to this problem, which does help the evaluation of risk and hence the counselling of patient's families.

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Research

X-ref *For other Roundups in this issue that cross-reference with Research see: Foot & Ankle Roundups 4 & 5; Shoulder & Elbow Roundup 2; Spine Roundup 2.*

The effect of haemorrhagic shock and resuscitation on fracture healing in a rabbit model X-ref

The early management of trauma follows a defined pathway, whether the advanced trauma life support (ATLS) principles are adhered to or pathology is tackled in a simultaneous manner in the modern resuscitation room. How the management of shock influences the subsequent healing of fractures sustained by the injured patient has not been investigated until now. Recently, however, a group in **Australia** have used a rabbit model with a femoral osteotomy and intramedullary fixation to examine the effect of haemorrhagic shock and resuscitation on fracture healing.[1] This is one of those areas where animal studies can rapidly drive innovation in clinical practice. After inducing stage III shock in nine adult male New Zealand rabbits and leaving nine others with the full circulating volume, a femoral osteotomy was created and treated with intramedullary nail fixation. Fracture healing was monitored using radiological measurements and serum markers of bone formation. Four animals, however, were excluded from the study due to postoperative complications. Despite this, this study conclusively showed that the serum concentration of osteocalcin was significantly elevated in the shock group postoperatively when compared with the normal group ($p < 0.0001$). Furthermore, study of serial radiographs showed that the callus index on both the anteroposterior ($p = 0.0069$) and lateral ($p = 0.0165$) radiographs was consistently increased in the shock group compared with the normal group radiographs from three weeks postoperatively. Overall, the presence of haemorrhagic shock and resuscitation showed larger callus formation but with delayed remodelling, emphasizing yet another benefit of the aggressive early management of shock in traumatized patients. Aside from highlighting the importance of early aggressive resuscitation, this study has value in posing the question, what is the mechanism here? If the mediators of this response could be established, then these could potentially be used to accelerate healing in those patients with significant closed injuries.

Vitamin D supplementation and infection? A mouse perspective X-ref

Prosthetic joint infections (PJI), which are often bacterial in nature, are a common aetiology for failure following all types of joint arthroplasty. Recent research has suggested a potential link between vitamin-D deficiency and PJI; in fact, >65% of patients undergoing total joint arthroplasties have low total 25-hydroxyvitamin D (25D) levels. Is this a potential point for intervention, and could an argument therefore be made to encourage patients to take vitamin D supplements in an effort to reduce the risk of PJI? The authors of this paper from **Los Angeles, California (USA)** have presented an *in vivo* mouse model that shows 25D may be an important modifiable risk factor for patients undergoing total joint arthroplasty.[2] The authors investigated $25D_3$ supplementation in a mouse model of PJI, infected with *Staphylococcus aureus*. A total of 20 mice were randomized to receive a vitamin D-sufficient diet and 40 were randomized to a vitamin D-deficient diet for six weeks prior to surgery; 20 mice in the deficient diet group were 'rescued' with one intraperitoneal dose of $25D_3$ three days prior to surgery. A stainless-steel implant was then implanted into the knee joint and all knees were inoculated with *S. aureus*. Blood sampling was used to confirm $25D_3$ levels three days prior to surgery and on postoperative day (POD) 0 and POD 14. The number of *S. aureus* colony-forming units (CFUs) were measured on POD 21 by culture. Myeloperoxidase and β-N-acetylglucoseaminidase assays were used to quantify neutrophil infiltration and activated tissue macrophage recruitment. Results confirmed that $25D_3$ deficiency results in increased bacterial burden and neutrophil infiltration, and that repletion by a preoperative intraperitoneal dose significantly reduces this effect. CFUs measured at POD 21 were similar between the $25D_3$-sufficient group and $25D_3$-rescued group, both of which were significantly lower than the $25D_3$-deficient group. Bacterial burden quantified by bioluminescent signal on the implant and surrounding tissues was clearly increased for $25D_3$-deficient mice compared with $25D_3$-sufficient mice. Of course, these results were from a mouse model and may not be applicable to humans; however, the data presented here is both interesting and encouraging. If further work in larger animal studies reveals similar results, vitamin D supplementation may in fact be a low-risk, high-reward prophylactic strategy for decreasing the risk of PJI.

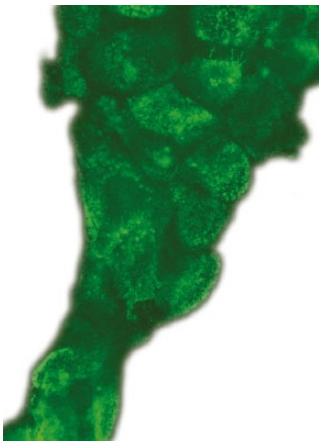
Sleep in hospitalized patients

Nobody involved in the provision of institutional care would be surprised that poor sleep is associated with poorer healthcare outcomes, particularly on patient-reported measures. Until now, we have had little idea as to what affects the quality of sleep on general hospital wards. This unique cross-sectional study, carried out across **The Netherlands**, collected data from 2005 adult inpatients from 39 hospitals and compared their last

night's sleep with their sleep from the month prior to admission.[3] Patients were recruited through social media, conventional media, and word of mouth. The quantity and quality of sleep was assessed using the Consensus Sleep Diary and the Dutch-Flemish Patient-Reported Outcomes Measurement Information System (PROMIS) Sleep Disturbance item bank. Additional questions were used to identify the factors that disturbed patient's sleep. Overall, there was a representative population sample, with 51.4% of responders being male and a median age of 68 years. Patients managed to sleep 83 minutes less than they would normally manage at home (95% confidence interval (CI) 75 to 92), with a mean of 3.3 reported awakenings overnight (95% CI 3.2 to 3.5). Patients not only fell asleep later, but woke an average of 44 minutes earlier than at home (95% CI 44 to 45). Just over 70% patients reported being woken by an external stimulus, of which 36% were hospital staff. The PROMIS results showed that sleep was of poorer quality in hospital than at home across the board. Sleep in hospital is at a premium, and when patients do rest, there are modifiable factors that influence its quality. As a result, healthcare staff need to be mindful of the role they play in reducing the quality and quantity of patient sleep, and consequently their recovery. The value of this paper is clearly showing that hospitals should tackle shortening of hospitalization period and look to optimize the sleeping environment.

Symptomatic pseudotumour after primary metal-on-polyethylene total hip arthroplasty with a standard femoral stem X-ref

■ In the modern era, orthopaedic surgeons worldwide are familiar with the complexities of metal-on-metal hip articulations and the association of some designs with early failure and pseudotumour. Early in the development of the total hip arthroplasty, the McKee–Farrar metal-on-metal hip prosthesis, initially developed in the 1950s, was adapted for use with a polyethylene acetabular bearing. This changed when osteolysis due to polyethylene wear was identified, and from around the year 2000, metal-on-metal type bearing surfaces came back into vogue with the aim of reduced wear and superior survival. These bearings, however, introduced new complications and failed to demonstrate superiority to the polyethylene-metal hip articulations. The major reason for reduced use of metal-on-metal articulations is the incidence of pseudotumour and other adverse metal reactions. Although this should be fairly clear-cut, the picture is further clouded by the hypothesized incidence of pseudotumours encountered with metal-on-polyethylene bearings, both from trunnion articulations (trunnionosis) and even in monoblock stems. In order to quantify the scale of this rare problem, a group from **Stockholm (Sweden)** has looked at 2102 patients who have received 2446 uncemented, monoblock metal-on-polyethylene total hip arthoplasties from 1999 until 2016, and followed them up using the Swedish Hip Arthroplasty Register.[4] Surgical and medical chart review and follow-up clinical visits were used to identify those patients suspected of pseudotumour, and serum metal ion levels and inflammatory markers were measured. A metal artefact reduction sequence (MARS) MRI was used to confirm pseudotumour when clinically suspected. Overall, 0.5% (13 cases) of patients underwent revision for pseudotumour within the seven years of the study, corresponding to a rate of 0.9 cases per 1000 person-years. This is significant because the stereotype that the metal-on-metal artificial joints, or those with a metal-on-metal morse taper for either modular head or neck, are solely



responsible for symptomatic pseudotumors has been planted in our mind. As a result, this study shows that symptomatic pseudotumor can occur in the polyethylene-metal type hip joint too, even though it is in this case a very rare complication.

One dose or two for tranexamic acid?

■ Tranexamic acid (TXA) plays an important role in trauma and orthopaedic surgery. Most are familiar with its use in trauma, and increasingly in arthroplasty and spinal surgery. However, its use is convoluted, with a loading dose followed by regular infusion being required to maintain what is thought to be the most effective plasma concentration. This is further complicated by a poor understanding of the most efficacious dose. In response to this fundamental difficulty, a group from **La Jolla, California (USA)** have investigated whether one dose of intravenous tranexamic acid is equivalent to two doses in reducing the requirement of postoperative blood transfusion, without increasing the incidence of complications.[5] The group responsible for this study identified 1736 patients who underwent total hip arthroplasty (THA) and 2042 patients who underwent total knee arthroplasty (TKA) between 2012 and 2016. Differences were reported in the change in serum haemoglobin concentration, rate of allogenic blood transfusions, and rate of complications between the subgroups who received no dose, a single dose, or two doses of TXA. Patients who underwent THA showed a similar drop in haemoglobin whether they received one or two doses of TXA. Both had a smaller drop in haemoglobin than those who did not receive any TXA. A multivariate analysis confirms that these findings are independent of age, sex, and preoperative haemoglobin level. In terms of transfusion, 12.5% of patients who did not receive TXA required a transfusion, compared with no patient who received one dose, and 0.7% of those who received two doses. Similar results were seen among those patients who underwent TKA. No patient group sustained more complications than any other (including the control groups). This study showed that single-dose administration of TXA is effective, and it is not necessary to administer more. In addition, the study offers favourable evidence that reduces the labour of medical staff and contributes to suppression of medical expenses.

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