

complications, mortality, re-operation, infection, pulmonary embolism and myocardial infarction.⁵³²

Regarding outcomes for daytime versus after-hours surgery in near hip fracture patients, a meta-analysis reported no significant differences in mortality, surgical time or blood loss.⁵³³ Delaying surgery in patients on DOACs has not been shown in observational studies to reduce peri-operative bleeding or affect their mortality.⁵³⁴ In a retrospective cohort, DOAC treatment was found to cause significant delay until surgery. No increased bleeding was found; however, in patients treated with DOACs compared with those treated with warfarin.⁵³⁵ One RCT has demonstrated, even with limitations, the nonsuperiority of spinal anaesthesia over general anaesthesia for hip fracture surgery.⁵³⁶ A recent multicentre RCT of 2970 patients with near-hip fracture showed that accelerated surgery (within 6 h) did not significantly lower the risk of mortality or a composite of major complications compared with standard care (10 to 42 h).⁵³⁷

Acquired factor XIII deficiency

Acquired FXIII deficiency with FXIII levels less than 70% in cases of trauma or surgical-related bleeding may have an effect on blood loss and transfusion. In trauma, as part of a goal-directed coagulation therapy, administration of FXIII in cases of ongoing bleeding and FXIII levels less than 60%, resulted in a reduction in allogeneic blood transfusion.^{538–540} In surgical patients, FXIII levels less than 60% have been associated with increased post-operative rebleeding and transfusion including cardiac and neurosurgical procedures.^{541–549} In a double-blinded randomised trial, untargeted administration of FXIII showed no effect, neither on blood transfusion nor on re-operation in cardiac surgery patients.³⁶¹ Additionally, FXIII may have some beneficial effects in surgical wound healing and burn injury.^{550–555} In cases of severe haemorrhagic complications during major orthopaedic surgery that raise suspicion of accelerated factor consumption (acquired deficiency), especially in oncological or septic procedures,^{556,557} it is suggested requesting a quantitative determination of FXIII activity (or antigen)⁵⁵⁸ to determine if the patient has sufficient levels to achieve haemostasis (50 to 60%), which will also favour proper wound healing.⁵⁵⁹ Replacement is suggested in cases of severe deficiency and risk of bleeding despite normal thrombo-elastometric or conventional coagulation variables.⁵⁶⁰

Cell salvage

Generally, cell salvage is an effective strategy for reducing the need for allogeneic blood transfusion, but in major orthopaedic procedures, the clinical use of autologous re-infusion systems has decreased. The risk of contamination and the nonsignificant cost-effectiveness^{561,562} have limited its use to certain nonseptic revision procedures, primarily THA⁵⁶³ and peri-acetabular osteotomies.⁵⁶⁴

There is little unbiased evidence⁵⁶⁵ to justify the routine use of cell salvage in orthopaedic surgery to reduce bleeding and transfusion. When an attempt was made to compare with TXA, the results were superior to cell salvage⁴⁷⁵ and no consensus has been reached on what pre-operative Hb level would be optimal for effective use of cell salvage.⁵⁶⁶ The appropriateness of its use should be assessed on an individual basis.

To prevent bleeding in major orthopaedic surgery, there is sufficient evidence of the effectiveness and safety of TXA and no conclusive data on the best dose or route of administration. As for surgical measures, the use of tourniquet in TKA or postsurgical drainage as a blood-saving measure are not recommended. There is also no conclusive evidence on the type of surgical approach for diminishing blood loss in THA or for osteosynthesis of hip fractures in the elderly, although the anterolateral minimally invasive approach and proximal endomedullary nailing would be the most optimal procedures, respectively. Femur fractures should be operated on within 48 h, even though accelerated surgery in less than 6 h after injury has not been shown to reduce global complications. Restrictive transfusion practices have been shown to decrease the incidence of surgical site infections. In a major haemorrhagic complication where other causes are discounted, it is advisable to determine the FXIII level to rule out an acquired deficiency. In severe cases, the factor should be replaced.

2.3 Patients undergoing visceral and transplant surgery

Recommendation 9

1. Liver resection

We recommend a low central venous pressure (CVP) and restrictive fluid administration during liver surgery to reduce bleeding. 1A

Intra-operative hypovolaemic phlebotomy or infrahepatic inferior vena cava clamping used together with low CVP strategy are suggested for decreasing intra-operative blood loss and transfusion requirements in selected patients undergoing major liver resections. 2C

Maintenance of high-stroke volume variation (10 to 20%) could be considered in liver resection surgery to reduce bleeding. 2B

During the liver resection phase, ventilation with low airway pressures achieved by low tidal volumes, and without positive end-expiratory pressure is suggested along with a low CVP strategy to decrease intra-operative bleeding. 2B

Together with other measures, terlipressin infusion may be considered during hepato-pancreatico-biliary (HPB) surgery to reduce bleeding. 2B

Improved surgical haemostatic devices and the use of topical haemostatic agents are suggested for reducing