

Impact of a fast track protocol on the development of heterotopic ossification following hip arthroplasty

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SUMMARY

Objective. Hip arthroplasty (HA) is a successful surgical procedure, but periarticular heterotopic ossification (HO) represents an uncommon cause of dissatisfaction. Although some risk factors for the development of HO have been identified, little is known about the influence of a fast track programme on the incidence of HO after HA.

Methods. we enrolled 135 patients who underwent hip arthroplasty by a direct lateral approach; patients were divided into two groups with regards to the introduction of a fast track protocol. The aim of our study was to compare the incidence of postoperative HO before (B-FT group) and after the enforcement of a fast track programme (A-FT) at our hospital.

Results. A total of 135 hip arthroplasty patients were met eligibility criteria of the present study. The overall incidence of HO was 45%. We found a lower incidence of HO in the A-FT group compared to the B-FT group (33 vs 59%). Furthermore, considering only Brooker grades III and IV, we found an incidence of 19% in the B-FT group and 9% in the A-FT group. **Conclusions.** Our study supports the hypothesis that the enrolment of a fast track protocol in the routine setting of hip arthroplasty could lead to other advantages in addition to an enhanced recovery: a lower incidence of HO could be among them.

Key words: fast track, hip arthroplasty, heterotopic ossification

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Conflict of interest

The Authors declare no conflict of interest

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Introduction

Hip arthroplasty (HA) is a successful surgical procedure for the treatment of degenerative pathologies of the coxofemoral joint; good to optimal clinical results in terms of pain relief and restoration of the joint function have led HA to be defined as “the Intervention of the century” by The Lancet ¹.

Despite optimal clinical results, there is still a small percentage of patients who are unsatisfied with their postoperative result: among possible causes of dissatisfaction, heterotopic ossification (HO) represents an uncommon reason of discontent ². Although HO is a well known nosological entity that occurs in 15 to 90% ^{2,3} of hip arthroplasties, the full comprehension of its aetiopathogenesis remains unclear³. HO usually develops at 4-5 weeks after positioning of the implant ².

Different studies established high risk factors for the development of post operative HO among which male gender, hip ankylosis and previous HO ⁴. Other risk factors associated with the development of HO are surgical approach, age of the patient, type of the implant used, obesity, blood loss and duration of the procedure ³⁻⁵.

Different prophylactic treatment for HO have been validated^{2,3,6}.

Postoperative radiotherapy represents the most effective prophylaxis treatment for heterotopic ossification; although its safety has been demonstrated, some concern is raised in relation to the cost-effectiveness ratio and its availability².

Nonsteroidal anti-inflammatory drugs (NSAIDs) are the most commonly used treatment to prevent postoperative HO; indomethacin often represents the benchmark used for the validation of other pharmacological treatments^{2,3}. Other validated nonselective NSAID are ibuprofen, ketorolac and diclofenac.

Unlike nonselective NSAIDs, selective non-steroidal drugs are attractive pharmacological option due to their lower gastrointestinal side effects and lack of interaction with platelet aggregation²; celecoxib, etoricoxib and rofecoxib have been demonstrated to be good medications in preventing HO with the former more effective than ibuprofen².

Although many prophylactic protocols have been validated for prevention of HO, their application in clinical practice is still sporadic mainly due to side effects of medications. Nowadays, the prescription of prophylaxis is recommended only for patients at high risk of developing HO⁷.

Ossifications within periarticular soft tissues are rarely symptomatic⁸ and usually represent an occasional radiographic finding during postoperative follow-up; nevertheless, high grades of HO can lead to painful symptomatology, reduction of the range of motion and swelling^{4,6}.

While different classifications have been proposed, the Brooker classification⁹ is commonly applied both for clinical use and research purposes and is based on an antero-posterior radiography of the pelvis.

The Brooker classification include four degrees of HO (Fig. 1): grade I represents an “island” of bone within soft tissue around the hip, grade II and III the presence of bone spurs on the proximal femur or pelvis with, respectively, > 1 cm or < 1 cm between bone surfaces and grade IV constitutes a “bridging” ossification determining a radiographic ankylosis.

Severe HO (e.g. Brooker III and IV) more commonly determine clinical symptoms related to pain and to reduction of the range of motion; when symptomatic, revision arthroplasty represents the only effective surgical therapy for HO.

To our knowledge, little is known about the influence of a fast track, enhanced recovery programme on the incidence of HO after hip arthroplasty.

The aim of this study is to assess whether introduction of a fast track protocol in the routine setting of hip arthroplasty could lead to a reduction in the incidence of postoperative HO.

Materials and methods

Between January 2016 and December 2019, 250 hip arthroplasty were performed at our Institution. From January 2018, a fast track protocol was introduced in the routine setting of hip arthroplasty.

We retrospectively enrolled 135 patients who underwent hip arthroplasty due to symptomatic osteoarthritis in two groups; a first group of patients, called B-FT (Before-Fast Track) treated between January 2016 and December 2017 and a second group who underwent HA from January 2018 to December 2019, called A-FT (After-Fast Track).

We selected only procedures performed by the senior author (MM) using a direct lateral approach (Hardinge) and using

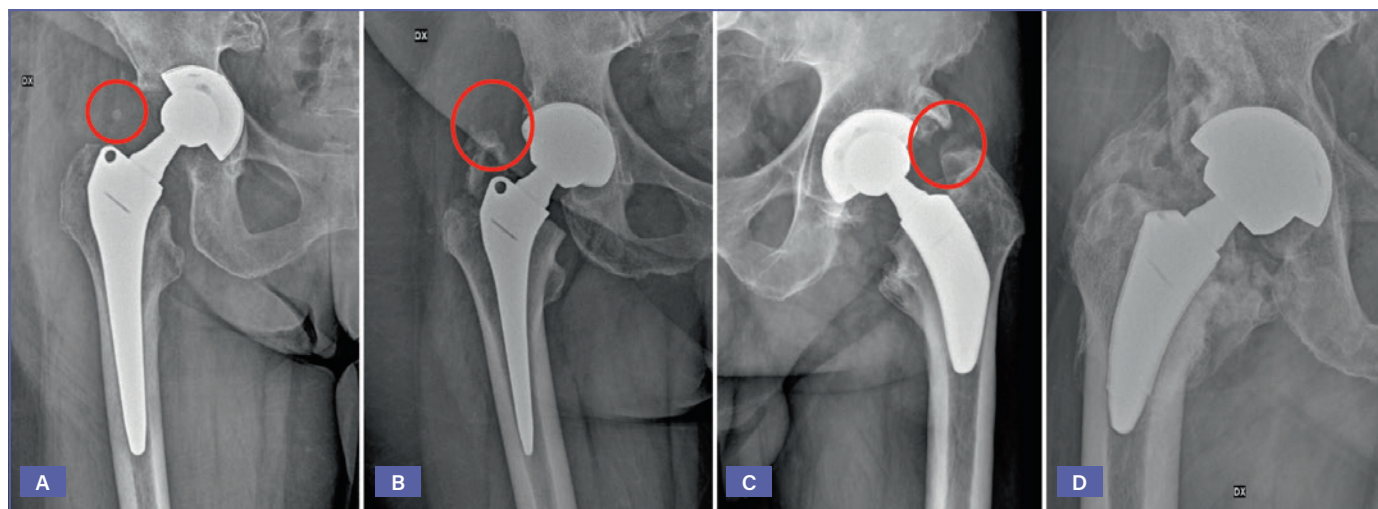


Figure 1. Brooker Classification of heterotopic ossifications (HO). A) Grade I: presence of an “island” of bone within soft tissue around the hip (red circle); B-C) Grade II-III: presence of bone spurs (red circles) on the proximal femur or pelvis with, respectively, > 1 cm (B) < 1 cm; D) between bone surfaces; D) Grade IV: a “bridging” ossification determining a radiographic ankylosis of the hip.

only two uncemented implants (Recta Fix® and Parva®, Adler Ortho™).

In other words, the only difference between the two groups was the introduction of a fast track protocol implemented in routine hip arthroplasty procedures starting from January 2018.

The enhanced recovery protocol (ERAS) that we adopted is a well known agreement used by other hospital of our healthcare company since 2016¹⁰.

Beyond preoperative optimisation of the patient's clinical parameters (e.g. correcting anaemia, hypertension, etc.), the fast track protocol provides the adoption of intraoperative and postoperative strategies to guarantee reduced bleeding, better control of pain and, overall, a better experience for the patient; pre-, intra- and postoperative procedures are refined to enhance early mobilisation of the patient and faster recovery after the procedure^{10,11}.

Our fast track protocol includes, among other features, an extensive use of tranexamic acid (TA) as a fundamental part of bleeding containment strategies and to exclude the positioning of a drainage; TA is an antifibrinolytic drug that inhibits the activation of plasminogen to plasmin thus preventing the degradation of the clot. TA is administered to the patient in a dose equivalent to 1 g i.v. at induction of the anaesthesia, 1 g i.v. during the surgery, 3 g intra-articular after the closure of the muscular fascia and 1 g 3 hours after the surgical procedure¹⁰.

The fast track protocol involves the use of an intraoperative local injection anesthesia (LIA, ropivacaine 0.2%) as a fundamental part of pain management; it also has the further goal of improving, as needed, intra-operative myoresolution.

The postoperative protocol introduces the application of cryo-compression in cycles (each cycle lasting 90 minutes at least 5 cycles at a distance of 8 hours from each other) with an appropriate and specific sleeve for the hip joint; furthermore, the hip of the patient is kept 30° flex for 3 hours after the procedure.

The patient is assisted in verticalisation and walking with a cane or walker on the same day of the operation.

Different from other fast track protocols, we do not use postoperative prophylaxis for HO.

We retrospectively reviewed the AP radiograph of the pelvis of the patients belonging to the two groups of patients made at a mean of 6 months after surgery: X-rays were analyzed by two independent authors (MM and PG) to detect and classify any postoperative HO according to the Brooker classification.

Our hypothesis was that careful hemostasis in association with extensive use of tranexamic acid and cryocompression without the positioning of a drainage could lead to a lower incidence of postoperative HO in hip arthroplasty performed by a direct lateral approach.

Results

A total of 135 total hip arthroplasties met eligibility criteria of the present study: hip arthroplasty performed due to osteo-

Table I. Personal details regarding the patients belonging to the two study groups (B-FT, Before-Fast Track Group; A-FT, After-Fast Track; pts, patients).

DETAILS	B-FT GROUP	A-FT GROUP
Number of female pts.	33	37
Mean age	72.90	74.86
Min age	50	58
Max age	89	88
Number of male pts.	30	35
Mean age	68.26	66.54
Min age	45	50
Max age	82	81
Number of pts.	63	72
Mean age	70.66 ± 8.46	70.81 ± 8.77

arthritis by the same surgeon (MM) using only a direct lateral approach and only two implants. All patients in the study had a minimum clinical and radiographic follow up of 6 months.

In the B-FT group, we recruited 63 patients (mean age 70.66 ± 8.46 years) of which 30 were male (mean age 68.26 years old, min 45, max 82) and 33 female (mean age 72.9 years, min 50, max 89).

In the A-FT group, we enrolled a total of 72 patients (mean age 70.81 ± 8.77 years), with 35 males (mean age 66.54 years, min 50, max 81) and 37 females (mean age 74.86 years, min 58, max 88) (Tab. I).

In the B-FT group at radiographic follow-up performed at a mean of 6 months (min 6, max 12), we detected an overall incidence of HO (Brooker I to IV) of 59% with a moderate prevalence among males (70%) compared to females (48%).

Furthermore, the difference between sex spread out if considered in relation to the grading of HO. Taking into account only the highest Brooker grade, 23% of the male population and 9% of the female resulted were affected by grade III HO; 6% of males and no females had grade IV HO.

In the B-FT group, male patients were affected more often than female patients and by a higher Brooker degree of HO.

The incidence of Brooker I and II in the B-FT group was 39% with only mild differences between gender.

With regards to the results obtained in the study group of patients who underwent hip arthroplasty after the introduction of a fast track protocol (A-FT group), we found a lower incidence of HO compared to the B-FT group, corresponding to 34%; different from the B-FT group, considering each grade of HO, males were less affected by postoperative HO compared to females (25.7 vs 40%). Nevertheless, higher grades of HO (grade III and IV) affected 14% of males population and 5% of females; the overall incidence of Brooker grades III and IV was 9%.

Considering Brooker grades I and II, we found an overall incidence of 23% considering male and female patients in the A-FT group.

While we did not calculate a patient satisfaction score (e.g. the Harris hip score), all patients were satisfied with the postoperative outcome and none required a revision surgery; as expected, 50% of both groups affected by grade III HO and all patient affected by grade IV HO experienced poorer results in term of postoperative range of motion and reduction of preoperative symptoms (pain).

Discussion

Our study confirms the hypothesis that a fast track protocol can lead to a reduction of postoperative HO even if applied with a less invasive hip approach. The available literature reports that the direct lateral approach and male gender are strong risk factors for the development of HO and our study confirms these findings¹³. Enhanced recovery protocols are usually applied in combination with internervous and intermuscular approaches (e.g. direct anterior, MIS) that can potentially lead to lower tissue damage and, possibly, faster recovery. At the present, it is recommend that surgeons choose the approach with which they have the most experience and ease¹²: this was the main reason why we continued the direct lateral approach for HA, although integrated with extensive use of a fast track protocol.

Furthermore, a recent study recommended the direct lateral approach in terms of postoperative pain, function and complications¹⁴.

Although the direct lateral approach is reported to have a higher rate of HO compared to other approaches, in a recent study by Parvizi¹⁵ a strict relation between the lateral approach and HO was not seen; moreover, considering the two groups of the study, we had an overall incidence of HO of 45% which is in line with previous studies^{2,14,15}.

Considering the two groups, we found a lower overall incidence of HO in the A-FT group compared to the B-FT group (34 vs 59%). Furthermore, after the implementation of the fast track protocol, we detected a lower incidence of both low and high grades of HO (respectively, 23 vs 39% for low grade and 9 vs 19% for high grade); these results seem of some interest considering that grade III and IV ossification have a greater possibility to become symptomatic.

A possible explanation in the reduction of HO in patients belonging to the fast track group could be related to the greater attention to preoperative prophylaxis and in intraoperative treatment of bleeding.

Considering that the haematoma is full of growth factors and that the lateral approach is associated with a higher grade of tissue damage, the two combined factors could lead to higher rate of HO. It has been previously published that the use of intra-articular drainage can lead to a higher incidence of formation of ectopic bone⁵.

The extensive use of tranexamic acid in different phases of the surgery avoiding the positioning of a drain combined with postoperative cryotherapy could lead to less damage to soft tissues and better control of the haematoma.

Although the LIA has a major influence on control of postoperative pain, we assume that the infiltration of peri-articular soft tissues could also have a minor protective role on muscular fibres due to induced myoresolution.

Despite several limitations of our study (small number of patients, no statistical strength, retrospective design of the study, lack of randomization), our case study has some strengths.

To our knowledge, this is one of the few studies in the literature to compare the effects of a fast track protocol on the incidence of postoperative HO after hip arthroplasty¹⁶.

We minimised any possible bias since we considered patients treated only by a single surgeon, using the same surgical approach and only two implants.

Moreover, the lack of prescription of a postoperative drug that could prevent the development of HO, although questionable, might represent another confounder that we avoided.

Despite any randomisation, the only variation that we introduced in the two groups of study was the fast track protocol, in particular with regards to the use of tranexamic acid, LIA and postoperative cryotherapy.

Conclusions

Our study supports the hypothesis that the adoption of a fast track protocol in the routine setting of hip arthroplasty can lead to advantages other than enhanced recovery, namely faster discharge and a better experience for the patient: a lower incidence of HO, despite the usage of a direct lateral approach, could be among these. The present study can be further implemented with the injection of a local intra-articular NSAID (e.g. ibuprofen) mixed with LIA or by prescription of postoperative prophylaxis (e.g. indomethacin, celecoxib) for HO; positive results augment the satisfaction both for the patient and surgeon.

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