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Case Report

Lethal Morel-Lavallée lesion: A forensic radiology-pathology correlation

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ABSTRACT

Morel Lavallée lesion or closed degloving injury is normally associated with severe trauma and occurs when the skin and subcutaneous fatty tissue traumatically and abruptly separated from the underlying fascia thus creating a potential space filled with fluid. MVA is the commonest etiology but large or lethal Morel Lavallée is extremely rare. A 35 years old, female pillion rider was involved in a motor vehicle accident and sustained injuries to the left pelvis and thigh. Emergency laparotomy and intra-op abdominal and bilateral lower limb arteriogram revealed no significant finding. Her general condition and vital signs continued to deteriorate despite aggressive resuscitation and eventually died. Post-Mortem Computed Tomography and Post-Mortem Computed Tomography Angiogram was performed and revealed a large cavity in the left thigh suggestive of a lethal Morel Lavallée lesion. Findings were confirmed by conventional autopsy.

Introduction

Vascular injury-related death (VIRD) due to trauma is commonly encountered in a mortuary. Majority of death were due to fatal penetrating trauma, but severe blunt injuries resulted from motor vehicle accident (MVA) is not uncommon. Fractured long bones or dislocated joints frequently increase the overall risk of VIRD [1]. A conventional autopsy is usually required for the definitive diagnosis of the cause of death (COD) in VIRD.

Post-Mortem Computed Tomography (PMCT) is used widely as an adjunct to autopsy in mortuaries [2]. In our establishment, the deceased will be submitted to PMCT prior to autopsy. It is well established in the diagnosis of bony and bony related injuries but has the disadvantage of limited organ parenchyma and vascular system visualization [3]. Therefore, Post-Mortem Computed Tomography Angiogram (PMCTA) was

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recently introduced in our center to complement these limitations, especially in VIRD.

Morel Lavallée lesion or closed degloving injury is normally associated with severe trauma and occurs when the skin and subcutaneous fatty tissue traumatically and abruptly separate from the underlying fascia [4]. This disrupts the perforating vessels and lymphatics, thus creating a potential space filled with fluid and commonly seen in the peritrochanteric region and proximal thigh.

MVA is the commonest etiology for this lesion due to the high energy needed to shear the tissues. The collection varies in size and most cases are small. Rarely the area involved could be very large, thus creating a huge potential space. Large or severe peripelvic Morel-Lavallée lesions have rarely been reported in the literature [5]. Death from Morel Lavallée has never been reported literature.

We report a case of a lethal Morel Lavallée lesion in a traumatic case which was diagnosed on PMCT and PMCTA. Findings were confirmed by conventional autopsy.

History

A 35-year-old, obese, female pillion rider was involved in an MVA. On arrival to the Emergency Room (ER), she was conscious and complaining of left pelvic and thigh pain. There were multiple abrasion wounds over the left thigh and the pelvic region. Bedside abdominal ultrasound and plain radiograph of the pelvis and left lower limb revealed no significant abnormality. The attending orthopedic team established clinical diagnosis of possible posterior dislocation of the left knee joint. Portable ultrasound Doppler of the left leg revealed week pulses.

Her general condition and vital signs continued to deteriorate despite aggressive resuscitation. A computed tomography angiogram (CTA) was planned but canceled due to her unstable clinical condition. An emergency laparotomy was performed for possible vascular injury but there was no significant intraoperative finding. The vascular team performed intra-op abdominal and bilateral lower limb arteriogram but the finding was negative. The orthopedic team performed a closed manual reduction and external fixation for the left knee dislocation. Despite aggressive resuscitation following surgery, she succumbed to her death a few hours later. The body was transferred to the mortuary for an autopsy in establishing the COD.

PMCT and PMCTA

PMCT and PMCTA procedures were performed on a 64-slice CT unit (Aquilion 64 CFX, Toshiba Medical Systems Corporations, Tochigi, Japan). Whole-body CT scans were made using the following parameters: 120 kVp, Auto set mAs (Caredose), FOV 500 (LL), 1.0 $\times$ 32 raw detector collimation, 0.844/standard pitch. The subject was scanned in the supine position and cranio-caudal direction in a radiolucent body bag.

The bodies underwent PMCTA after the external examination was performed. The angiography was performed according to a modified PMCTA protocol based on body weight and using a "neck approach" for the Asian population practiced in our center.

The protocol was adapted from the Institute of Forensic Medicine, University of Zurich, Switzerland [6] and the Victoria Institute of Forensic Medicine, Melbourne, Australia [7]. Following the native PMCT scan and collection of post-mortem body fluids for toxicological and biochemistry analysis, cannulation of the right common carotid artery (CCA) and internal jugular vein was performed using cannula (MAQUET Gmbh & Co.KG, Rastatt, Germany) with a diameter of 16-French for arteries and 18-French for veins. An embalming machine (Porti-Boy Merk V, ESCO, East Lyme, CT, USA) was used to inject a mixture of non-ionic, water-soluble contrast medium (Iopamiro 300, Bracco Imaging, Milan, Italy) and clinical polyethylene glycol for synthesis (PEG 200, Merck, Darmstadt, Germany) at a ratio of 1:10. Three phases (arterial, venous and dynamic) were performed. The arterial phase (A) infused through the CCA, the venous phase (V) infused through the internal jugular vein and the dynamic phase (D) again infused through the CCA. The arterial phase was performed first and followed by the venous phase and finally the dynamic phase The amount of contrast media (CM) infused depended on the respective body weight: for Small:$<$60 kg (A = 1.0 L, V = 1.2 L and D = 0.3-0.5 L), for Medium:60-100 kg (A = 1.2 L, V = 1.5 L and D = 0.3-0.5 L) and Large:$>$100 kg (A = 1.5 L, V = 1.8 L, and D = 0.5 L). The pressure and infusion rate for arterial and venous phases were gradually increased from 0 mmHg-80 mmHg with a flow rate of 0 L/min-0.5 L/min. For the dynamic phase, the CM was injected continuously with a flow rate of 200 ml/min. The scanning parameters were identical to those used for the native PMCT scan. In this case, we used the Large size protocol as the bodyweight was 110 kg.

PMCT and PMCTA findings

PMCT showed an extensive fusiform and circumferential cavity with fluid collection located in between the skin and the underlying muscles, extending from the left pelvis region to the left thigh (Fig. 1). No underlying bony fracture or dislocation. Other than, the metallic artifact caused by the external fixator, there was no significant abnormality of the other systems noted.

The external fixators were removed prior to PMCTA procedure. PMCTA using the neck approach was performed in this case as the injuries were in the pelvis and lower limb. No extravasation of CM noted in the arterial phase. The left femoral artery and the other vessels in the lower abdomen and pelvis were intact. However, in the venous phase, there was extravasation of CM into the surrounding soft tissue noted at the postero-lateral aspect of the left thigh. Multiple foci of extravasation of CM we also noted at the periphery of the large collection indicating small vessel injury. The distal end of the left femoral vein was transected. However, there was minimal extravasation of CM and surrounding hematoma with external

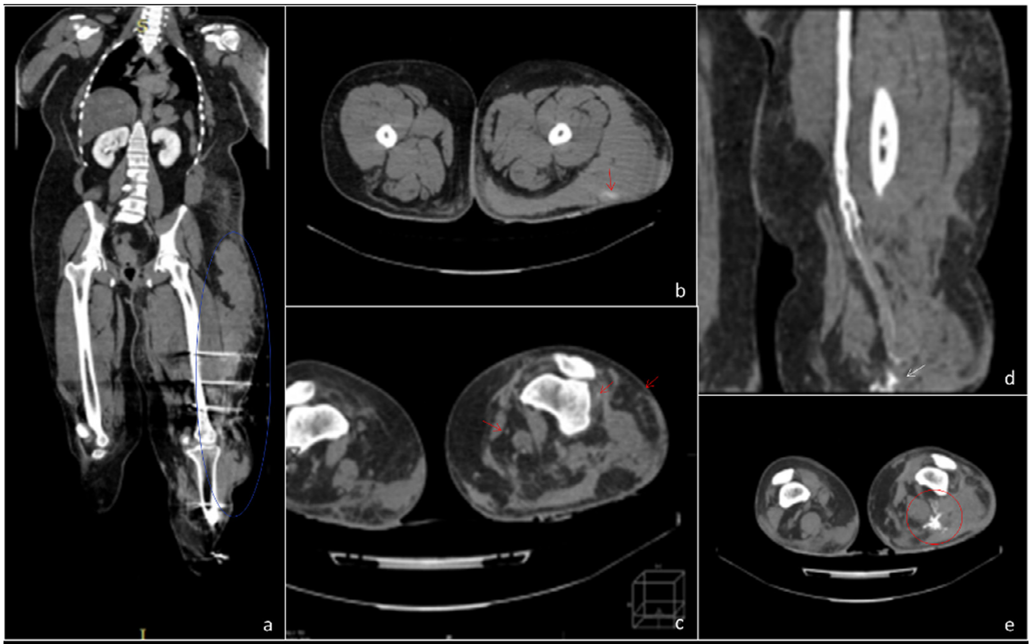

Fig. 1 – (a) PMCT axial section in soft tissue window showing in coronal view showing the extensive soft tissue collection and artifact from the external fixator noted (blue circle) and (b) CM from the intra-op angiogram seen within the collection (red arrow). (c) PMCTA in axial section in venous phase showing foci of extravasation of CM (red arrows) seen scattered at the periphery of the collection, (d) coronal MIP image of the venous run showing the transected femoral vein (white arrow) and axial section showing extravasation of CM from the femoral vein (red circle).

compression by the large collection of the left thigh. No communication demonstrated in between them.

Autopsy findings

External examination revealed multiple abrasions with bruises over the left iliac crest area and lateral aspect of the proximal left thigh. The left thigh was larger compared with the right with a different mid-thigh circumferential of about 3.0 cm. No obvious fluctuation, deformity, or fracture from palpation.

Exploration of the left thigh showed separation and formation of a large cavity (space volume) between the skin and subcutaneous tissue with the superficial fascia of the underlying left thigh muscles. A circumferential space volume measured approximately 57.0 cm x 43.0 cm from the iliac crest to the knee with about 2 [2] liters of accumulated fluid and clotted blood (Fig. 2). The underlying thigh muscles were intact with no evidence of laceration or contusion seen. The transected distal left femoral vein with surrounding hematoma and compressed by the large cavity demonstrated on PMCTA was confirmed by autopsy. Autopsy also confirmed no communication between the transected left femoral vein and the large cavity.

The COD was hypovolemic shock secondary to massive venous bleeding secondary to MVA. A final diagnosis of a rare case of lethal large Morel-Lavallée with vascular injury was established.

Discussion

Morel-Lavallée is a closed degloving injury usually related to severe trauma and was first described in 1848 by Victor-Auguste-François Morel-Lavallé [4]. It occurs when the skin and subcutaneous fatty tissue traumatically and abruptly separate from the underlying fascia and disrupts the perforating vessels and lymphatics, thus creating a potential space filled with serous fluid, frank blood, and even necrotic fat also known as hemolymphatic mass. The lesions are particularly common in the peritrochanteric region and proximal thigh but lesions at the abdominal wall, buttocks, lower lumbar spine, the scapular region, calves and the suprapatellar regions of the knee have been reported previously [8,9].

Trauma-related to MVA is one of the commonest causes of Morel-Lavallée lesions due to the high energy needed to shear the soft tissues. Other pre-existing conditions that might influence the outcome of the lesions include diabetes, obesity, smoking history and the use of anticoagulants. Our victim was obese, and obesity is one of the risk factors for developing degloving injury [10]. Trauma-related Morel-Lavallée lesions are typically small and resolved spontaneously or become encapsulated and persistent which then presents as a soft tissue mass even month to several years after the initial injury. Superimposed infection or necrosis is not uncommon. Death due to Morel-Lavallée is extremely rare and has never been reported.

The Morel-Lavellée lesion had variable appearances on plain radiograph depending on the size and contents of the

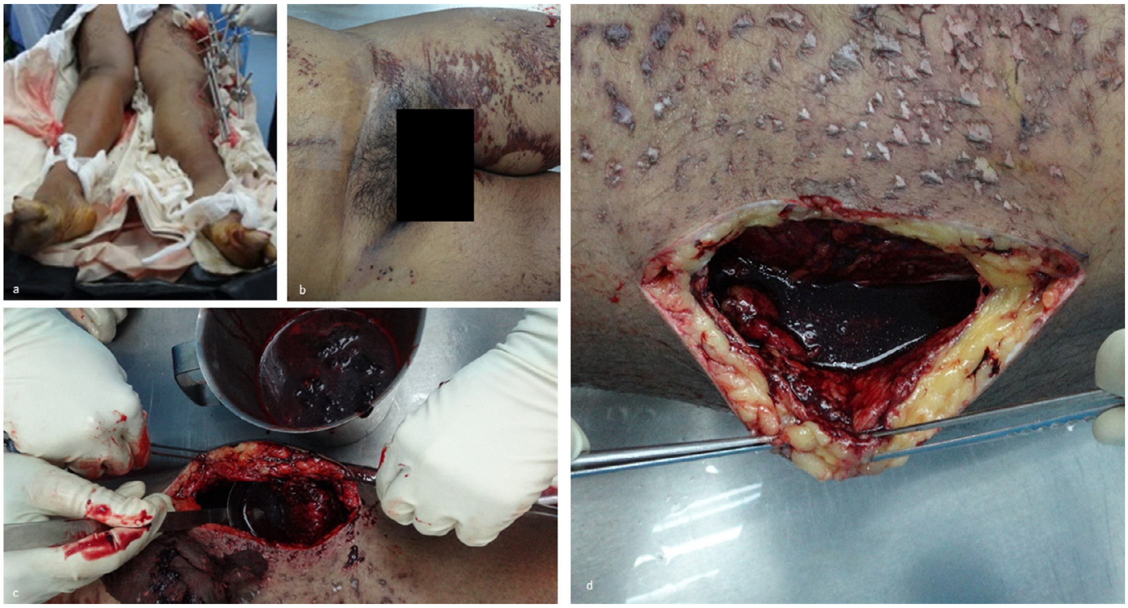

Fig. 2 – Autopsy findings showing (a) The significantly enlarged left thigh compared to the right thigh. Also noted the presence of external fixators of the left lower limb, (b) Extensive soft tissue abrasion over left lower quadrant of abdomen, left inguinal area and both thighs (left > right), (c) Serous fluid, hematoma, and clotted blood in the 'pocket space': ˜ 2L (1.2 kg of pure blood clot) and (d) An aerial view of the large collection seen within the soft tissue area of the left thigh.

lesion but usually, appear as soft tissue density lesion. This finding is nonspecific, and the role of the x-ray is to demonstrate bony Injuries which are associated with these lesions include femoral and pelvic fractures. Ultrasound could also be used to assess soft tissue lesion or mass. Typically, these lesions appear anechoic or hypoechoic but also depending on their content and age. It could have the standard hematoma features which are predominantly echogenic in the acute phase, becoming more hypoechoic over time and internal debris may give rise to echogenic foci or fluid-fluid levels. Capsule and septation of variable thickness may be seen [11].

Hematoma, fluid collection, hyperattenuating fluid or even fluid-fluid level within the potential space could be diagnosed on plain CT [12]. Associated injuries like fractures are also well documented on CT. The role of CTA is crucial in diagnosing any vascular-related injury but only indicated in large or life-threatning conditions. No documented CTA or PMCTA findings of Morel-Lavelle lesion up to date. MRI is the modally of choice due to the superior soft-tissue delineation and contrast as well as the ability to gauge hemorrhage chronicity of the lesion [12]. It can demonstrate the relationship of the collection with the underlying fascia, the fibrous pseudocapsule, and fluid-fluid level.

In our case study, the skin and subcutaneous fatty tissue were traumatically and abruptly separated from the underlying fascia due to severe shearing injury from the MVA and thus creating a huge potential space filled by serous fluid and frank blood. This huge fluid collection extending from the left iliac crest to the left knee region was well visualized on PMCT. CTA of the lower limb would be an ideal investigation for this case but unfortunately, it was not done due to unstable clinical conditions. The multiple bleeding small veins were well demonstrated on PMCTA as foci of extravasation of CM. The external fixator did not contribute to any large vascular injury, but small bleeders were demonstrated at the external fixator pin sites.

These findings could explain why her vital signs and general condition remained unstable despite aggressive resuscitation and eventually led to the death, as the intravenous resuscitation fluid has accumulated in the large potential space. The large Morel-Lavallée together with the presence of the transected distal left femoral vein due to the posterior dislocation of the left knee joint further worsens the prognosis. However, the transected left femoral vein with surrounding hematoma was compressed by the large collection and deemed not severe enough to cause death in this case. Furthermore, there was no communication in between the transected femoral vein and the large collection. The arterial system was completely intact on PMCTA. All findings demonstrated on PMCT/PMCTA were confirmed by autopsy.

To the best of our knowledge, this is the first case study of a large and lethal Morel-Lavallée which was well documented on PMCT, PMCTA and confirmed by autopsy. In this case, PMCTA findings helped the forensic pathologist to "pinpoint" the exact location of the bleeder as well as tailoring and focusing his autopsy technique into the left pelvic and thigh regions instead of dissecting the whole pelvic cavity and left lower limb.

Conclusion

This case report has demonstrated the role of PMCT and PMCTA as a very powerful tool and important adjunct to conventional autopsy in Morel-Lavellée lesions specifically and VIRD cases generally. The forensic pathologists were able to focus and altered their autopsy based on the PMCT and PM-CTA findings. We have demonstrated that all PMCT and PM-CTA findings on VIRD were confirmed by autopsy. The images were adequate and optimal for diagnosing the COD in a rare large and lethal Morel-Lavellée lesion.

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