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Research Article

Surgical Relevance of Corona Mortis and Clinical Outcome in Pelvic Trauma

Kai Oliver Jensen*#, Kai Sprengel#, Ladislav Mica, Lukas Somlyay, Thorsten Jentzsch and Clément ML Werner

Division of Trauma Surgery, University of Zurich, Switzerland

#Both authors contribute equally

***Corresponding author:** Kai Oliver Jensen, Division of Trauma Surgery, University Hospital Zurich, University of Zurich, Switzerland, Raemistrasse 100, 8091 Zürich

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Abstract

Introduction: The Corona Mortis (CM), also termed the crown of death, is an anastomosis between the obturator and the external iliac or inferior epigastric vessels. It has been accused to be a source of major bleeding complications in many instances. Not only pelvic surgeons know that dislocated fractures or iatrogenic injury may cause life-threatening bleeding. For the investigation of the incidence and surgical relevance of the CM, we conducted a retrospective study considering the intra- and peri-operative findings at our institution.

Methods: All consecutive patients, who underwent pelvic surgery due to an acetabular fracture or pelvic ring instability were analysed. Patients were excluded if an approach without standard visualization of the CM was used. The incidence of the CM and its associated bleeding complications and mortality was investigated as documented by the operative report and patients' medical records. After performing a two-tailed Kolmogorov-Smirnov test for normal distribution, a Mann-Whitney U test was used due to a nonparametric distribution to test nominal variables. *P*-values of <0.05 were considered statistically significant.

Results: We evaluated the data of 130 consecutive patients. The incidence of the CM was 41.5% (n=54). Neither a significant correlation between the presence of the CM and bleeding complications (p=0.068), nor the mortality (p=0.068) was observed. The mortality was also not significantly affected by the presence of the CM or bleeding complications (p=0.338 and p=0.113, respectively).

Conclusion: This study points out the high incidence of the CM. However, it is not associated with bleeding complications or mortality. Therefore, it does not seem to be the main source of bleeding in pelvic trauma in case of delayed surgery and can be regarded as a controllable anatomic structure.

Keywords: Corona mortis; Pelvic fracture; Incidence; Bleeding; Complications; Mortality

Abbreviations

CM: Corona Mortis; CT: Computed Tomography

Introduction

The Corona Mortis (CM) is known as an anastomosis between the obturator and the external iliac or the inferior epigastric vessels. It is described as an anatomical variant with variable size (>1 mm to <4 mm), distance to the ramus pubis (40 mm to 96 mm) and incidence (25% to 83 %) [1-4]. During pelvic surgeries, most surgeons use an anterior approach for the reduction and fixation of fractures of the pelvic ring and acetabulum [5-8]. On the one hand, the CM is a cause of major bleeding complications due to dislocated fractures and, on the other hand, it is a potential risk factor for significant haemorrhage by iatrogenic, intraoperative lesions, which may be limb- and life-threatening [3,9-12]. However, the current literature is based on cadaver, angiographic and Computed Tomography (CT) studies. To determine the incidence and clinical relevance of the CM, we conducted a retrospective study based on intra- and peri-operative findings at our institution.

Patients and Methods

Approval by the local ethics committee for database analysis was obtained: "Retrospektive Analysen in der Chirurgischen Intensivmedizin" Nr. St.V 01/2008.

For this retrospective data base study, we enrolled patients, who underwent pelvic surgery due to an acetabular fracture or pelvic ring instability. All patients were treated at our institution. Inclusion criteria were an acetabular fracture and/or pelvic ring instability, senior author participation in the operation and surgery between March 2006 and December 2013. Patients with an age under 15 years, or a pathologic fracture were excluded. In order to further stratify the patients for the evaluation of the CM, any posterior, Olerud and percutaneous surgical approaches were neglected. Up to three approaches were used. The fractures were classified using the classification system described by Young and Burgess [13]. The incidence of the CM was defined by documented intraoperative findings in the operative report. Complications were evaluated based on retrospective chart review of patients' medical records including follow-up radiographs. The minimal follow up time was set at six

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Table 1: Diagnosis (fracture) classified using the classification system described by Young and Burgess of all included cases (n1) and cases with approaches with possible visibility of the CM (n2).

Diagnosis (fracture)	n1	%1	n2	%2
LC II	73	37.4	32	24.6
LC III	11	5.6	11	8.5
APC II	14	7.2	14	10.8
APC III	5	2.6	5	3.8
VS	9	4.6	8	6.2
Combined mechanism	22	1.3	21	16.2
Acetabular fracture	61	31.3	39	30.0
Acetabular fracture in combination with a pelvic ring fracture	38		32	
Patients	195	100	130	100

Abbreviations: LC: Lateral Compression; APC: Antero Posterior Compression; VS: Vertical Shear

Table 2: Detailed description of the approaches of all included cases. Combinations are possible.

Approach	n	%
Anterior		
Stoppa	79	40.5
Ilioinguinal	43	22.1
Laparotomy	22	11.3
Olerud	15	7.7
Posterior		
Kocher-Langenbeck Original or Gibson modification	51	16.9
Wiltse	5	3.8
Hardinge	1	0.5
Miscellaneous	3	1.5
Percutaneous	99	43.2

months. Outcome parameters were the incidence of the CM and its association with bleeding complications, general postoperative complications, and mortality.

Statistical analysis

All data were recorded in an Excel database (Microsoft Corp., Washington, DC, USA) and statistically analysed with IBM SPSS Statistics for Windows (Version 22.0; IBM Corp., Armonk, NY, USA). Descriptive data are given as mean values and standard deviations or absolute numbers. Normal distribution of the data was tested with a two-tailed Kolmogorov-Smirnov test. Because of the nonparametric distribution, a Mann-Whitney U test was used to test nominal variables. *P*-values of <0.05 were considered as statistically significant.

Results

A total of 195 patients were evaluated in this study. The mean age of was 51 ± 19 years and there were 66 (33.8%) females as well as 129 (66.2%) males. The diagnoses and approaches (n=318; 1.6 approaches per patient) are presented in Tables 1-3. In 48.7% (n=95), an anterior approach was used and in 10.8% (n=21), a posterior approach was used. A combination of both approaches was performed in 17.9% (n=35) and an individual approach in 1.5% (n=3), while 29.4%

Table 3: Summarized description of the approaches of all included cases.

Approach	n	%
Only anterior	95	48.7
Only posterior	21	10.8
Anterior and posterior	35	17.9
Additional percutaneous	58	29.7
Only percutaneous	41	21.0
Miscellaneous	3	1.5

Table 4: Complications of all included cases (n1=195) and cases with approaches where the CM is potentially visible (n2=130).

Complications	n1	%1	n2	%2
Lesion of the LFCN	14	7.2	14	10.8
Bladder injury	5	2.6	4	3.8
Infection	18	9.2	17	13.1
Deep vein thrombosis	10	5.1	9	6.9
Pulmonary embolism	3	1.5	3	2.3
Loss of reduction	8	4.1	7	5.4
Hernia	11	5.6	11	8.5
Hip dislocation	2	1.0	2	1.5
Ectopic ossification	26	13.3	21	16.2
Pseudarthrosis	6	3.1	6	4.6
Coxarthrosis	36	18.5	28	21.5
(due to necrosis of the caput femoris)	3		2	
Necrosis of the caput femoris	4	2.1	3	2.3

Abbreviation: LFCN: Lateral Femoral Cutaneous Nerve

(n=58) were complemented by a percutaneous approach. According to the intraoperative approach and potential documentation of the CM, 130 patients were eventually available for further stratification. The incidence of the CM was 41.5% (n=54). Bleeding complications occurred in 5.1% (n=10) of all patients and 6.2% (n=8) of patients with the CM. The complications are summarized in Table 4. The overall mortality was 8.2% (n=16) and the mortality of patients with the CM was 9.2% (n=12). There was no significant association between the presence of the CM and bleeding complications (p=0.068). Furthermore, the presence of the CM did not have an influence on the mortality (p=0.068). In accordance with these results, the mortality was not significantly affected by the presence of the CM or bleeding complications (p=0.338/0.113).

Discussion

The intend of this study was to determine the incidence and the clinical relevance of the CM based on intraoperative findings because previous studies are based on CT results, angiographic findings, and cadaver dissections. Our data show that the CM was documented in 41.5% of the cases, which is consistent with the current literature; although even higher incidences of vascular anastomoses have been reported [1-4]. Against our assumption and despite a bleeding complication rate of 6.2%, the presence of the CM was not associated with increased bleeding complications or higher mortality. Therefore, relevant bleeding might arise not only from the CM, but from other sources such as the posterior part of the pelvis. Another reason might be an ongoing bleeding from cancellous bone

exposed from the fracture [14]. In addition, the standard surgical procedure for acetabular fractures and pelvic ring instabilities at our institution includes delayed definite, open surgery with prior external stabilization if necessary, in order to allow auto-tamponade to control the bleeding.

There are ways of detecting the CM preoperatively by using a CT-angiography or plain peripheral angiography [1,12,15]. The presented data suggest that there is no need for pre-operative identification if a gentle surgical technique with careful dissection is performed while keeping the high incidence of the CM in mind. This is backed up by the fact that elaborated imaging modalities are time-consuming modalities, which are often challenging to perform in hemodynamically unstable patients with an urgent need for surgical stabilization [16].

In the present study, we used the classification described by Young and Burgess [13] because it has been shown to have a higher inter- and intraobserver reliability [17,18] than the classification system introduced by Tile [19].

We are aware of several limitations of this study. First, it is a retrospective database study with a rather small sample size. Furthermore, a known limitation for studies dealing with pelvic ring instabilities is that concomitant injuries might influence complications. However, the fact that patients were treated by only one senior surgeon is a clear advantage because of the thorough documentation regarding the presence of the CM. Therefore, the data concerning the incidence of the CM seems to be valid, but data about the outcome should be interpreted with care.

The incidence of the CM is comparable to the current literature, but the clinical relevance in the form of bleeding complications and mortality does not seem to be as high as initially thought.

Conclusion

The high incidence of the CM was not associated with increased bleeding complications or a higher rate of mortality. Major bleeding in pelvic trauma surgeries may occur at other sites such as the central vessels or venous plexus at the back of the pelvis. Nevertheless, the CM seems to be an important but manageable anatomic structure if handled cautiously with the high incidence in mind; preferably during delayed, definite open surgeries for pelvic trauma.

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