

Case Report

Coronary Artery Rupture Associated with Blunt Force to the Thorax: An Autopsy Report

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Abstrak: Kematian merupakan sebuah fenomena alami yang terjadi pada semua makhluk hidup. Kondisi kematian mendadak merupakan sebuah tantangan bagi ahli forensik untuk menyingkirkan kemungkinan kematian tidak wajar. Kematian mendadak biasanya disebabkan penyakit kardiovaskular seperti infark miokard atau aritmia. Penyebab lainnya adalah ruptur arteri seperti diseksi aorta atau arteri koroner. Kematian akibat benturan benda tumpul ke dada bisa mencapai 15%. Kebanyakan kasus ruptur arteri koroner biasanya bermanifestasi sebagai tamponade jantung. Kondisi ini biasanya menyebabkan kematian bila tidak ditangani dengan cepat. Presentasi Kasus Kasus yang kami dapatkan adalah seorang Wanita usia lanjut yang dibawa dalam kondisi sudah meninggal dicurigakan akibat jatuh dari ketinggian 3 meter. Setelah pemeriksaan forensik lengkap didapatkan adanya ruptur arteri koroner disertai hematoma pada otot miokard. Kesimpulan Kematian akibat penyakit kardiovaskular awam dijumpai terutama pada pasien yang tidak menjalani pengobatan dengan tepat. Pemeriksaan forensik didapatkan lebih baik dibandingkan dengan pencitraan pada evaluasi kerusakan organ atau jaringan.

Kata kunci: ruptur arteri koroner, haemo-perikardium, arteri desenden anterior kiri.

Abstract: Death is a natural occurrence which happens to all living things. In cases of sudden death, it is a challenge for forensic experts to exclude unnatural causes. Sudden death is majorly caused by cardiovascular diseases such as myocardial infarction, or arrhythmia. Other causes of cardiovascular deaths are associated with artery rupture such as aortic dissection or coronary artery rupture. Mortality caused by blunt chest trauma is up to 15%. Most cases of coronary artery rupture are marked with cardiac tamponade which leads to death if no prompt treatment is provided. Our case was an elderly lady who was brought in with death due to a fall from a height of approximately 3 meters. Complete forensic examination later revealed a coronary artery rupture which may be caused by a rupture either in the ventricular muscle or the coronary artery itself. Death due to a cardiovascular event is common due to several reasons, especially when patients aren't provided with prompt treatment. When compared with imaging studies, direct visualization using conventional forensic examination remains superior in evaluating organ or tissue damage.

Keywords: coronary artery rupture; haemo-pericardium; left anterior descending artery

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1. INTRODUCTION

Death is often sudden and unexpected in people with chronic silent illnesses. Natural death is defined as death which is caused purely by disease or aging with no involvement of trauma or toxic agents. It is very important to distinguish these cases to exclude any possibilities of homicide and wrongful convictions. Without proper evidence there is a huge chance of mistrials and wrongful convictions. Collaboration of forensic medicine with the judiciary system has provided a lot of impact in crime investigation and prosecutions. The precise incidence of cardiac injury after a blunt chest trauma is unknown as rates vary greatly in the literature from

between 7% and 76% of cases. Coronary artery rupture due to blunt trauma is extremely rare, with studies reporting a prevalence of around 0.1% or less [1].

Blunt chest trauma can be associated with injuries to the chest wall, along with internal organs such as pneumothorax, lung contusion or hemothorax. Injuries may also involve the heart can range from a simple arrhythmia up to dissection involving the large arteries or even the coronary arteries. Blunt chest traumas can also induce an acute myocardial infarct. The most common causes of blunt cardiac trauma is due to traffic accident, falls, or sport accidents [1]. Coronary artery dissection is

not a common finding. Coronary artery dissection can be spontaneous, traumatic or due to iatrogenic causes [2], [3].

According to a study by Tweet et al, Spontaneous Coronary Artery Dissection (SCAD) in women mostly involves the left anterior descending artery [4], [5]. It is an uncommon cause of acute myocardial infarction, with increased report in old and postmenopausal women. In most cases, a predisposing artery disease is the main contributor, however up to 20% of cases remain idiopathic [6]. In this case we would like to report an elderly woman with a blunt chest trauma resulting in left anterior descending artery rupture causing acute myocardial infarction and eventually death. The main risk factor presumed to be involved in this case is age and prior history of dyslipidemia.

2. CASE HISTORY

The subject was a 60 years old female who was found lying in prone position on the ground after falling from the attic at a height of approximately 3 meters. Witnesses reported seeing her cleaning the attic 2 hours prior to alleged time of death. There was no witness on how the subject fell from the attic. She managed to crawl 5 meters from the fall site before expiring and was later brought to the Forensics Department of Tangerang Regional Hospital to undergo autopsy by a forensic expert. The initial purpose of a full autopsy was to exclude any possibilities of a homicide. Patient had prior history of dyslipidemia however she neglected medications. There was no prior history of chest pain, dyspnea or orthopnea.

3. AUTOPSY FINDINGS

3.1. External Examination

The subject underwent autopsy 8 hours after body discovery. The subject seemed adequately nourished with normal complexion. She had a height of 154cm and weight of 63 kg, her body mass index was 26.5 kg/m². On examination, signs of rigor mortis were already present throughout the body with complete pupil dilatation. Minor lacerations and bruising were found in the eyelids of the right eye.

There were no signs of fracture in the sternum or ribs as well as other parts of the body. We found no signs of edema or clubbing fingers in the extremities.

3.2. Internal Examination

From internal examination we found signs of blood pooling and hematoma in the interior sternal region, mainly focused in the left 4th intercostal muscles. Macroscopically we found the cardiac tissue to be extensively enveloped in adipose tissue (Figure 1). We also found hematoma in the cardiac tissue mainly in the apex region. Size of hematoma was around 6 cm in length and 4 cm in width. With further examination we found signs of coronary artery stenosis beginning from the proximal left descending artery ranging from ten to eighty percent stenosis. Signs of blood clots were also found in the immediate vicinity of the heart apex, reaching into the ventricular lumen. We also found shreds of the left ventricular myocardium extending to the visceral layer of the pericardium.

Histological reports showed that submitted tissue consisted of shredded myocardial fibers with abundant lipid infiltrations (Figure 4a, 4b). There were also signs of hemorrhage and signs of inflammatory cells.



Figure 1. Macroscopic feature of the heart showing adipose tissue enveloping the cardiac tissue as well as signs of hematoma in the apex region. This shows signs of coronary artery rupture (marked with red arrow).

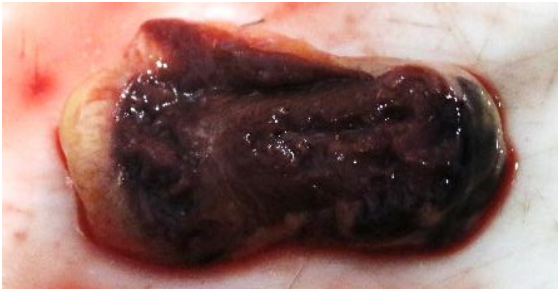


Figure 2. Blood clots in the Cardiac Apex region. This suggests presence of blood pooling inside the pericardium due to left anterior descending coronary artery rupture. The myocardial structure appears intact; therefore, no free wall rupture was evident.

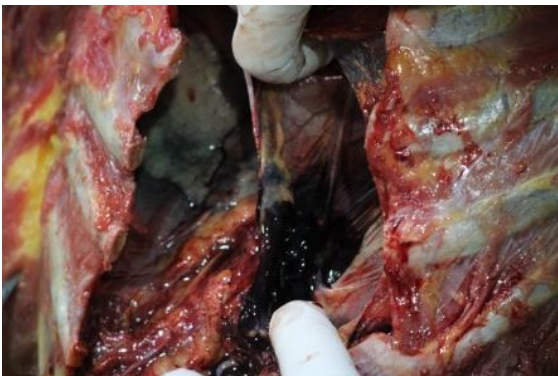


Figure 3. Blood clots in the posterior pericardial sac. There were no signs fractured ribs, both lungs and the aorta were intact.

In conclusion, histo-pathological report shows a pattern of degenerative heart disease with inflammatory cells and minor occlusions in coronary artery. As shown in figure 4B, we can see multiple adipose tissue surrounding the myocardial tissue.

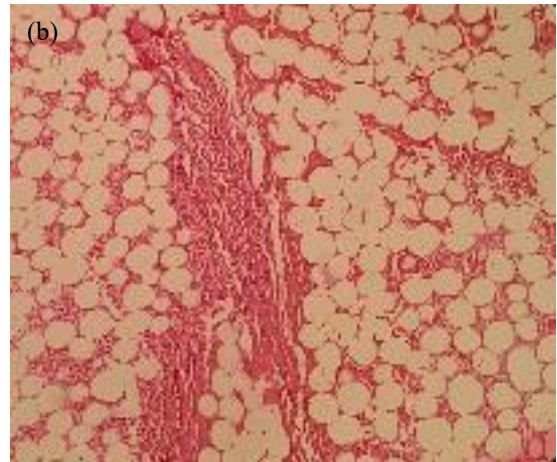
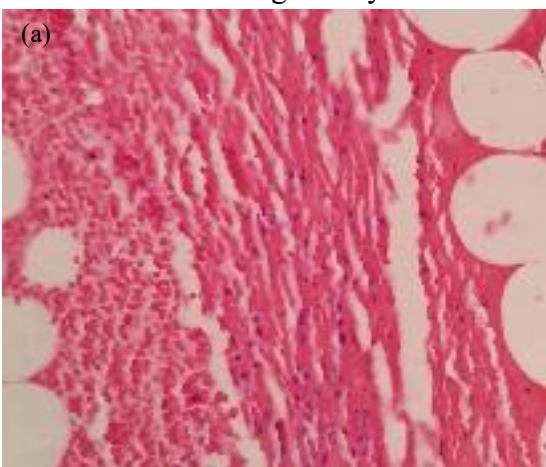


Figure 4. (a, b) Histological findings of Cardiac Myocardium.

4. DISCUSSIONS

Coronary artery rupture due to trauma is uncommon however potentially fatal, the incidence of cardiac injury due to blunt trauma is around 2% [7], [8]. The spectrum of injury can vary from a mild cardiac contusion up to coronary artery rupture, acute myocardial infarction, cardiac failure or death [9]. Blunt trauma causes sheer stress to the coronary vessel wall resulting in dissection, or rupture. A small intimal tear will initiate platelet activation resulting in thrombus formation thereby inducing acute myocardial infarction [10]. The pathogenesis of coronary artery dissection following a blunt trauma involves intimal tears, wall dissection, disruption of atherosclerotic plaque, coronary artery spasm or epicardial hematoma which results in epicardial hematomas [7]. This will later cause ischemia in the distal areas of the heart and potential infarction. Epicardial Adipose tissue are fat deposits which are usually located in the pericardium which is in contact with most of the coronary arteries. Under normal conditions, epicardial adipose tissue constitutes up to 20% of total heart weight. If these fat deposits increase above the normal limits, it begins to infiltrate coronary blood vessels and the myocardium [11]. The presence of adipose tissue in the heart is mainly seen in the right ventricle, atrial septa and atrioventricular sulci but not in the left ventricular papillary muscle or ventricular septum where cardiac rupture tends to happen unless there are sites of pre-existing scars caused by Acute

Myocardial Infarction (AMI) [12]. So, for left ventricular wall rupture to happen, there has to be an existing scar in the left ventricle which compromises the structure.

In the case of cardiac rupture, there are several mechanisms theorized such as a direct force to the cardiac tissue, compression between the sternum and the vertebrae, concussion, damage by broken ribs or bone shards, blast injury, rapid acceleration or deceleration and “hydraulic ram” effect where a sudden compression in the abdomen pushes the cardiac tissue rapidly thereby distending the chambers [13], [14]. The greatest probability of damage to the heart is in the apex of the heart if the region involved is the precordial area, with the left anterior descending coronary artery as the most common site for dissection. This risk is increased if the vessels have preexisting conditions such as atherosclerosis or calcification [3].

The diagnosis of coronary dissection is very challenging as imaging, chemical markers or nuclear studies cannot correlate with the severity of the injury inflicted. EAST (Eastern Association for the Surgery of Trauma) guidelines have recommended against the use of chemical markers for diagnosing coronary artery dissection. According to the EAST guidelines, patients with blunt cardiac injury should undergo basic 12 lead ECG (electrocardiogram) to evaluate presence of arrhythmias, ST changes, or presence of block. However, these tests are used to evaluate damage to the cardiac structure itself. There might be no ECG changes in early stages of coronary artery dissection. Imaging studies such as trans thoracic echocardiography or trans esophageal echocardiography should be performed in patients with suspected blunt cardiac injury. There isn't sufficient evidence for the use of Transthoracic Echocardiography (TTE) in diagnosing coronary artery dissection. TTE is extremely valuable in diagnosing and assessing Acute Aortic Syndromes (AAS), while transesophageal echocardiography (TEE) is considered equal with helical CT and MRI in diagnostic accuracy and is considered a gold standard in diagnosing Type A dissection [15]. Since this case is a forensic examination, TTE is useless. Cardiac rupture may be detected using a post mortem

CT scan. Digital autopsy holds a promising future in determining cause of death by blunt trauma. Post Mortem Computed Tomography (PMCT) is better than autopsy in detecting skeletal, organ and soft tissue injuries, however autopsy is superior in detecting cardiac and pericardial injuries [16]. Several studies have declared that CT has a low sensitivity when detecting cardiac injury [16], [17], [18].

There are a few risk factors for coronary artery dissection ending in acute myocardial infarction. These include female gender, in cases of Spontaneous Coronary Artery Dissection (SCAD) it's particularly healthy young women with atherosclerotic risk factors. In elderly females, it's mostly attributed to preexisting atherosclerosis or fat deposition in the coronary artery [19]. Our patient is a 60-year-old woman who had no prior hospital admission, however her medical background is incomplete as she never performed any routine check-up or continued her medication for dyslipidemia. There are two theories on how SCAD develops, the first theory explains that dissection occurs after years of disruption in the intimal wall forming a false lumen, while a second theory proposes that SCAD occurs after a spontaneous tear in the vasa vasorum from within the vessel wall [20].

Troponin is a sensitive marker of myocardial injury and may be elevated in cases with traumatic coronary injury. However, since in this case, forensic examination was performed 8 hours after body discovery, no blood tests were feasible. CT angiography is also a useful modality in evaluating coronary artery anatomy although IVUS (Intravascular Ultrasound) provides a better quantitative and qualitative assessment of coronary arteries when compared to angiography. IVUS may provide details of plaque rupture, presence of thrombus, dissection or external compression and help in determining the cause of coronary artery occlusion [2], [9], [10]. Invasive modalities are also impossible in this case since this was a forensic examination. Therefore, the best modality is direct visualization of the vessels along with histopathological study.

Since the onset was acute and patient was alone in her house, there was no way to provide the first aid she desperately needed. The onset of infarct must have occurred when she fell and suffered a blunt trauma to the chest, rupturing the left anterior descending artery, and inducing an fatal acute myocardial infarction. As the hemorrhage progressed, heart function eventually declined and death was inevitable.

5. CONCLUSIONS

In conclusion, medical autopsy is a necessity in cases of sudden, suspicious or unnatural deaths. Acute myocardial infarct is the most common cause of sudden death. This case may show us the importance of early recognition and proper management of coronary artery diseases, and prompt management in cases of acute myocardial infarction. Complete autopsy proved that this is an acute myocardial infarction with coronary dissection which ended with fall and eventually patient' death. This would not have been revealed without a proper autopsy.

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