

Orthopedic Implications of the Corona Mortis: A Case Report

Implicaciones Ortopédicas de la Corona Mortis: Reporte de un Caso

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SUMMARY: Corona mortis is classified as a connection between the inferior epigastric and obturator vessels over the superior pubic ramus. Its incidence varies among different studies. The corona mortis is an extremely important anatomical variation as it can be injured in a great number of procedures. Moreover, it can also be injured during pelvic or acetabular fractures. A male cadaver fixed in a 10 % formalin solution had its pelvic region dissected and an arterial corona mortis was observed on its right side. The left hemipelvis presented no variations whatsoever. This vessel was measured with the aid of a digital caliper. We aim to report this variation and address - from an orthopedic point of view – the clinical and surgical significance of the corona mortis.

KEY WORDS: Anatomical variations; Corona mortis; Orthopedic Procedures; Acetabulum; Pelvic bones.

INTRODUCTION

Corona mortis (CM) is defined as an arterial or venous anastomosis between anastomotic branches of the obturator artery (OA) and the inferior epigastric artery (IEA) over the superior pubic ramus (SPR) (Baena *et al.*, 2015; Al Talalwah, 2016; Tajra *et al.*, 2016; Wada *et al.*, 2017).

The prevalence of this connection is motif of debate in the literature due to discrepancies of rates in different studies (Stavropoulou-Deli & Anagnostopoulou, 2013; Pellegrino *et al.*, 2014; Al Talalwah; Tajra *et al.*; Wada *et al.*).

Despite that, the CM possesses a surgical and clinical interest as it is susceptible to iatrogenic injuries during a great deal of surgical procedures (hernia repairs and orthopedic access to treat acetabular fractures for instance). Moreover, there is great difficulty in achieving hemostasis when the CM is injured during surgery (Davey & Santore, 1999; Theodorides *et al.*, 2011; Garrido-Gomez *et al.*, 2012; Palacio & Albareda, 2014; Yang *et al.*, 2015; Wada *et al.*).

In addition, it can be ruptured in acetabular and SPR fractures, thus, leading more complication to a patient's health (Theodorides *et al.*; Garrido-Gomez *et al.*; Palacio & Albareda).

This present work aims to describe a case of an arterial and venous CM and discuss its surgical and clinical aspects.

CASE REPORT

During regular dissection in the anatomical laboratory of the Fluminense Federal University, a male cadaver fixated in a 10 % formalin solution showed an arterial and venous CM on its right hemipelvis (Fig. 1). There were no variations on its left side. Measurements were taken with a digital caliper.

The vessels were carefully dissected. The length (origin x pubic symphysis) of the corona mortis vessels was 54 mm and it possessed 3 mm of caliber.

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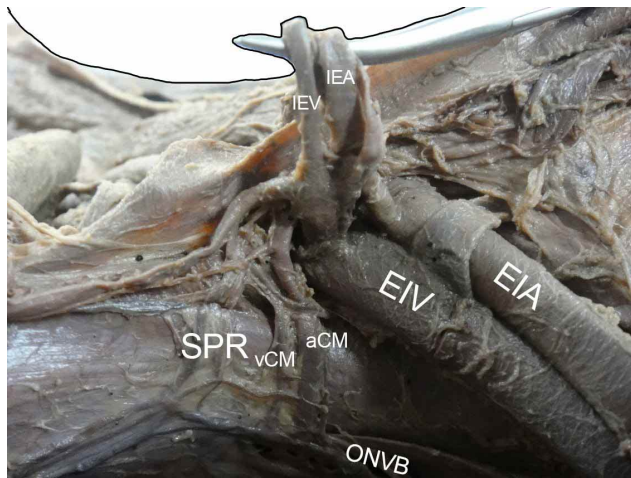


Fig. 1. Superior view of the right hemipelvis, the arterial and venous corona mortis can be seen (aCM and vCM, respectively). Legend: EIA = External iliac artery; EIV = External iliac vein; ONVB = Obturator neurovascular bundle; SPR = Superior pubic ramus; IEV = Inferior epigastric vein; IEA = Inferior epigastric artery.

DISCUSSION

The common, external and internal iliac arteries are formed through a connection between the umbilical arteries and the fifth pair of lumbar intersegmental branches (pelvic plexus). This begins during the fifth week of embryonic development (Jusoh *et al.*, 2010; Schoenwolf *et al.*, 2014; Goke *et al.*, 2016).

Branches of those vessels are formed as sprouts through a series of anastomotic channels, some of them enlarge, others diminish in size, thus, variations in the caliber, origin and trajectory of these branches are quite common (Jusoh *et al.*; Schoenwolf *et al.*; Goke *et al.*).

Variations of the OA and IEA are well described in the literature (Testut & Latarjet, 1958; Sañudo *et al.*, 2011; Al Talalwah; Goke *et al.*; Tubbs *et al.*, 2016). CM incidence varies from 12 % to 40 % in most recent studies (Stavropoulou-Deli & Anagnostopoulou; Pellegrino *et al.*; Baena *et al.*; Al Talalwah; Tajra *et al.*; Wada *et al.*).

Clinically, the CM can be easily ruptured in cases of acetabular and SPR fractures and cause severe hemorrhage. This is a concern, since incidence of low-energy osteoporotic pelvic fractures in the elderly are quite high (Henning *et al.*, 2007; Ebraheim *et al.*, 2008; Theodorides *et al.*; Garrido-Gomez *et al.*; Palacio & Albareda).

CM rupture can result in life-threatening hypovolemic shock even though SPR fractures do not usually require

surgical treatment. Patients with pubic ramus fracture include young people sustaining high-energy trauma such as motor vehicle accident or falls from height and elderly people after minor falls (Henning *et al.*; Theodorides *et al.*; Garrido-Gomez *et al.*; Palacio & Albareda). Early signs of vascular injury are clinical hypoperfusion, lower abdominal mass in the abdomen (Chiu *et al.*, 2009; Theodorides *et al.*).

Thus, the presence of a CM imposes threat and should not be overlooked in cases of these fractures.

Recent studies showed that the CM if one of the structures that the surgeon must observe during modified Stoppa approaches. Among other structures that should be identified are the external iliac artery and the superior gluteal neurovascular bundle (Bible *et al.*, 2014).

Traditional, modified Stoppa, ilioinguinal and iliofemoral approaches are often used to treat acetabular and pelvic ring fractures, with a fairly good success rate (70-95 %) and low rates of complications (Karunakar *et al.*, 2004; Balbachevsky *et al.*, 2006; Kacra *et al.*, 2011; Bible *et al.*; Court-Brown *et al.*, 2014; Jensen *et al.*, 2015). Despite that, some studies showed vascular injury rates of 6.2 % of patients with CM (Jensen *et al.*).

Ilioinguinal and iliofemoral approaches are related to higher risk of neurovascular bundle injuries, thus are becoming less and less preferred as a surgical treatment for fractures of the anterior region of the pelvis and acetabulum (Balbachevsky *et al.*; Yang *et al.*). Due to this, newer techniques such as minimally invasive ilioinguinal approach are being performed (Yang *et al.*).

Despite that, the ilioinguinal approach is still a good treatment choice in cases of anterior wall and column fractures, and two column fractures as well. The surgeon should access the medial window that is created by dissection of the iliopectineal fascia and retraction of the adjacent structures. This window exposes the anterior wall, the iliopectineal eminence and the quadrilateral surface, although before the vessels are retracted, the surgeon must carefully look for the CM (Karunakar *et al.*; Court-Brown *et al.*).

Modified Stoppa access have vantages such as smaller surgical incision and soft parts dissection and allows the surgeon to place the implant directly at the internal surface of the pelvis, thus, possessing less complication rates (Balbachevsky *et al.*).

In order to treat acetabular dysplasia, acetabular retroversion and other hips deformities, pelvic and acetabular osteotomies are usually the first choice of surgical treatment

(De Kleuver *et al.*, 1998; Wada *et al.*). Both are also good procedures to reduce symptoms and progression of hip osteoarthritis (Wada *et al.*).

Despite its good result rates, pelvic osteotomy is often associated with high complication rates (6-37 %). Studies suggested that major hemorrhage is an important complication and even though vascular injuries are uncommon, they are quite dangerous (Davey & Santore; Brenøe *et al.*, 2006; Wada *et al.*). The CM is in danger specifically during the medial approach. During other approaches for pelvic osteotomy the surgeon does not face the CM, as they are not exposed (De Kleuver *et al.*).

The medial approach seems technically easier to perform, although there is risk of CM injury and difficulty to get close to the hip joint. In addition, it does not seem to produce good results (De Kleuver *et al.*).

During ischial osteotomies, the OA and CM can be injured due to a difficulty of visualization during an anterior approach (Kamada *et al.*, 2011; Wada *et al.*).

Different approaches of osteotomies possess different risks of iatrogenic injury since the structures involved are different. A recent study showed that the OA and CM are in greater danger in rotational acetabular osteotomy and pubic osteotomy than ischial osteotomy (Wada *et al.*).

Thus, knowledge of the incidence, size and anatomical relations of the CM is essential, especially to orthopedic surgeons, as osteotomies and Stoppa access are among the most performed orthopedic procedures. This knowledge is necessary in order to avoid complication rates due to iatrogenic rupture of this vessel.

Furthermore, the CM can be injured in pubic and acetabular fractures. Both types of trauma have a relatively high incidence among the elderly, hence, awareness of the CM is of great significance as to reduce delay in treatment of the hemorrhage.

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RESUMEN: La corona mortis es clasificada como una conexión entre los vasos epigástricos inferiores y obturadores sobre la rama superior del pubis. Su incidencia varía según los diferentes estudios. La corona mortis es una variación anatómica extremadamente importante, ya que se es posible dañarla en un número significativo de procedimientos. Además, también puede re-

sultar lesionada durante las fracturas pélvicas o acetabulares. Durante la disección de un cadáver de sexo masculino fijado en solución de formalina al 10 %, se observó la corona mortis arterial en el lado derecho de la región pélvica. El lado izquierdo de la pelvis no presentó ninguna variación. Se midió la corona mortis con ayuda de un calibre digital. Nuestro objetivo fue informar sobre esta variación y abordar - desde el punto de vista ortopédico - la importancia clínica y quirúrgica de la corona mortis.

PALABRAS CLAVE: Variaciones anatómicas; Corona mortis; Procedimientos ortopédicos; Acetábulo; Huesos pélvicos.

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