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Abstract

A continual increase in the prevalence of osteoarthritis drives growing demand for total joint arthroplasty. So far, a decrease in length of stay has been the target for health professionals globally. However, a consensus pathway of achieving this has not yet been reached. This article reviews recent advances in preoperative and perioperative factors impacting length of stay.

Keywords

Length of stay
Arthroplasty
Perioperative care
Recovery of function

Main text

Introduction

Total joint arthroplasty (TJA) is increasingly being performed in the context of an ageing population with an ever-increasing prevalence of osteoarthritis (1). With this increased demand for procedures, interest has surged to reduce length of stay (LOS) for total knee arthroplasty (TKA) and total hip arthroplasty (THA) – culminating in outpatient-based surgery (2). In Australia, LOS for TKA and THA has decreased from 5.7 and 5.4 days, respectively, in 2013 – 2014 (3) to 4.8 and 4.6 days, respectively, in 2017 – 2018 (1).

The concept of enhanced recovery after surgery (ERAS) was conceived by Kehlet et al in the 1990s for colorectal surgery (4). Since then, ERAS has evolved to incorporate a number of principles that serve to facilitate recovery, but consensus has not been reached for orthopaedic surgery despite being a high volume and pathway driven specialty (5, 6). Nonetheless, shortening of LOS for arthroplasty has been heralded by changes in preoperative and perioperative care (7). At its core, patient recovery can be safely hastened by identifying and assessing risk factors for extended LOS and utilising operative, anaesthetic and analgesic techniques that promote patient mobilisation as a prelude to early discharge.

This narrative review aims to present preoperative and perioperative factors that affect LOS in TJA, highlighting recent advances that can shorten LOS. These findings may have relevance to other high-volume surgeries in middle-aged and elderly patients.

Preoperative factors

Patient characteristics

Preoperative patient characteristics that impact LOS can be categorised as non-modifiable factors that identify patients at risk of longer LOS; and modifiable factors that can shorten LOS.

A recent meta-analysis identified a number of non-modifiable characteristics including age and female gender that are associated with longer LOS for TKA (8). However, with improvements in perioperative care (9), focus has shifted onto patients' fitness for surgery, through measures such as frailty, rather than age. To date, studies have consistently shown frailty increases the risk of longer LOS for TJA (10), irrespective of the measure used to identify frailty. Hence, to improve the generalisability of the impact of frailty on TJA, investigation into a universal measure of frailty is warranted.

Modifiable characteristics affecting LOS include body mass index (BMI) and preoperative mobility. LOS is affected by BMI $\geq$ 30 (8) in a linear dose-response relationship (11), with preoperative weight loss reducing the risk of prolonged LOS (12). Albeit, rapid weight loss in the form of bariatric surgery has not been found to offer greater reductions in LOS in a recent systematic review (13), despite improving symptoms of knee osteoarthritis enough to delay

TKA (14). Given strong associations between BMI and LOS and need for arthroplasty, weight loss requires further investigation.

The preoperative timed-up-and-go test (TUG) strongly correlates with postoperative function (15). The TUG was found to identify patients with a short LOS, with every 5-second increase in preoperative TUG doubling risk of LOS > 48 hours (16). Though no firm cut-off exists, the TUG represents an easy, efficient and accurate measure to stratify and identify patients at increased risk of extended LOS.

Other modifiable characteristics include preoperative mental health issues and opioid use. In general, psychiatric disorders are associated with increased risk of LOS > 4 days for TJA (17). Similarly, preoperative opioid use connoted a longer LOS for TJA (18). Hence, both cohorts may benefit from individualised perioperative care pathways.

Risk assessment tools

The American Society of Anesthesiology (ASA) score, a marker for surgical fitness, is a subjective assessment of a patient's fitness for surgery (19). Amongst large retrospective database studies, ASA ≥ 3 has consistently been a strong risk factor and independent predictor for extended LOS in TJA (20, 21). The Charleston Comorbidity Index (CCI) is an illness rating system predicting mortality (22). Being another indicator of general health, retrospective analyses have found higher CCI to be associated with longer LOS (23). And in an ageing population, preoperative function, rather than illness rating systems, appears to be associated with LOS (24). Thus, illness rating systems may provide only a rough estimate of recovery.

A number of tools have been produced that are specific to orthopaedic surgery; these include the Risk assessment and Prediction Tool (RAPT) (25) and the Baylock Risk Assessment Screening Score (BRASS) (26) – both determining discharge destination. The RAPT has shown mixed predictive capabilities for LOS in TKA amongst prospective studies (27, 28) and there is a paucity of data for THA. Comparatively, BRASS was shown to predict LOS in TJA (29). A more specific tool for early discharge is the outpatient arthroplasty risk assessment (OARA) (30). Within a highly structured early discharge program, the OARA score was associated with a greater predictive power than either ASA or Romano-CCI for same-day and next-day discharge (30). However, further studies comparing orthopaedic specific tools mentioned previously are required.

Preoperative education

Preoperative education is built on the principle of improving patient's health knowledge, behaviours and outcomes (31).

Two Cochrane systematic reviews on the topic of preoperative education found mixed results. McDonald et al found no effect of preoperative education on LOS (32). A follow-up review, with a high degree of heterogeneity, found preoperative education significantly

reduced LOS in those undergoing TKA and reduced LOS, though insignificantly, in THA (33).

Institution of formalised preoperative arthroplasty education program(s) have reduced LOS. A number of different types of preoperative education have been found to be effective including a multidisciplinary program involving physiotherapists, a care-coordinator and orthopaedic surgeon (34); a preoperative educator (35); and a home-based rehabilitation program (36). Therefore, institution of formalised preoperative education programs is appropriate to implement prior to surgery.

Implicit in these educational programs is a clear explanation of LOS. Interestingly, patients have placed least value on LOS in preoperative decision making for osteoarthritis (37); as such, LOS maybe only broached on the surgeon's discretion. Patients should be actively engaged in discussion surrounding planned LOS as it offers a reduction in LOS (38), and higher degrees of planning can shorten LOS (39).

Provider characteristics

The type of service provider also effects LOS for TJA. Shorter LOS has been observed in private hospitals and specialist orthopaedic centres compared to public hospitals (40); and in centres with higher case volumes (41). Hospital teaching status has had conflicting effects on LOS (42, 43), and requires further investigation. In addition, studies analysing differences between provider pathways for arthroplasty are needed to understand differences in LOS.

The effect of the surgeon on LOS has also found analogous results; wherein, higher case volumes shorten LOS (41) – with one study suggesting a threshold of <15 THA/year causing a slight increase in LOS (44). THA performed by trainee-surgeons has not been found to effect LOS in a recent meta-analysis (45); and similarly for TKA (46) – however, without the support of a meta-analysis..

Perioperative factors

Anaesthesia

General anaesthesia (GA) techniques have traditionally connoted a longer LOS and higher complication rate compared with neuraxial anaesthesia (NA), which is seen most prominently in those with greater preoperative morbidity (47). Whereas, amongst young patients with few comorbidities, no difference between GA and NA has been observed (48). Hence, patient characteristics appear equally as important as anaesthetic type.

A systematic review found NA to significantly shorten LOS (49). The wide time frame (1995 – 2015) of included studies limits the accountability of changes and advances in anaesthetic techniques to perioperative protocols in TJA. Given the small but significant difference in LOS between GA and NA techniques, it is likely that changes seen in GA techniques are making this method more amenable to TJA procedures with shorter LOS.

Enhanced recovery protocols for TJA have favoured the use of NA where possible. An observational study, where the standard of care included spinal anaesthesia (SA), showed the implementation of a fast track program reduced LOS (50). Taking this study in context of others implementing fast-track programs, it appears that NA may have played a small role in reducing LOS.

The advent of modern GA techniques has already indicated that the narrative on the use of GA in TJA and fast-track surgeries may be changing. More recently, two randomised controlled trials (RCTs) found no difference in LOS for THA and TKA between SA and GA techniques within a fast-track stream (51, 52).

Surgical technique

A myriad of techniques exists for THA. Reduction in LOS has been observed with the anterior compared to posterior approach (53). In more recent times, focus has shifted toward more minimally invasive techniques – including the direct anterior approach (DAA), which has been associated with a shorter LOS (54). However, no difference in LOS was observed between the DAA and direct lateral with level I evidence (55) or mini-posterior in a retrospective study (56). Thus, the approach utilised in THA may appear to play a smaller role in determining LOS compared to other perioperative management strategies.

The medial parapatellar approach (MPA) is the most common approach for TKA. However, it's disruption of the quadriceps extensor mechanism has garnered interest in approaches that minimise quadriceps invasion (57). Albeit, meta-analyses have found no difference in LOS between MPA and midvatus or subvastus approaches (58). Hence, the approach to TKA does not appear to contribute to LOS, but rather to knee function.

Recently, computer-assisted (CAS) and robot-assisted (RAS) surgery has increased accuracy and precision to improve patient outcomes (59, 60). The effect of CAS on reducing LOS compared to conventional TKA has been mixed with a high degree of variability between studies (61). Comparatively, RAS-TKA has shown to be more promising with a reduction in LOS compared to conventional surgery (62). Being a newer technology, RCTs and prospective studies have primarily focused on safety. However, more research is required comparing short-term outcomes of RAS with conventional surgery.

Blood management

As a major procedure, TJA is often associated with significant blood loss and high blood transfusion rates (63). Both anaemia and blood transfusions are associated with prolonging LOS (64). Consequently, preoperative and intra-operative strategies which minimise the chance of postoperative anaemia should be adopted.

Oral or IV iron supplementation is a known method to improve preoperative anaemia, and has been found to reduce LOS (65). However, iron supplementation should be implemented

preoperatively with enough time to correct anaemia (66). Therefore, screening and correction of anaemia should both be conducted preoperatively.

The use of IV or topical tranexamic acid (TXA) remains a valid strategy to minimise bleeding. TXA has been shown to decrease LOS in TJA (7) regardless of tourniquet use (67). No difference in LOS has been found when comparing IV, topical or their combination in meta-analyses (68). Given tourniquets have little impact on LOS amongst level I evidence (69), TXA should be utilised in TJA, with its route determined by experience, safety and cost.

Analgesia

Several opioid-sparing agents can ensure adequate pain relief. Perhaps the simplest is paracetamol, others include non-steroidal anti-inflammatory drugs (NSAIDs), and gabapentanoids. IV paracetamol has shown a small, but significant, reduction in LOS compared to oral paracetamol (70), driven by decreased opioid consumption (71).

Many advances have been made to facilitate intraoperative methods of providing analgesia. These techniques include peripheral nerve blocks (PNBs) and local infiltration of analgesics (LIA). For TKA, adductor canal blocks (ACB) and femoral nerve blocks (FNB) have both improved postoperative pain. The primary issues involved with FNB include prolonged quadriceps dysfunction and sensory nerve dysfunction leading to adverse postoperative events (72). Comparatively, RCT evidence indicates ACB allows patients to maintain a greater degree of quadriceps muscle function (73) - connoting a shorter LOS (74).

Options for PNB in THA include the psoas compartment block, FNB and the fascia iliaca block. Compared to TKA, LOS with PNBs during THA is reported less often. A Cochrane review conducted in 2017 found PNBs reduced LOS (75). However, the included studies did not compare different PNB techniques – and this remains an area requiring investigation.

Local infiltration of analgesia (LIA) techniques are another tool in a multimodal methodology offering pain-relief to further accelerate recovery. Level I evidence shows LIA significantly reduce LOS and improve pain management (76). Despite evidence suggesting sciatic nerve block in addition to FNB decreases nociception around the entire knee joint (77), LIA techniques have avoided injection in the posterior joint capsule due to risk of popliteal nerve injury. More recently, this combination was examined again with infiltration between the popliteal artery and the capsule of the knee (iPACK) block; and shown to facilitate a faster discharge in combination with ACB (78). This finding supports the notion that analgesic coverage should encompass the entire knee to connote a faster recovery of function. As such, the use of both LIA and PNB could be hypothesised to improve function and further reduce LOS.

Postoperative mobilisation

The implementation of ERAS pathways focusing on shortening the interval between operating theatre and mobilisation has continually shown reductions in LOS (79). However,

the included studies in this meta-analysis implemented more than one change in protocol. Hence, the effect of early mobilisation on LOS appears to be lost amongst a myriad of changes.

Recent studies trying to isolate the timing of physiotherapy have found no effect on LOS (80). Furthermore, a reduction in LOS is observed when assessing increased duration combined with early timing of physiotherapy (81). Thus, the type and duration of physiotherapy may play a greater role in determining LOS but requires further investigation.

Conclusion

Overall, the management of patients undergoing TJA has changed markedly over time. Although several advances have connoted a shorter LOS including patient selection and management of pain and blood loss, there are vast areas that are uncertain.

Firstly, more research is required that focuses on frailty to assess patient suitability for fast-track programs. Moreover, a further review of current predictive tools for LOS is warranted, or even the development of a new tool rather than adaptions of others. Secondly, the optimal anaesthetic technique for fast-track surgery remains to be found. And finally, postoperative care remains unclear, with questions surrounding early mobilisation remaining unanswered.

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