

Traditions and myths in hip and knee arthroplasty

A narrative review

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Background and purpose — Traditions are passed on from experienced surgeons to younger fellows and become “the right way to do it”. Traditions associated with arthroplasty surgery may, however, not be evidence-based and may be potentially deleterious to both patients and society, increasing morbidity and mortality, slowing early functional recovery, and increasing cost.

Methods — We identified selected traditions and performed a literature search using relevant search criteria (June 2014). We present a narrative review grading the studies according to evidence, and we suggest some lines of future research.

Results — We present traditions and evaluate them against the published evidence. Preoperative removal of hair, urine testing for bacteria, use of plastic adhesive drapes intraoperatively, and pre-warming of the operation room should be abandoned—as should use of a tourniquet, a space suit, a urinary catheter, and closure of the knee in extension. The safety and efficacy of tranexamic acid is supported by meta-analyses. Postoperatively, there is no evidence to support postponement of showering or postponement of changing of dressings to after 48 h. There is no evidence to recommend routine dental antibiotic prophylaxis, continuous passive motion (CPM), the use of compression stockings, cooling for pain control or reduction of swelling, flexion of at least 90 degrees as a discharge criterion following TKA, or having restrictions after THA. We present evidence supporting the use of NSAIDs, early mobilization, allowing early travel, and a low hemoglobin trigger for transfusion.

Interpretation — Revision of traditions and myths surrounding hip and knee arthroplasty towards more contemporary evidence-based principles can be expected to improve early functional recovery, thus reducing morbidity, mortality, and costs.

Traditions are passed on from experienced surgeons to younger colleagues, and therefore become rooted in hospitals as “the way to do it”. This is knowledge obtained in a specific setting by a specific surgeon, representing “in my hands” experience only—the equivalent of an observational study at best with level-4 evidence only (Harbour and Miller 2001; Table). Some of these traditions may go against the existing evidence, and therefore represent myths: “this was the best treatment yesterday and it is still the best treatment today”. Some of these traditions have been investigated in more formal studies, and the aim of this narrative review is to highlight some of these studies in order to critically evaluate the traditions: are they according to existing evidence or are they myths that should be revised? The implications of continuing practicing unproven traditions and myths may cause the patients more pain, infections, blood loss, morbidity and mortality, and may also increase the costs.

Material and methods

We identified selected traditions by evaluating preoperative, intraoperative, and postoperative clinical initiatives possibly followed in the arthroplasty pathway. A literature search was performed using relevant search criteria (June 2014). This study is a narrative review in which the studies presented are graded according to the level of evidence (given in parentheses following each study) (Harbour and Miller 2001; Table), thus allowing the reader to re-evaluate his or her own traditions against the existing evidence and to judge whether or not the evidence presented is sufficient to over-

Revised grading system for recommendations in evidence-based guidelines (Harbour and Miller 2001)

Levels of evidence	
1++	High-quality meta-analyses, systematic reviews of RCTs, or RCTs with a very low risk of bias
1+	Well-conducted meta-analyses, systematic reviews of RCTs, or RCTs with a low risk of bias
1–	Meta-analyses, systematic reviews or RCTs, or RCTs with a high risk of bias
2++	High-quality systematic reviews of case-control or cohort studies or high-quality case-control or cohort studies with a very low risk of confounding, bias, or chance and a high probability that the relationship is causal
2+	Well-conducted case-control or cohort studies with a low risk of confounding, bias, or chance and a moderate probability that the relationship is causal
2–	Case-control or cohort studies with a high risk of confounding, bias, or chance and a significant risk that the relationship is not causal
3	Non-analytical studies, e.g. case reports, case series
4	Expert opinion

throw them as myths. We also put forward suggestions for future research.

Selected perioperative traditions are presented, and these are divided into preoperative, intraoperative, and postoperative traditions.

Preoperative traditions

Removal of hair is often performed with the intention of reducing the risk of infection, to avoid interference with the incision, and to avoid hair getting caught during closing of the wound. However, a Cochrane review of 14 trials concluded that there is no difference between hair removal and no hair removal regarding surgical site infection (SSI). Although the comparison was underpowered, there were no study results in favor of hair removal. It was concluded that if it is necessary to remove hair, clippers are associated with fewer SSIs than razors—as microscopic cuts and abrasions are avoided (Tanner et al. 2011 (1–)). As there was only 1 study on elective orthopedic lower limb surgery, a sufficiently powered RCT comparing removal of hair using a clipper with no removal of hair is warranted.

Urine sampling and testing is a long-standing tradition enabling treatment of asymptomatic bacteriuria. But is it really necessary? In a study on THA and hemiarthroplasty (n = 471), 46 patients had asymptomatic bacteriuria and 13 developed SSI, but all SSIs were with bacteria that were dissimilar to those cultured in the urine and none of the patients presented with SSI after 1 year attributable to asymptomatic bacteriuria whether treated or not (Cordero-Ampuero et al. 2013 (2++)). Another study (n = 510, on THA and TKA) found that 36% of patients had asymptomatic bacteriuria preoperatively; most had a single shot of cefuroxime as prophylaxis intraoperatively. On postoperative day 3, 41% had bacteriuria, but in 51% of cases the bacterial strains were different from the

strains identified from preoperative culture. 5% developed symptomatic urinary tract infection within 3 months, but 66% of these cases of infection were caused by strains dissimilar to the bacteria identified during admission. None of the patients developed an SSI, and it was concluded that testing and treatment of asymptomatic urinary tract colonization before joint replacement is unnecessary (Bouvet et al. 2014 (2++)). Studies using different prophylaxis (i.e. antibiotics with a narrower spectrum) are lacking.

Plastic adhesive drapes are often used with the intention of reducing infection (and sometimes also keeping the dressings in place during surgery). However, a Cochrane review including 7 RCTs found no effect of the drape on SSI as compared to having no drape: on the contrary in fact (RR = 1.2 for SSI). Whether or not iodine was added to the impregnation made no difference (Webster and Alghamdi 2013 (1++)). As only 1 of these studies dealt with orthopedic patients (hip fracture) and as another study found that skin disinfectant influenced the adhesion of the drape, possibly causing lift-off of the drape and therefore facilitating contamination (Grove and Eyberg 2012 (2–)), a sufficiently powered RCT using a standardized contemporary skin preparation in arthroplasty patients is needed. However, the current evidence is clearly against the use of plastic adhesive drapes. The most recent study in cardiac surgery comparing drapes with no drapes was in favor of the latter, with earlier and more contamination occurring after using drapes (Falk-Brynhildsen et al. 2013 (1+)).

Prewarming of the operating theater is sometimes used, and it is thought to benefit the patient because the risk of hypothermia (core temperature < 36°C) may be lower. Hypothermia has been found to be associated with bleeding, infections, and cardiac episodes. But a study comparing prewarming of operation rooms to 24°C and to 17°C in patients undergoing THA or TKA found no difference in mean core temperature at the end of the operation (36.4°C as opposed to 36.2°C), indicating no clinical importance of prewarming the room (Deren et al. 2011 (1+)). Also, the cement may cure earlier as there is an inverse relationship between operation room temperature and the setting time for cement (Langdown et al. 2006 (1+)). More studies examining the possible association between laminar air-flow, forced air warming, operation room temperature, core temperature of the patient, and infection are certainly warranted.

Intraoperative traditions

“Tranexamic acid is associated with an increased risk of venous thromboembolic events” is an unsubstantiated saying that—especially in the USA—has kept surgeons from using this anti-fibrinolytic drug. The reality is that the use of tranexamic acid in TKA and THA is both efficient and safe. A recent meta-analysis (15 RCTs) on the efficacy and safety of tranexamic acid in TKA found less blood loss (–505 mL), less risk of blood transfusion (OR = 0.2), and less blood transfused (–1.4 units)—all favoring the use of tranexamic acid (Yang et

al. 2012 (1++)). The safety issues were addressed in 13 of the studies regarding deep venous thrombosis (DVT), 10 of 361 patients in the tranexamic group as opposed to 13 of 361 in the placebo group developed a DVT (OR = 0.8). For pulmonary embolism (PE) (6 studies), 2 of 174 patients in the tranexamic group as opposed to 4 of 175 in the placebo group developed a PE (OR = 0.7). Also, prothrombin time and activated partial thromboplastin time were not affected by tranexamic acid. In THA, similar favorable results were found in a meta-analysis comprising 19 RCTs (Zhou et al. 2013 (1++)). For the tranexamic group compared to the placebo group, a reduction in blood loss of 305 mL was seen, leading to a reduced need for blood transfusion (OR = 0.3). There was no difference in the venous thromboembolic episodes between groups (DVT: 15 of 539 patients in the tranexamic group as opposed to 19 of 535 in the placebo group; PE: 3 of 539 and 1 of 535, respectively; neither comparison was statistically significant. Also, in a cohort study involving 1,977 consecutive unselected THA and TKA patients where all patients were given tranexamic acid routinely, some of the lowest published incidences of DVT and PE were found (Husted et al. 2010 (2++)). High-volume RCTs with venous thromboembolic events as the primary outcome would add further evidence.

The use of a tourniquet improves the quality of cementation in TKA is a myth that keeps surgeons using a tourniquet despite meta-analyses showing more venous thromboembolic episodes and reduced early recovery if a tourniquet is inflated (Alcelik et al. 2012 (1++), Zhang et al. 2014 (1++)). In the most recent meta-analysis involving 13 RCTs, the intraoperative blood loss was 198 mL less and the OR time was 4.6 minutes shorter with a tourniquet. In disfavor of the tourniquet, flexion before day 10 was 10 degrees less, the number of venous thromboembolic episodes was increased 5 times, and the number of other complications was doubled. The meta-analysis found identical postoperative blood loss, the same total amount of blood loss calculated, and the same number of blood transfusions whether or not a tourniquet was used (Zhang et al. 2014 (1++)). On top of that, the 2 published RSA-based RCTs on cemented knee prosthesis fixation with and without a tourniquet found no difference in fixation whether or not the tourniquet had been inflated (Ledin et al. 2012 (1++), Molt et al. 2014 (1++)). Confirmatory studies with different prostheses are needed.

Space suits/body exhaust suits were developed to reduce contamination from the surgeon. However, a 10-year cohort study from the New Zealand Joint Registry revealed statistically significantly more SSI when a space suit was used in THA and TKA (Hooper et al. 2011 (2++)). One possible explanation may be the positive pressure inside modern space suits, which may result in leakage of contaminated particles from the unsealed area around the surgeon's cuff into the operative field (Young et al. 2014 (2++)). An earlier study analyzing different modalities to prevent infection based on results from the Swedish National Hip Arthroplasty Register found

increased revision rates when a ventilated suit was added to any other modality; the conclusion was that their use can never be justified (Persson et al. 1999 (2++)). No study has shown any clinical benefit of a space suit regarding infection rates, but a study on specific helmets resulting in low particle counts or with sealant tape around cuffs may be interesting (McGovern et al. 2013 (1–)).

A disposable skin knife is an old tradition. This was studied in a cohort study in theaters with laminar air-flow. 15% of the skin knives were contaminated, and 11% and 6% of the deep knives and the control knives, respectively, were also contaminated. However, despite the fact that the corresponding bacteria were found on only one-tenth of the skin knives and deep knives, it was concluded that a separate skin knife should be maintained as good medical practice (Schindler et al. 2006 (2–)). In contrast, a recent study with no laminar air-flow but contemporary antiseptic techniques without the use of plastic adhesive drapes, 12-day cultures from knives from 277 patients showed contamination rates of only 2.8% for skin knives, 1.8% for deep knives, and 1.8% from control knives. The patients were followed for 1 year, after which no SSI was found. It was concluded that a separate skin knife is not needed (Ottesen et al. 2014 (2++)). A large study with a long follow-up time in patients who are operated on under laminar air-flow but without plastic adhesive drapes would be of value.

Pulse lavage using only small amounts of saline to clean the joint from debris before and after cementation is standard treatment in some departments. However, studies have consistently found that following TKA, at least 4 L of saline is needed before the concentration of debris is not reduced by additional lavage (Helmets et al. 1999 (2+), Niki et al. 2007 (2+)). The debris consists of bone particles and PMMA particles, and can cause third-body formation, accelerated wear, osteolysis, and heterotopic ossification. Thus at least 4 L should be used to reduce these complications. Although a retrospective study found a reduced incidence of heterotopic ossification following an increase in pulse lavage from 1 L to 2 L in hip resurfacing (Le Duff et al. 2011 (2–)), no prospective studies have been published on the minimum amount of pulse lavage needed in cemented THA.

Urinary catheters have widespread use on a routine basis, despite the associated risks of detrusor problems and urinary tract infections. A meta-analysis (of 60 studies, 30 of them RCTs) found the risk of urinary retention to be 32% following both general anaesthesia and regional analgesia without any difference between an indwelling catheter and intermittent catheterization regarding urinary tract infection or bacteriuria. However, this means that 68% would not need any catheterization, and the study recommended not using a catheter routinely (Balderi and Carli 2010 (1++)). An RCT (n = 200, THA) found no difference between patients who received an indwelling catheter and those who did not regarding prevalence of urinary retention or urinary tract infection. The conclusion was that using a catheter routinely was not to be rec-

ommended (Miller et al. 2013 (1–)). Also, in a cohort study (n = 6,154, TKA) it was shown that avoiding a urinary catheter was associated with shorter hospital stay, less cost, less complications, and fewer re-admissions before 30 days (Loftus et al. 2014 (2++)). It seems evident that the routine use of catheters should be avoided, but there have been few studies on when to perform intermittent catheterization (i.e. on the amount of urine found by bladder scans to necessitate catheterization).

Drains are intended to reduce the risk of hematomas necessitating operative evacuation. However, drains have never been found to be of any benefit in THA and TKA; quite the opposite. Even so, they are still widely used routinely in many departments. Meta-analyses comparing drains and no drains have consistently found that drains result in increased total blood loss and increased requirement for blood transfusion without any difference in hematoma formation, SSI, or reoperation for any reason (Parker et al. 2004 (1++), Kelly et al. 2014 (1++)). As reinfusion drains have also failed to show any benefit regarding blood loss and blood transfusions, it is a little puzzling why drains are still used. They add a substantial amount of extra cost to an already expensive procedure. At the Hospital for Special Surgery in New York, drains added \$538 of additional cost per THA, and \$455 per TKA, leading to drain-associated costs for the hospital of \$432,972 over a 10-week period (Bjerke-Kroll et al. 2014 (2+)). No more studies on drains are needed and they have no place in arthroplasty treatment.

Closure of TKA in extension is a tradition that is often followed (as opposed to closure of the knee in flexion (around 90 degrees)). The evidence supporting closure in extension is non-existent, while a few studies have found favorable outcomes when closure is performed in flexion: patients closed in flexion had greater flexion range of motion and required less outpatient physiotherapy, and they also had less loss of isokinetic muscle strength (Smith et al. 2010 (1–), Kömürcü et al. 2014 (1–)). Also, care should be taken to close the medial arthrotomy anatomically correctly, as a recent study has found huge implications for patellar tracking, tilting, lift-off, and knee flexion, of shifting the closure proximally or distally (Plate et al. 2014 (2+)). This is facilitated by closure also in flexion if the knee was opened in flexion. Detailed studies on early functional outcome, patellar tracking, and possible differences in blood loss between different positions of closure, and without a tourniquet, are lacking.

Postoperative traditions

“Showering should be postponed” is often the advice given to patients, and there are various local recommendations regarding for how long. A Cochrane review found only 1 study (n = 857) in minor skin incision surgery that compared early showering (after 12 h) with delayed showering (after 48 h), and there was no difference in SSI (Toon et al. 2013a (1–)). Thus, there is no evidence to support waiting with showering, but there has been no sufficiently powered study in arthroplasty

surgery. Different dressings, the use of sutures or clamps, and possible use of glue may preclude any general conclusion.

“Dressings should be left untouched for at least 48 h” is a tradition in many wards—but is it justified? A Cochrane review with 3 trials (n = 280) found no difference in superficial SSI or wound dehiscence between removal of dressings before or after 48 h; none of the patients developed a deep SSI (Toon et al. 2013b (1–)). The data are limited and a large, controlled standardized RCT is warranted.

Avoidance of NSAIDs postoperatively due to the risk of prosthetic loosening is an unsubstantiated fear that prevents patients from receiving evidence-based multimodal analgesia including NSAIDs. Fear of negative interference with bone healing and prosthetic fixation means that some surgeons refrain from prescribing this drug. However, a study using radiostereometric analysis (RSA) on 50 patients who were randomized to either placebo or celecoxib treatment (400 mg) for 3 weeks after TKA found no difference regarding maximum total point motion of the tibial component after 2 years (Meunier et al. 2009 (1++)). Less pain and opioid requirement and better ROM for the first 3 postoperative days and up to 1 year after surgery has been found following 6 weeks of use of a Cox-2 inhibitor (Huang et al. 2008 (1++), Schroer et al. 2011 (1++)). Also, better Knee Society score, Oxford knee score, and Short-Form 12 physical composite score were found in patients who received Cox-2 inhibitor. Studies on dose-duration-outcome following other NSAIDs are warranted.

“Avoid flying early after THA/TKA” is advice that is often given to patients—but is it true? A cohort study (n = 608) of patients receiving chemical prophylaxis who traveled more than 200 miles within 6 weeks of THA or resurfacing (average distance 1,377 miles on average 6.5 days after surgery; 462 traveled by plane, 143 by car, and 3 by train) found no deaths, no symptomatic PE, and only 0.8% symptomatic DVT. The conclusion was that early travel is safe (Ball et al. 2007 (2+)). Another study confirmed this by studying 1,465 consecutive THA and TKA patients (96% of whom received aspirin only as prophylaxis). 15% flew home after mean 2.9 days following surgery and 85% did not fly. There was no difference regarding venous thromboembolic episodes (1.4% as opposed to 1.2%). Allowing air travel early after THA and TKA appears to be safe (Cooper et al. 2014 (2+)). There have been no studies on short prophylaxis (until discharge only).

Antibiotic prophylaxis before dental procedures is still widely practiced and is rooted in—among others—recommendations from the American Academy of Orthopedic Surgeons (AAOS), who could only give a limited recommendation that the practitioner should refrain from the long-standing practice of routinely prescribing prophylactic antibiotics for patients with orthopedic implants who undergo dental procedures (Watters et al. 2013 (1++)). There are various recommendations in different countries, but there is no published evidence that patients who are not immunocompromised would benefit from prophylaxis before any dental procedure (Jørgensen et

al. 2010 (1++), Alao et al. 2014 (1++). Patients with additional risk factors, e.g. immunosuppression, may benefit from prophylactic antibiotics, but the evidence is anecdotal. A large case-control study rather than an RCT may give additional information and strengthen the decision making.

Bed rest on the day of operation or longer is a long-standing tradition, but no studies have shown any benefit of it; on the contrary. Bed rest and immobility are associated with loss of muscle, reduced oxygen saturation, longer hospital stay, and an increase in venous thromboembolic episodes. A cohort study ($n = 195$, TKA, all with tourniquet) found a 30-fold reduction in the risk of DVT in patients who were mobilized within 24 h of surgery (Pearse et al. 2007 (2++)). In another cohort study, mobilization on the first postoperative day was compared to strict bed rest on the first postoperative day, and there was less DVT in the mobilized group (Chandrasekaran et al. 2009 (2+)). These findings are supported by studies on early mobilization a few hours after surgery, where venous thromboembolic episodes were very rare despite short prophylaxis (until discharge only) (Husted et al. 2010 (2++), Jørgensen et al. 2013 (2++)). Studies addressing the association between the timing of early ambulation, the amount of ambulation, and the incidences of venous thromboembolic episodes are very much needed.

Continuous passive motion (CPM) is an old tradition following TKA, and it is still used routinely in some departments. A Cochrane review involving 24 RCTs found an effect on active ROM of 2 degrees when comparing CPM to no CPM, and the conclusion was that CPM does not have any clinically important effects on active knee flexion ROM, pain, function, or quality of life to justify its routine use (Harvey et al. 2014 (1++)). There was very low-quality evidence to indicate that CPM reduces the risk of manipulation (a risk reduction of 4%). However, a recent study on 141 TKA patients with initial active knee flexion of < 75 degrees found no difference from adding the CPM for 2 h/day on any outcome parameter including discharge ROM (Herbold et al. 2014 (1+)). No further studies seem necessary.

Compression stockings are often prescribed in order to reduce the risk of DVT. A Cochrane review concluded that these are efficient in reducing the risk of DVT, either alone or in conjunction with other modalities (Sachdeva et al. 2010 (1++)). However, looking specifically at THA and TKA patients, an RCT ($n = 177$, THA and TKA) found no effect on the rate of DVT (Hui et al. 1996 (1–)). Failure of the stockings to deliver the “ideal” pressure gradient ($\pm 20\%$) of 18, 14, and 8 mmHg from the ankle to the knee was found in 98% of patients in another study, while 54% produced a “reversed gradient”—which was associated with a significantly higher incidence of DVT (Best et al. 2000 (2+)). The ACCP guidelines do not recommend compression stockings routinely if pharmacological DVT prophylaxis is given, as they do not reduce symptomatic DVT or PE (only asymptomatic DVT), but at the price of a 4-fold increase in skin complications (Falck-Ytter et

al. 2012 (1++)). As they are extremely uncomfortable for the patients, difficult to use by the patients themselves, and costly, routine use is not recommended. A study of their possible efficacy in fast-track patients who are mobilized early and receiving pharmacological prophylaxis only for a very short period would be of interest.

Cooling is a cheap, non-invasive and unharmed modality often used for its purported pain- and swelling-reducing ability; however, that has not been found in the literature. A Cochrane review involving 12 studies found a small benefit of cryotherapy on blood loss (mean 225 mL less), reduced pain (-1.3 on a 10-point VAS) at 48 h but not at 24 or 72 h postoperatively, and improved ROM at discharge (11 degrees)—but no effect on transfusions rate, analgesia use, swelling, or length of hospital stay (Adie et al. 2012 (1–)). The evidence was low or very low for all outcomes and the clinical relevance was questioned. Functional outcomes were not evaluated in the studies included, but a review on cooling and functional outcomes included 6 studies that focused on quadriceps strength. That review found focal joint cooling of the knee to have the potential to improve both quadriceps activation and quadriceps torque and force production in patients with arthrogenic muscle inhibition (Ewell et al. 2014 (1–)). However, the studies were heterogeneous, with varying effect sizes. Much needs to be learned about the mechanisms underlying quadriceps inhibition postoperatively. Also, cooling shortly after TKA may be of very limited value. A crossover RCT on cooling of the knee versus the elbow (placebo) for 30 min, 7 and 10 days postoperatively, found no effect of cooling on knee extension strength or pain (Holm et al. 2012 (1+)). Well-designed RCTs on standardized cooling with temperature measurements of the joint versus various outcomes are required to improve the quality of the evidence.

Discharge criteria including at least 90 degrees of flexion following TKA are standard in many hospitals. However, this is a tradition that is not evidence-based. No studies have shown that achieving 90 degrees of flexion at discharge is associated with better outcomes. An RCT found that achieving at least 60 degrees at discharge was not associated with extra use of the health service (Davies et al. 2003 (1–)). A cohort study found that only 2% of patients achieved discharge criteria of flexion of at least 80 degrees and of extension lag of at most 5 degrees, with a hospital stay of 6–8 days, and the conclusion was that the criteria were unrealistic (Naylor et al. 2012a (2+)). In the same cohort, it was found that greater discharge knee flexion was a predictor of greater post-rehabilitation flexion but not of 1-year knee flexion. Better discharge knee extension was, however, a predictor of better 1-year knee extension. Discharge ROM did not predict Oxford score; these findings indicate that the emphasis should be more on achieving full extension at discharge (Naylor et al. 2012b (2+)). Discharge criteria should be functional, reflecting activities of daily living. Studies on fast-track TKA and “safe zones” of ROM at discharge resulting in less manipulations are warranted.

Restrictions following THA for at least 3 months are widely practiced. They are an unsubstantiated tradition, as no studies have been published that have shown any benefit of having any postoperative restrictions on the risk of dislocation. Inherent, patient-associated, or surgery-associated risk factors have been identified; increased head size was found to be protective against dislocation (Wetters et al. 2013 (2+)). Successful no-restriction protocols have been presented in a study cohort (n = 2,386) with anterior or anterolateral approach, large head sizes (28–36 mm), and a dislocation rate of 0.15% (Restrepo et al. 2011 (2+)). A dislocation rate of 0% was presented in a patient cohort (n = 265) where some restrictions were removed (but they were still not allowed to flex more than 90 degrees in the hip and were limited to less than 45 degrees of external and internal rotation—and in avoidance of adduction for the first 6 weeks postoperatively) (Peak et al. 2005 (1+)). However, it was not known in the studies whether or not the patients were compliant regarding the restrictions. We need cohort studies on the posterior approach followed by no restrictions, and also RCTs with and without restrictions.

Hemoglobin trigger of 10 g/dL or a drop in hematocrit of 30% (the so-called 10/30 rule) is an old tradition. A nationwide Danish study on blood transfusion following THA found variations in blood transfusion rates between departments from 7% to 71%, highlighting the need for guidelines based on research, identification of an evidence-based transfusion trigger, and the potential for improvement by patient blood management (Jans et al. 2011 (2+)). One study differentiated between patients with different hemoglobin values (≤ 8.0 , 8.1–9.0, 9.1–10.0, and > 10.0 g/dL), finding no difference between groups regarding the difference (decrease) in distance walked preoperatively and postoperatively, or in the outcome of a 6-minute walking test). Also, no differences were found regarding perception of effort, maximal dominant hand strength, or SF-36 QoL scores (Vuille-Lessard et al. 2012 (2+)). Other studies have investigated length of hospital stay, complications, silent myocardial ischemia, and mortality without finding any difference between hemoglobin triggering transfusion of 7.5–8.0 and 9–10 g/dL (Grover et al. 2006 (1+), Naylor et al. 2010 (2+), So-Osman et al. 2013 (2+)). So, it appears that moderate postoperative anemia is well-tolerated, having no impact on fatigue, QoL, cardiovascular complications, LOS, and mortality—and with the possibility of fewer infections. Also, the tradition of giving transfusions in pairs (2, 4, 6) has been challenged, with similar outcomes from single-transfusion units when needed (Naylor et al. 2010 (2+)). Last but not least, a meta-analysis (18 studies, 7,593 patients) also found less infections in the restrictive group (RR = 0.8). For trials with a restrictive hemoglobin threshold of < 7.0 g/dL, the RR was 0.8 and it was 0.7 in patients undergoing orthopedic surgery (Rohde et al. 2014 (1+)). Not all patients may tolerate a restrictive approach, as a pilot study on patients with symptomatic acute coronary artery disease found a higher mortality rate at 30 days in the

restrictive group (8.0 g/dL) than in the liberal group (10.0 g/dL) (Carson et al. 2013 (1–)). More studies on transfusion triggers and outcomes in various subgroups are warranted.

Discussion

The American astronomer and astrophysicist Carl Sagan is quoted for his saying “absence of evidence is not evidence of absence”. The same can be said for traditions: as long as the subject at hand has not been investigated, we do not know whether it is true or not (hence a myth). But Dr Sagan is also said to have stated that “it is better to light a candle than to curse at the darkness”. The existing evidence may not always be overwhelming—in the form of level 1++ studies leading to grade-A recommendations—but if we want to improve patient outcomes, we should follow the evidence or, where there is none, perform properly designed, sufficiently powered RCTs or large-sample prospective cohort studies (depending on the research question). The narrative form of this review may seem ironic when dealing with unsubstantiated traditions in the context that a narrative review may be evidence-based but does not in itself – as a systematic review – constitute evidence. However, we have included Cochrane database systemic reviews, other systematic reviews, and meta-analyses if they exist. It was not practically possible—or our intention—to conduct systematic reviews of all the traditions mentioned here. Our aim has been to give an overview, to stimulate discussion, to encourage readers to re-evaluate their own practices, and to point out future studies. It is up to the reader to decide whether or not the evidence presented is strong enough to justify change. A revision of traditions is one of the cornerstones of fast-track surgery (Husted 2012 (1+)).

Based on this narrative review, we can make the following recommendations. Preoperative removal of hair, testing of urine for bacteria, use of plastic adhesive drapes, and pre-warming of the operating theater should be abandoned—as should intraoperative use of a tourniquet, use of a space suit, use of a urinary catheter, and closure of the knee in extension. The safety and efficacy of tranexamic acid is supported by meta-analyses. Postoperatively, there is no evidence to support postponement of showering or postponement of changing of dressings to after 48 h. Also, there is no evidence to recommend routine dental antibiotic prophylaxis, continuous passive motion, the use of compression stockings, cooling for pain control or reduction of swelling, flexion of at least 90 degrees as a discharge criterion following TKA, or having restrictions following THA. There is evidence to support using NSAIDs, allowing early travel, and allowing early mobilization. A low hemoglobin trigger for transfusion has been found to be safe and to give better outcomes.

HH conceived the study and all the authors searched for relevant studies and evaluated them. HH wrote the first draft of the manuscript, and all authors revised it and approved the final version to be published.

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