradial approach of primary PCI using the coronary stent because of diagnoses of inferior acute myocardial infarct on April 26th, 2019. Seven hours after the procedure, a swelling and a pale were noted in his right wrist, extending to the fingers and elbow. The patient also complains of paresthesia in the tip of his fingers, and there were no pulses on the radial artery. Blisters started to appear on his right wrist a day after PCI. There was no medical history of hypertension or diabetes. Upon arrival at the ER, he had a 160/80 mmHg systolic blood pressure with oxygen saturation at each right finger ranging from 93-95%. There was swelling and bullae on the right forearm (FIGURE 1). From the examination it was tender to palpation, and there was positive passive stretch pain with a limited range of motion (ROM). The patient had a relatively normal pre-PCI laboratory result aside from the elevation of white blood cells of 14.870/mL and SGOT/SGPT of 98/37 U/L.

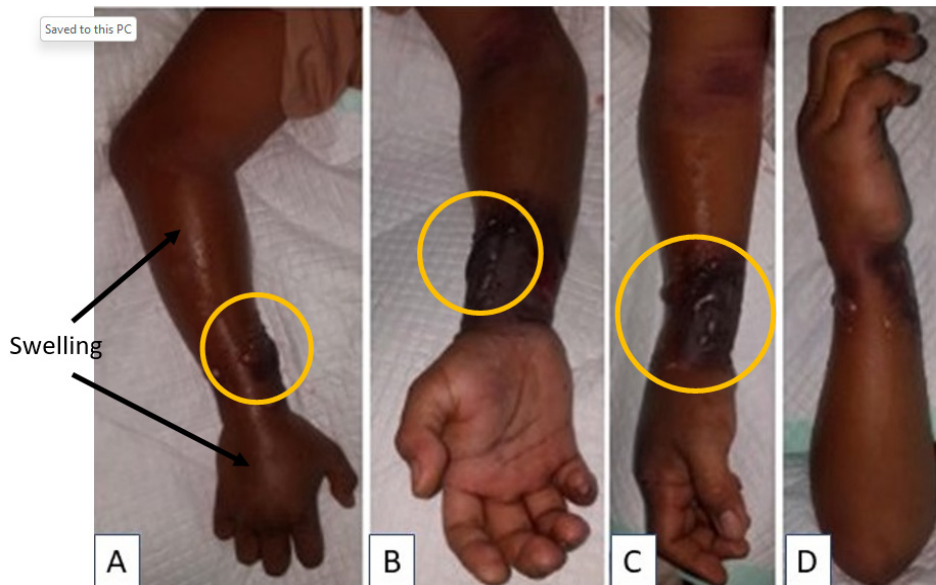


FIGURE 1. The clinical picture of compartment syndrome in right hands. There was swelling and bullae at the right forearm. The circle indicates the presence of a bulla, and black arrows show swelling that occurs in the patient's right hand

From the anamnesis and physical examination, the patient was diagnosed with ACS of the right forearm based on 4 out of 5 cardinal signs and symptoms of ACS that consists of pain, pallor, paresthesia, and pulselessness. Emergency fasciotomy was performed to release the compartment of the forearm with four lines of incisions; one at the volar side of the forearm (FIGURE 2A), one at the volar side of the thenar, and two at the dorsal of the hand (FIGURE 2B). Upon surgical examination, the muscle looks bulging and dark colored

(FIGURE 2A). Antibiotic and antitetanic were given, and the patient was also consulted to the cardiology division for post PCI evaluation, especially regarding the reuse of anticoagulants after fasciotomy. Three days after the emergency of fasciotomy, the patient underwent a second-look procedure for re-debridement. The patient's outcome is good, with an excellent post-operative follow-up 2 wk and 4 mo after initial admission with a Disability of Arm-Shoulder-Hand (DASH) score of 65 or satisfactory (FIGURE 3).



FIGURE 2. Emergency fasciotomy was performed to release compartment of the forearm. One at the volar side of the forearm and two at the dorsal of the hand.



FIGURE 3. Clinical picture outcome after emergency of fasciotomy and the follow up after four months.

DISCUSSION

Acute compartment syndrome arises when there is an elevation of intercompartmental pressure within a nonexpandable space. The forearm contains three compartments: volar, dorsal, and mobile wad. Pressure elevation in the forearm could result in increased interstitial pressure and progressive tissue oedema, which leads to irreversible muscle and nerve damage.⁷

Acute compartment syndrome is diagnosed clinically based on the prompt recognition of those symptoms, and in cases where the diagnosis is ambiguous, the measurement of compartment pressures may be used to confirm the diagnosis.⁸

The cardinal sign and symptoms of AS involving “5P”: pain, paresthesia, pallor, pulselessness, and paralysis. The most frequent and identifying symptom is severe pain. This pain frequently outweighs the obvious damage and is resistant to analgesics. The absence of the other symptoms and signs does not rule out ACS because they are not always present. Paresthesia and paralysis are later symptoms, whereas edema is an early symptom (caused by nerve ischemia).⁹

The incidence of compartment syndrome of the forearm after trans-radial approach is very low with an incidence <0.01%.¹⁰ Another study reported that incidence of ACS on forearm 2 of the 51,296 incidences after trans-radial procedures (0.004%).⁷¹ In the PubMed review, only five cases have been reported. The unrecognized perforation at a distance from the puncture site, unsuccessful compression at the puncture site, or radial artery laceration become possible etiologies.⁷

Our study presents a rare case of ACS in the forearm after the transradial approach PCI. Tizon-Marcos and Barbeau reported two similar cases of

acute compartment syndrome in the forearm after the trans-radial approach in 2008.⁷ The first case reported differs from our case in the onset of symptoms and treatment, but the outcome of both cases is good. The second case also differs from our case in the onset of symptoms which is three days vs seven hours for our case, and the outcome is better in our case. It was probably because of the active bleeding in the second case, which triggered a rapid increase in intercompartmental pressure and thus made a worse prognosis.⁷ Another case reported by Jue *et al.*,¹¹ presented an ACS of the hand after the transradial approach PCI. In this case, there is a slight difference in the decision of treatment. The case by Jue *et al.*,¹¹ was initially treated with a conservative measure using inflation of a blood pressure cuff to 15 mmHg below systolic blood pressure over the right brachial artery, the elevation of the arm and placement of a cold pack to relieve symptoms. In contrast, in our case, an emergency fasciotomy was performed promptly upon the patient arrival.¹¹

Omori *et al.*,¹² reported 4 cases of compartment syndrome after PCI, but only 1 case used a transradial approach. This case had the quickest onset of all other cases reviewed in this study (30 min), and the compartment syndrome of the arm was induced by hematoma formation because of active bleeding from a branch of the radial artery. An urgent open decompression fasciotomy was also performed in this case, the same as ours, and it results in similarly good patient recovery and full movement of the upper extremity.¹²

The formation of an anticoagulant-related hematoma has also been cited as the cause of compartment syndrome. In addition, patients on anticoagulation are at higher risk of developing compartment syndrome given the propensity to develop hematomas.¹ Moreover, anticoagulation has been reported to be a risk factor for the development of ACS. Although

aspirin and clopidogrel are frequently given for the secondary prevention of atherosclerotic vascular events, a few studies have reported that antiplatelet treatment is associated with an increased incidence of compartment syndrome.¹³ There is some literature explaining the effect of using anticoagulant post fasciotomy. They suggested discontinuing warfarin or heparin and switching to heparin with a low molecular weight (LMWH). Consequently, it is crucial that a cardiologist evaluate the patient during the initial 36 hr.^{13,14} Furthermore, the cardiologist gives full consideration to the maintenance of post PCI management and the administration of anticoagulants after the emergency in the musculoskeletal area has been resolved.

Lower rates of bleeding and vascular sequelae make transradial approach PCI more popular than the transfemoral approach. Although transradial was superior to the transfemoral approach, it still has complications such as radial artery spasm, occlusion, hematoma, perforation, and pseudoaneurysm.¹² Acute compartment syndrome of the forearm is a rare complication of trans radial approach PCI. Because of its rarity, the diagnosis could be missed in the clinical setting. A high level of awareness must always be done for the sign and symptoms of ACS. A rapid and accurate diagnosis with prompt surgical treatment could decrease the morbidity caused by this limb-threatening condition. In this case, transradial approach of PCI could predispose a patient to a risk of acute compartment syndrome, but whether this risk correlated significantly or not still needs further research.

Almost all four other studies apart from our study reported a good outcome with an emergency fasciotomy. One case was initially treated conservatively but later proceed with fasciotomy and end in an excellent outcome. However, another case showed poor functional outcome

because of active bleeding, which rapidly increased the intercompartmental pressure. In line with this study, the patient was diagnosed with ACS according to the AAOS guideline,¹⁵ and as soon as the diagnosis was confirmed, a fasciotomy was performed as soon as possible. In result, the patient had a good outcome.

Despite the quick surgical intervention done to the patient in our case, the DASH score is still only satisfactory. Therefore, this complication must be quickly recognized to preserve the hand function as much as possible. Based on the case in this study and all other reports presenting similar cases, it shows that transradial approach PCI could predispose the patient to a risk of upper extremity ACS. However, it is still cannot be concluded whether it is significantly correlated or not. The study only presents one case and compares it with the other four cases. Our limitation in this study is the rarity of acute compartment syndrome after the upper extremity approach of PCI. A future study with more cases presented is needed.

CONCLUSION

A high level of awareness to make the diagnosis as quickly, accurately, with the best management as possible could prevent morbidity caused by late and unrecognized management compartment syndrome that could make a better clinical outcome.

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