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Review

Proximal femoral fractures and vascular injuries in adults: Incidence, aetiology and outcomes

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ABSTRACT

Introduction: Vascular injuries (VI) presenting during internal fixation (IF) of proximal femoral fractures (PFF) are potentially limb- and life-threatening. The purpose of this systematic review of the literature is to report on their incidence, associated complications and to give special emphasis in their prevention.
Materials and methods: A comprehensive review of the literature was undertaken using the PRISMA guidelines with no language restriction. Case reports of VIPFF-IF and series of PFF-IF with cases of VI published between inception of journals to March 2015 were eligible for inclusion. Relevant information was divided in two parts. Part I included the analysis of cases of VIPFF-IF, with the objective of establishing the frequency of injury of each vessel, the types and mechanisms of injury, the diagnostic and therapeutic modalities, and the outcomes. Part II analysed series of PFF-IF, which included case(s) of VI for assessing the incidence of VIPFF-IF.
Results: Overall 160 articles with 182 cases of VIPFF-IF met the inclusion criteria. The injuries to extrapelvic vessels prevailed over those of intrapelvic vessels. There was a higher frequency of injury to the deep femoral artery and its branches in extrapelvic vessels and of external iliac artery and vein in intrapelvic vessels. The types of injury were: compression, intimal flap tear, disruption of the intimal layer with thrombosis, laceration with haemorrhage, and puncture or progressive erosion leading to a pseudoaneurysm (PSA) or arteriovenous fistula (AVF), with high prevalence for PSA, followed by lacerations. PSAs were more frequent in extrapelvic lesions and lacerations in the intrapelvic vessels. There were 7 non-iatrogenic injuries, produced by a displaced lesser trochanter fragment or other bone fragments, and 175 iatrogenic injuries (96.15%). The intrapelvic intraoperative protrusion of instruments or implants, or the post-operative migration of implants produced the injuries of intrapelvic vessels. For iatrogenic injuries of extrapelvic vessels the prevalent mechanism was a displaced lesser trochanter fragment, either intra- or postoperatively, followed by injuries by an overshot drill bit or a protruding screw; several other mechanisms completed the list.

The clinical and radiological investigations were similar to those of VI elsewhere. VI occurred either at the time of fracture, during surgery or after it, early or late, weeks, months or even years after IF. The diagnostic and therapeutic modalities were most diverse, and the incidence of morbidity and mortality was 18.06%. The overall incidence of VIPFF-IF was 0.49%.
Conclusion: The incidence of VIPFF-IF is low, though it will probably rise because of the increasing frequency of PFF. With few exceptions, these injuries, which are potentially limb and life-threatening, are iatrogenic, resulting of errors in IF, with different types of lesions to intra- and extrapelvic vessels running in close proximity to the bone. Although the surgeon should bear in mind this possibility and achieve early diagnosis and prompt accurate treatment, there is no consensus as to what is the best diagnostic or therapeutic modality. A precise diagnosis of the preoperative vascular status of the limb, monitoring of the displacement of the lesser trochanter fragment, careful and gentle reduction of the fracture, and precise handling of instruments and implant selection and placement during IF, are factors to consider in order to prevent this complication, which should never be underestimated.

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Introduction

Proximal femoral fractures (PFF) and their management continue to be a subject of great attention to the clinicians. The underlying poor bone stock, the increased incidence of fracture comminution, and the high incidence of comorbidities in the elderly patient population may lead to a higher risk of complications and mortality [1–7].

Vascular injuries (VI) during the course of internal fixation (IF) in PFF could be potentially limb and life-threatening [8]. There are infrequent reports about their presentation in journals [9] and some references in expert textbooks of orthopaedic trauma [10–13]. As the incidence of hip fractures is expected to increase dramatically during the next decades, similarly, the incidence of VIPFF-IF is expected to rise.

The purpose of this systematic review of the literature therefore is to investigate the distinct frequency of each of the injured vessels, the mechanisms and types of injury, the diagnostic and therapeutic modalities, the outcomes, and to recommend several tips for its prevention.

Materials and methods

This review was conducted in accordance to the PRISMA guidelines [14]. Data were documented according to a standardised protocol, where objectives and inclusion criteria were specified in detail.

Searches were conducted using the following databases: Cochrane Library, Pubmed, Embase, Springer, OvidSP, ScienceDirect, Dialnet, J-Stage, Scielo, and KoreaMed, and also the Google Scholar searcher. The following keywords were used: "artery", "vein", "injury", "pseudoaneurysm", "thrombosis", "compression", "arteriovenous aneurysm", "arteriovenous fistula", "femoral neck fracture", "trochanteric fracture", and "subtrochanteric fracture". Two reviewers selected potentially relevant abstracts and obtained full copies of the articles. Additionally all references of the retrieved articles were also appraised.

Criteria for eligibility

Studies selected were original clinical articles that addressed VIPFF-IF in adult patients 18 year-old and older, with no language restriction. Cases with fractures in pathological bone, resulting of penetrating trauma or undergoing treatment with hip replacement were excluded. Date limits were set from inception of journals to 31 March 2015.

Data extraction

Relevant information obtained was divided in two parts. Part I of the study included detailed case reports or cases of VIPFF-IF containing useful information for extraction of such data as type of study, age, gender, type of fracture, fracture treatment (implant used), injured vessel, mechanism of injury, type of vessel lesion, clinical presentation, time to onset of symptoms and signs, diagnostic and treatment modalities, and outcome.

Part II of the study included series of PFF with cases of VI, with such data extracted as type of study, time period of study, number of patients, time to follow-up, and number of cases of VI, for assessing the incidence of this complication.

Statistical analysis

As the majority of the data collected were from case reports and few case series statistical analysis was not possible. However, descriptive statistics were employed where possible.

Results

After omitting studies that did not fulfil the inclusion criteria or were repeated in the databases search, 161 studies were primarily selected for review. Of these, one case included in one study [15] is questionable and for this reason was excluded, leaving 160 articles reporting on 182 cases [16–175], which were included in part I of the analysis (Table 1): 104 were written in English [16,17,19,20,21,22,24,25,26,27,29,30,32,33,37,38,39,40,43,44,46,47,48,49,50,51,52,54,56,58,59,61,63,64,65,67–69,71,73,75,77,79,82,83,84,85,88,89,91,92,94,95,98,101,102,104,105,106,107,109,110,111,113,114,117,118,119,120,121,122,123,124,125,126,127,128,130,131,132,135,136,137,139,146,148,149,150,151,152,156,158,160,162,164,165,166,167,168,169,170,173,174,175], 14 in Spanish [57,81,99,103,115,134,141,143,144,153–155,159,172], 12 in German [28,34,62,70,72,80,87,90,93,113,142,163], 7 in Japanese [76,100,108,112,145,147,171], 6 in French [23,31,35,36,53,116], 5 in Dutch [66,129,138,140,161], 3 in Korean [74,96,157], 2 in Portuguese [78,86], 2 in Russian [18,42], 2 in Turkish [41,97], 1 in Chinese [60], 1 in Danish [55], and 1 in Hungarian language [45].

For the completion of part II of the study we analysed the information of 4 series with 12 cases of VI already considered in part I of the study – after 2.604 PFF [28,34,93,100] (Table 2). Additional articles were also reviewed to facilitate the development of the discussion [176–222].

Part I

Gender and age. There were 60 males and 105 females in 165 cases with gender information, and the mean age in 174 cases was 76 years (range, 22–97).

Fracture type. Displacement of the lesser trochanter fragment. The types and groups of PFF in 182 cases with information, using the AO classification, were as follows: 132 A (trochanteric) fractures,