

R E V I E W

Are vascular grafts at risk of occlusion after total hip replacement? A systematic review of the literature

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Abstract. Vascular complications during and after total hip replacement are relatively uncommon despite the close relationship between the involved structures. Previous surgical procedure of arterial reconstruction or substitution may be at higher risk of damage due to the modification in the anatomical landmarks or to the mechanical properties of the grafts different from native vessels. In literature few cases of graft occlusion or failure are reported during or soon after a total hip replacement. The aim of this review is to report them highlighting common features and risk factors. (www.actabiomedica.it)

Key words: hip, arthroplasty, vascular, complications, vascular graft

Introduction

Total hip arthroplasty (THA) is one of the commonest and most successful orthopedics performed nowadays with thousands of patients treated every year with good to excellent results.

Complications are uncommon, with patients with multiple comorbidities being at higher risk of peri-operative events.

Characteristic early and late complications of THA may be septic or aseptic loosening, dislocation and leg length discrepancy. On the other hand, intra-operative vascular and neurological damages are rather unusual, despite the close relationship between the involved structures.

Arterial occlusion due to thrombosis is rarely reported but potentially it may determine severe outcomes in terms of irreversible lower limb ischemia.

Previous surgical procedure of arterial reconstruction or substitution may be at higher risk of damage due to the modification in the anatomical landmarks or to the different mechanical properties of the grafts in terms of tensile and torsion strength.

In literature few cases of peri-operative graft occlusion or failure are reported after a THA or a total hip revision. The present review aims to collect them highlighting common features and risk factors.

Methods

PUBMED and Google Scholar databases was searched for articles including case reports and case series (in the English language) of vascular injuries on previous lower limb bypass or grafting in association with total hip arthroplasty (primary and revision) between January 1975 and March 2021.

Scientific publications were searched for the following keywords: “artery”, “arterial”, “vessel” and “vascular” (search one). Another search was conducted for articles containing any of the following keywords: “hip replacement”, “hip revision”, “hip arthroplasty”, “hip resurfacing” and “hip surgery” (search two). Another search was conducted for articles containing any of the following keywords: “stent”, “graft”, “bypass” (search three). Finally we searched for articles containing at

least one of the following keywords: “injury”, “damage”, “lesion” and “occlusion” (search four).

The results of the searches were merged into one list. Following this, the titles and abstracts of the shortlisted articles were reviewed to ensure the inclusion of only those that described vascular occlusion of a bypass/graft in association with hip arthroplasty, including resurfacing arthroplasty and revision THA.

Two investigators (FM, MMB) independently evaluated the eligibility of relevant abstracts and full articles, and all pertinent references of the were also reviewed.

In cases of disagreement between the 2 investigators, further discussions were made with a third investigator (PDB).

Only 9 case reports were found, without any randomized control clinical trials or comparative studies (1-9).

The information about patient demographic (age and sex), the history of hip operation (diagnosis, side, surgical approach, previous hip surgery, method of fixation, leg length discrepancy) and vascular details (type of bypass/graft, complication treatment) were recorded.

Statistical analysis

The 9 cases were analyzed only using descriptive statistics.

Results

Nine case reports of vascular occlusion are reported in literature (details are reported in table 1).

They include 9 males of mean age of 69 years (range 58-85) who underwent a THA (7 cases) or a

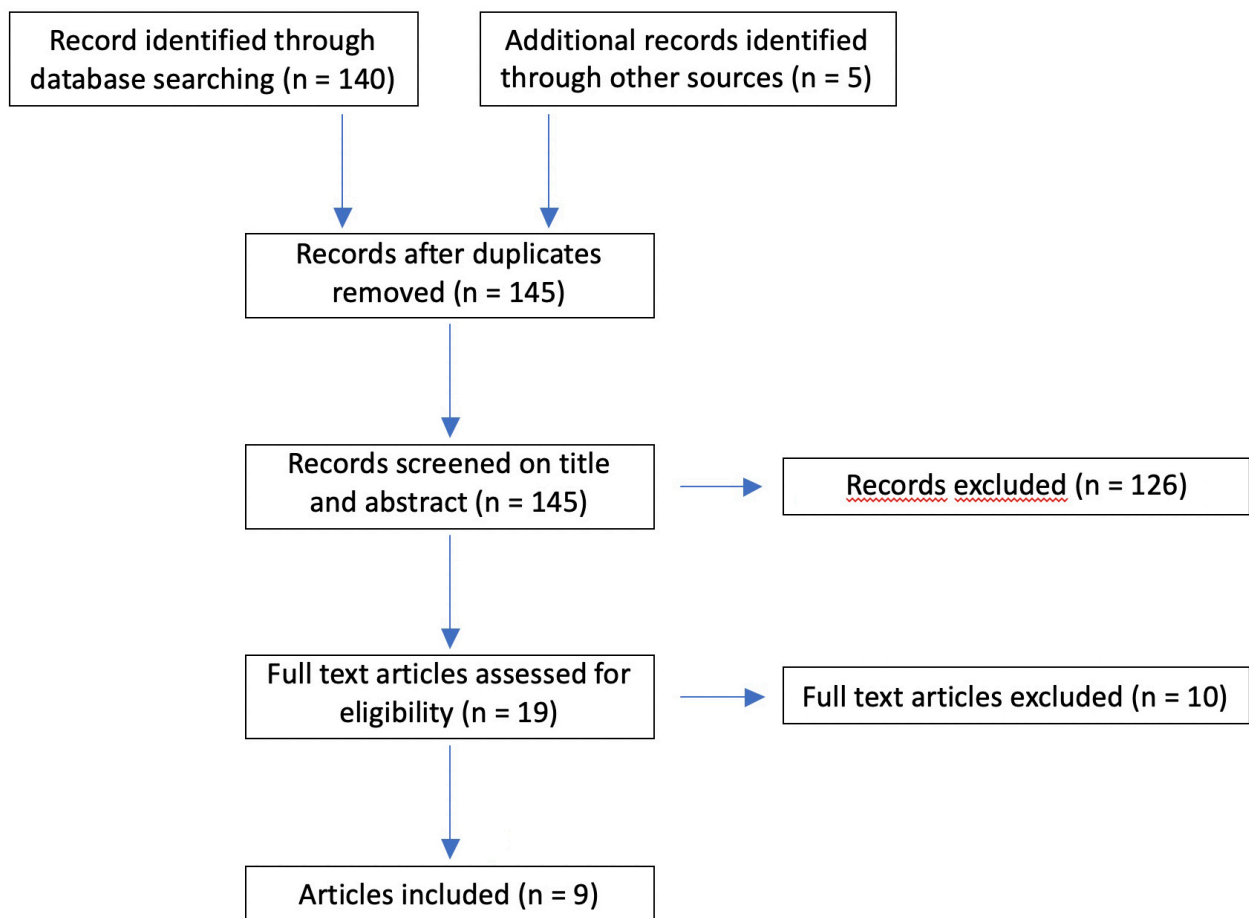


Figure 1. Flow chart showing the study selection process

Table 1. Case reports details (AVN: avascular necrosis; OA: osteoarthritis; FNF: femoral neck fracture; PJI: periprosthetic joint infection; THA: total hip arthroplasty; NS: non specified).

Year	Author	Sex	Age	Diagnosis	Surgery	Prior surgery	Hip side	Approach	Fixation	Bypass/graft	Complication	Vascular treatment
1994	Parfenchuck	M	61	AVN	THA	0	Left	Posterolateral	cementless	Aortobiliac graft for an abdominal aortic aneurysm	day 0	surgical thrombectomy
1999	Trousdale	M	63	OA	THA	0	Right	Posterolateral	hybrid	aortobifemoral bypass graft with Microvel knitted polyester graft	day 2	surgical thrombectomy
2003	Woo	M	62	AVN	THA	0	Left	Posterior	NS	Zenith bifurcated stent-graft for a 5-cm abdominal aortic aneurysm	day 0	suction thrombectomy and Fogarty embolectomy + Wallstent
2009	Saez Martinez	M	74	OA	THA	0	Left	Posterolateral	cementless	Femoro-femoral Dacron bypass	day 3	surgical thrombectomy
2011	Willis-Owen	M	69	OA	THA	0	Left	Posterior	cementless	Common iliac artery stents and a subsequent right femoro-femoral cross over graft	day 2	surgical thrombectomy
2013	Park	M	77	FNF non union	THA	1	Left	Posterolateral	cementless	Left common iliac artery stent and femoro-popliteal bypass	day 0	selective thrombolytic therapy using urokinase
2015	Brookes-Fazakerley	M	74	FNF	THA	0	Left (right ischaemia)	Posterior	cemented	Endovascular aortic aneurysm repair + femoro-femoral crossover graft	day 0	surgical thrombectomy
2015	Worsham	M	58	AVN	repeat revision	2	Left	Modified Hardinge	NS	Aorto-bifemoral bypass graft	day 0	open aortoiliac, femoropopliteal thrombectomy with bovine patch angioplasty
2021	Ishmael	M	85	PJI	revision	3	Right	Posterior	cemented	Aorto-bifemoral bypass	day 2	open balloon thrombectomy

revision THA (2 cases). Left hip was involved in 7 out of 9 cases (78%) and the operation was performed through a posterior or postero-lateral approach in 8 out of 9 patients (89%). In one case with previous endovascular aortic aneurysm repair and femoro-femoral crossover graft, the acute ischaemia happened to the contralateral lower limb (the right one) to the replaced hip (the left one) (9).

Occlusion were diagnosed at the end or in the first hours after the operation in half of the cases and in any case within the first 3 post-operative days.

All the patients required a specific treatment, in particular graft revision with open thrombectomy in most of the cases, with good recovery and long-term outcomes.

Discussion

Iatrogenic vascular injuries, with either hemorrhagic or ischemic complications, during total hip arthroplasty are rare with a reported average frequency between 0,16% and 0,25% (10).

An incidence of 0,04% increasing to 0,19% in revision THA has been reported by Abullarage et al (11), with the acetabular cup revision being considered one of the main risk factor for vascular lesions.

These percentages include a wide spectrum of injuries which may lead to lower limb ischemia, pseudoaneurysm formation, hemorrhage and arterial transection (10, 12).

The mechanism of iatrogenic vascular injuries may results from elongation and torsion during dislocation maneuvers and femoral canal preparation, from persistent pressure of the retractors tip or from direct vessels penetration or cut.

Patients affected by peripheral arteriopathy, already treated with vascular graft or by-pass, may be at higher risk of vascular complications due to the loss of usual anatomical landmarks, to the tissue scarring and to the modifications of the mechanical properties of the grafts compared to the native vessels.

In this series of case reports, graft occlusion seems to happen mainly during THA performed through a posterior or postero-lateral approach (89%). According to literature, the correct placement of the Hohm-

ann retractors is the real concern rather the surgical approach, which is not considered as an independent cause of neurovascular injury during THA (13-15).

Dislocation and reduction maneuvers together with the prolonged position of the lower limb during femoral canal preparation probably not influence healthy and native vessels but may determine flow alterations in atherosclerotic structures or grafts.

Posterior and postero-lateral approach require a flexed, adducted and internally rotated hip position to be maintained during femoral broaching and stem implant (2). This position may determine an abnormal kinking of the graft, thus occluding or simply generating flow turbulence, which may promote the thrombogenesis.

On the other hand, anterior and antero-lateral approaches usually require external rotation, adduction without extreme degree of hip extension or flexion.

The role of surgical approach, although without evidence of association with vascular complications, needs to be taken into consideration trying to avoid, or at least to limit, extreme hip positions.

Although peripheral arterial occlusive disease prevalence does not vary by gender (16) and females seems to be at higher risk of developing hip osteoarthritis (17), all patients included in the present review are males. Hussain et al suggested that men are at increased risk for adverse limb events leading to minor amputation and arterial bypass surgery (18). According to Al Zoubi et al, common artery involvement with hemodynamic relevant atherosclerotic lesions was significantly higher in males than females (19). These results may explain an higher prevalence of lower limb vascular grafting among male patients who undergo a THA.

Cement may be involved in vascular complications, either for the exothermic reaction resulting in vessel thrombosis or for the cement leakage around or into the vascular structures (10, 20). Occlusion of the common femoral artery after a cement leakage under the transverse ligament during pressurization implanting a cemented acetabular cup has been reported (21). Among the involved patients there is not a clear relationship between vascular complication and fixation method as the use of cement has been clearly reported only in a couple of patients.

Vascular injuries may lead to death, amputation and long term disabilities in percentages respectively as high as 4%, 7%, 11% (22), thus early diagnosis with a timely and effective treatment are the key factors to prevent severe consequences.

According to Calligaro et al, iatrogenic vascular injuries, either in total hip or knee replacement, failed to be detected on the day of surgery in up to 44% of cases (12).

This percentage reflects data of the reported cases in which the vascular occlusion was recognized on the operation day, already after drapes removal with a pulseless and cool limb or in the first post-operative hours with a patient complaining of pain and numbness after anesthesia resolution.

Further discussion about the role of leg length discrepancy or the type of previous surgical procedure is not possible as the case reports do not show all the required details or include a wide heterogeneity of vascular procedure.

Conclusion

The present low quality literature review including only case reports does not allow to draw any definitive conclusion about the risk factors of vascular complications occurring after a THA in patients who previously underwent a vascular bypass or grafting.

THA is a safe procedure in terms of vascular complications but previous arterial grafting of the lower limbs should raise particular attention in the choice of the surgical approach, during the femoral canal preparation and during the post-operative phases to monitor early signs of vascular ischemia.

Further data are needed to confirm if the flexed and internally rotated hip position during femoral broaching in the posterior approaches may have a role in increasing the risk of graft occlusion.

Conflict of interest: Each author declares that he or she has no commercial associations (e.g., consultancies, stock ownership, equity interest, patent/licensing arrangement etc.) that might pose a conflict of interest in connection with the submitted article.

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