Care principles at four fast-track arthroplasty departments in Denmark

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ABSTRACT

INTRODUCTION: The goal of this study was to describe the logistic and clinical set-up at four Danish arthroplasty departments offering fast-track surgery.

MATERIAL AND METHODS: Based on the National Patient Registry's information on patients who have undergone total hip and knee arthroplasty, four departments were chosen for evaluation in accordance with the following inclusion criteria: documented fast-track surgery with written care plans, a surgical volume of > 450 arthroplasties and short length of stay (LOS) (< 5 days).

RESULTS: The mean LOS ranged from 2.8 to 3.9 days. Logistic features included homogeneous entities, regular staff, high level of continuity, preoperative information including intended LOS, admission on the day of surgery and functional discharge criteria. The clinical features were both intraoperative (spinal anaesthesia, local infiltration analgesia, plans for fluid therapy, small standard incisions, no drains, compression bandages and cooling) and postoperative (deep venous thrombosis prophylaxis starting 6-8 hours postoperatively, multimodal opioid-sparing analgesia, early mobilisation and discharge when functional criteria were met) facilitating early rehabilitation and discharge.

CONCLUSION: The logistic set-up at the four departments was almost identical. The basic care prerequisites to pooling the patients from these four departments were in place. Future studies will include outcomes as well as safety aspects of this set-up.

Fast-track surgery is defined as the synergistic, beneficent effect on convalescence achieved by adding multimodal evidence-based care principles and combining these with optimised logistics [1]. Fast-track surgery has yielded quicker functional recovery, reduced morbidity, decreased length of convalescence, increased satisfaction and – as a secondary gain – reduced hospital costs. These results have also been achieved in total hip arthroplasty (THA) and total knee arthroplasty (TKA) [2, 3].

In THA and TKA, several studies have focused on patient characteristics associated with a reduction of the length of stay (LOS) and on specific elements of the track [2, 4]. However, single modality treatment has limited effect on outcome parameters compared with multimodal treatment – and only a few studies have presented the care plan in sufficient detail to reveal the combined efforts leading to an optimised outcome – most easily measured as a reduction in LOS [2, 5, 6]. However, even LOS reduction can be difficult to interpret as some departments transfer patients to rehabilitation facilities outside the hospital – thus simply shifting costs or even increasing the combined time spent on rehabilitation outside the home.

The Lundbeck Foundation in Denmark has donated about € 4.5 million to further improve fast-track surgery in THA and TKA during a five-year period (starting mid 2009). A multitude of studies have been planned, e.g. on the optimisation of pain treatment, rehabilitation, blood transfusion strategies, the need for deep venous thrombosis (DVT) prophylaxis, postoperative cognitive dysfunction and safety aspects (minimisation of complications).

This descriptive study highlights the characteristics of the initial four departments involved, presenting detailed baseline information on how the departments are organised and which care plans are in use.

MATERIAL AND METHODS

Eligible departments for this study were departments performing fast-track arthroplasties which had: an intended and actual LOS below five days, a volume of more than 450 arthroplasties including revisions (3% of the annual total number of arthroplasties in Denmark), and written care plans. Four departments were chosen based on an earlier nationwide study [6]. Together the included departments perform more than 3,700 THAs and TKAs per year – approximately one quarter of Denmark's production. The exact logistic and clinical set-up of the departments was not known in advance of this retrospective study with the prospective aim of performing a series of studies.

The mean LOS for 2008 was calculated; this figure included all primary unilateral THAs and TKAs for each department; and the results were stratified by type of operation. The existence of written care plans was checked and these were presented.

RESULTS

The characteristics of the four departments divided into

ORIGINAL ARTICLE

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logistic and clinical features and summarised in **Table 1** and **Table 2**. **Table 3** describes the overall structure of a fast-track department.

Logistics

The number of beds occupied on a weekly basis for each department varied between 20 and 23, and 7-8 operating theatres were used to fill these beds with 21-28 patients. The numbers of arthroplasties performed in 2008 were somewhat smaller than usual due to a three-month nurse strike. LOS for 2008 was 3.1-3.8 days for TKAs and 2.8-3.9 days for THAs, counting numbers of postoperative overnight stays till discharge as whole days. All departments admitted patients on the day of

TABLE 1

Logistic set-up at the four departments.

	Hvidovre	Hørsholm	Holstebro	Aarhus
Ward: beds, n	21	21	23	20
Operations, 2008, n	228 TKA, 193 THA	263 TKA, 465 THA	201 TKA, 225 THA	246 TKA, 355 THA
Operating theatres, n	7	8	8	8
Production, weekly, n	21	28	24	25
Postoperative LOS, 2008, days, TKA/THA	3.2/3.9	3.6/3.4	3.1/2.8	3.8/3.8
Written information	+	+	+	+
Information on LOS	3 days	4 days	3-4 days TKA, 2-3 days THA	4 days
Patient clinic preoperatively	+	+	+	+
Day of admission	OP	OP	OP	OP (THA –1)
Discharge criteria	Self-dependent, in/out of bed, into/up from chair, independent 70 m walk with crutches	Self-dependent, in/out of bed, into/up from chair, independent walk with aid	Self-dependent, in/out of bed, into/up from chair, independent walk with aid, sufficient pain treatment, know/ observe restrictions, wound inspected for drainage/infection	Self-dependent (bath/ toilet), in/out of bed, independent walk with crutches

+ = yes; - = no; LOS = length of stay; OP = day of surgery; THA = total hip arthroplasty; THA-1 = THA patients admitted the day before surgery; TKA = total knee arthroplasty.

TABLE 2

Clinical set-up at the four departments.

	Hvidovre	Hørsholm	Holstebro	Aarhus
Anaesthesia	Spinal	Spinal	Spinal	Spinal
Surgery	Standard incision	Standard incision	Standard incision	Standard incision
LIA (TKA/THA)	+/+	+/+	+/+	+/+
Catheter, bolus/continuous	+/bolus 1 day	TKA: +/bolus × 3; THA: +/bolus × 2	+/bolus 1 day	+/bolus x 4/ × 7
Compression bandage/stockings	+/-	+/-	+, TKA: compression stockings, 14 days	+/TKA +
Cooling	+	+	+	+
Fluid plan during surgery	+	+	+	+
Drain	-	-	-	+/+
Mobilisation, start	2-3 hours post-operatively	6 hours post-operatively	2-3 hours post-operatively	3-4 hours post-operatively
Physiotherapy, start	× 1/day, day 2	× 2/day, day 2	× 1/day, day 2	× 2/day, day 2
DVT prophylaxis, start	Enoxaparin, 6-8 hours postoperatively	Enoxaparin, 6-8 hours postoperatively	Dalteparin, 6-8 hours postoperatively	Fondaparinux, 6-8 hours postoperatively
DVT prophylaxis, duration	Discharge	Discharge	7 days	TKA 5 days, THA 7 days
Pain treatment, preoperatively	PCM R, Celebra, Gabapentin	Own medication	PCM	PCM
Pain treatment, postoperatively	PCM R, celecoxib, Gabapentin tabl. oxycodon 5 mg PN	PCM 1 g x 4 Oxycodon 5-10 mg PN Ibuprofen/etodolac (TK) PN	Ibuprofen 400 mg × 3/ etodolac 200 mg × 2 Oxycodon 5-10 mg PN	PCM 1 g × 4 oxycodon 5-10 mg PN
Prophylaxis/ treatment of PONV	-/+	-/+	-/+	-/+

+ = yes; - = no; LIA = local infiltration analgesia; PCM R = paracetamol retard; PN = pro necessitae, as needed; PONV= postoperative nausea and vomiting; THA = total hip arthroplasty; TKA = total knee arthroplasty.

surgery except for Aarhus where patients scheduled for THA were admitted the day before.

The departments were homogenous entities with shielded arthroplasty wards with regular staff and a high level of continuity (the operating surgeon performed daily rounds). Patients were not selected as all patients entered the accelerated track.

All departments had written information in the form of booklets including information on intended LOS. All departments had preoperative patient clinics with multidisciplinary patient information/education, and all departments discharged patients directly to their homes after fulfilment of strict functional and almost identical discharge criteria.

After discharge, patients were seen at different time intervals and by multidisciplinary staff in three of the four departments.

Clinical features

All four departments used spinal analgesia only – with 2 ml hyperbaric bupivacaine 0.5%. All departments used specific fluid plans during surgery: infusion of isotonic saline 5 ml/kg/hour and plasma expander (Voluven) 7.5 ml/kg/hour. Blood loss > 800 ml was substituted by 1 ml blood transfusion and 1 ml Voluven for each 2 ml blood loss. Hypotension not reacting to injection of ephedrine was treated by infusion of 500 ml Voluven. In the recovery ward, fluids were allowed freely per os. Pain breakthrough was handled with repeated injections of sufentanil five microgram administered intravenously.

All surgery was performed using small standard incisions (no minimally invasive surgery (MIS) and only standard instrumentation): the medial parapatellar approach for TKA and the posterior approach for THA. TKA was done in a bloodless field using a femoral tourniquet (inflated to 100 mmHg above the systolic blood pressure) from the time of incision until the prosthesis was inserted. Drains were not used – except in Aarhus, where drains were removed the day after the operation. Fifteen minutes prior to incision, 500 mg of intravenous tranexamic acid was administered and another 500 mg was administered just before tourniquet release for TKA.

TABLE 3

Structure of a fast track department.

Optimisation of logistics
Written care plan
Information on intended length of stay
Multidisciplinary preoperative patient clinic
Spinal anaesthesia
Multimodal pain treatment
Early mobilisation
Well-defined functional discharge criteria

A patient who has undergone fast-track knee arthroplasty 24 hours earlier. The patient is now ready for discharge following completion of the discharge criteria.

For THA, 1 gram of tranexamic acid was administered 15 minutes prior to incision.

Intraoperatively, all patients received local infiltration analgesia with 120-150 ml ropivacaine 0.2% with epinephrine (10 microgram/ml) and 50 ml ropivacaine 0.2% (without epinephrine), resulting in a total volume of 170-200 ml. The departments at Hørsholm and Aarhus used ketorolac in the mixture. The aim was to infiltrate all tissues incised or otherwise instrumented [7]. A 16G epidural catheter was inserted. A compression bandage was then applied firmly around the operated knee from the toes to the mid-thigh. The bandage consisted of an inner double layer of soft padding surrounded by an overlapping layer of an elastic adhesive bandage. The catheters were injected with boluses with 20 ml ropivacaine 0.5% at various intervals which were different from department to department. The catheters were removed after 24 hours. All departments used cooling from operation to discharge in the form of ice-packs or ice water, one department used compression stockings for two weeks after TKA.

Mobilisation was initiated within six hours postoperatively, in most cases 2-4 hours after the operation as soon as the spinal anaesthesia had worn off. The nursing staff performed the initial mobilisation, and regular physiotherapy was started the day after surgery and consisted of individual exercise once or twice daily.

DVT prophylaxis was started 6-8 hours postopera-

ABBREVIATIONS

COX-2 = cyclooxygenase-2
DVT = deep venous thrombosis
LIA = local infiltration analgesia
LOS = length of stay
MIS = minimally invasive surgery
NSAIDs = non-steroidal anti-inflammatory drugs
PONV = postoperative nausea and vomiting
THA = total hip arthroplasty
TKA = total knee arthroplasty

tively and continued until discharge or in two departments for up to seven days, in which case the patient performed the injections after discharge.

Preoperatively, the patients were started on paracetamol and at one department also on gabapentin and a cyclooxygenase-2 (COX-2) inhibitor on the morning of the surgery – otherwise no pre-medication was used. Patients continued this treatment for one week and all departments added a short-acting opioid (oxycodon) for breakthrough pain. Non-steroidal anti-inflammatory drugs (NSAIDs) were used routinely at all but one department and at the department using a COX-2 inhibitor.

At all departments, postoperative nausea and vomiting (PONV) was treated only when needed without standard prophylaxis.

DISCUSSION

This study found an almost similar logistic set-up at all four departments. Specialised units for THA and TKA patients had been established, allowing patients to be among equals and to share their experiences, and the staff specialises in treatment, nursing and training of these patients – without needing to focus on other patient groups with different needs.

The operating surgeon performed the daily rounds. Apart from giving the highest continuity possible and resulting in an increased patient satisfaction, this also allows the surgeon to continuously monitor the patient's progress [8].

Patients were unselected as there was no reason to exclude any patient from evidence-based accelerated tracks – the patient receives the best available combination of anaesthesia, pain treatment, mobilisation, etc. Comorbidities are no obstacle – on the contrary: these patients benefit from the evidence-based approach offering targeted treatment [9].

The existence of a written care plan addressing the various aspects of the fast track is mandatory and should include information on the intended short LOS in order to motivate the patient to become an active participant. An updated care plan ensures that the staff follows the individual patient's progression according to the planned track, that documentation is at hand and that the staff is ready to act by directing attention and resources to those patients whose progression diverge from the desired course.

All departments had preoperative patient clinics with multidisciplinary patient information/education, which is an excellent way to inform groups of patients. However, such information has not been shown to benefit LOS or improve satisfaction [10].

All departments discharged patients directly to their homes after fulfilment of strict functional discharge criteria. In Denmark, no in-home rehabilitation facilities exist and to the best of our knowledge, there is no evidence that extended in-house physical training is of any benefit [11] – apart from its possible cost-shifting effects. Fast-track treatment has been shown to reduce total costs from operation up to one year postoperatively [3, 12]. Also, there is no documented need for patients to fulfil any additional criteria regarding range of motion before discharge.

After discharge, patients were seen at different time intervals and by multidisciplinary staff in three of the four departments. No evidence exists on *when* or by *whom* patients should be seen after discharge – as long as a qualified staff member ensures progress and lack of complications.

Regional analgesia is superior to general anaesthesia as it reduces postoperative complications by 30-60% [13]. Spinal analgesia gives the surgeon sufficient time to do the surgery and does not entail the motor blocking risk associated with epidural analgesia. Also, a fluid plan during surgery ensured that the patient was not hypovolaemic at the first mobilisation a few hours postoperatively – hypovolaemia could potentially cause dizziness, PONV and delayed mobilisation.

All patients received surgery performed with standard incisions – no MIS was used. MIS has not convincingly been shown to have an effect on LOS, but has been associated with poor implant positioning. However, reducing the tourniquet pressure and the time of inflation of the tourniquet reduces the local pressure on the thigh and may reduce postoperative ischaemia and pain in this area.

Drains were not used – except for one day in Aarhus – as randomized data have shown no clear beneficial effect of the use of drains [14].

Tranexamic acid was used by all departments as it is effective in reducing the blood loss and the need for transfusion in both THA and TKA [15]. Using this drug routinely may reduce the need for blood transfusion thereby leading to a reduction in LOS as blood transfusion is associated with longer hospital stays [2].

The use of local infiltration analgesia was implemented for immediate postoperative pain control and has been found to reduce pain in several studies, as has

the appliance of a compression bandage [16]. Also cooling has been shown to reduce tissue swelling and pain postoperatively.

Mobilisation on the day of surgery is associated with short LOS [2] and may reduce the incidence of DVT. Whereas it has been shown that the vast majority of patients can be mobilized on the day of surgery [17], there is no evidence of a beneficial effect of standard physiotherapy on the medium-term or long-term outcome after arthroplasty surgery. However, specialized regimens may have an effect, e.g. on the strength of the quadriceps.

The use of compression stockings was only routinely performed at one of the four departments, but has not been shown to reduce the incidence of DVT after THA or TKA when used in addition to low molecular weight heparin [18].

DVT prophylaxis was initialised 6-8 hours postoperatively, which has been shown to be an appropriate timing [18]. The ideal duration of treatment and which drug to use is still being much debated [18].

Preemptive analgesia was not used, as it remains controversial whether it has any effect. The four departments initiated oral pain treatment during the morning of surgery simply because they wanted to have an effective treatment in place when the spinal anaesthesia wore off. The choice of drugs differed between the departments, but the same principle was applied. NSAIDs were used routinely at two departments as it reduces the need for opioids by 30-50%. The potential of NSAIDs to disturb bony remodelling and prosthetic ingrowth has caused some concern, but the concern is clinically poorly substantiated. Furthermore, COX-2 inhibitors have been found not to interfere with prosthetic ingrowth [19]. Multimodal pain treatment is essential for an enhanced recovery and should be used whenever possible [20].

Minor differences were seen between the departments with regard to clinical features. Variation was observed in the use of drains at one department, ketorolac in the local infiltration analgesia (LIA) mixture at two departments, and the use of a variable number of boluses in the catheter with the LIA technique across departments. The department using the most boluses did not use NSAIDs for postoperative pain treatment – future studies will reveal if any of these differences are of significance to patients' satisfaction with pain treatment or with the entire stay – as LOS seemed to be unaffected.

In conclusion, the logistic set-up at the four departments with documented fast-track was almost identical and only minor differences were found in LOS. Thus, the basic prerequisites are in place to undertake multicentre studies and to pool the patients from these four departments. Future studies will include safety aspects, outcomes and patient satisfaction.

Finally, the set-up and clinical regimens described here are evidence-based and may hopefully serve as inspiration to other departments.

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