Guidelines

Principles for management of hip fracture for older adults taking direct oral anticoagulants: an international consensus statement

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Summary

Hip fracture is a common serious injury among older adults, yet the management of hip fractures for patients taking direct oral anticoagulants remains inconsistent worldwide. Drawing from a synthesis of available evidence and expert opinion, best practice approaches for managing patients with a hip fracture and who are taking direct oral anticoagulants pre-operatively were considered by a working group of the Fragility Fracture Network Hip Fracture Audit Special Interest Group. The literature and related clinical guidelines were reviewed and a two-round modified Delphi study was conducted with a panel of experts from 16 countries and involved seven clinical specialities. Four consensus statements were achieved: peripheral nerve blocks can reasonably be performed on presentation for patients with hip fracture who are receiving direct oral anticoagulants; hip fracture surgery can reasonably be performed for patients taking direct oral anticoagulants < 36 h from last dose; general anaesthesia could reasonably be administered for patients with hip fracture and who are taking direct oral anticoagulants < 36 h from last dose (assuming eGFR > 60 $ml.min^{-1}.1.73\ m^{-2}$); and it is generally reasonable to consider recommencing direct oral anticoagulants (considering blood loss and haemoglobin) < 48 h after hip fracture surgery. No consensus was achieved regarding timing of spinal anaesthesia. The consensus statements were developed to aid clinicians in their decision-making and to reduce practice variations in the management of patients with hip fracture and who are taking direct oral anticoagulants. Each statement will need to be considered specific to each individual patient's treatment.

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Recommendations

1 Peripheral nerve blocks can reasonably be performed on presentation for patients with hip fracture who are receiving direct oral anticoagulants (DOACs).
2 Hip fracture surgery can reasonably be performed for patients who were taking DOACs within 36 h from last dose.
3 General anaesthesia could reasonably be administered for hip fracture surgery in patients who were taking DOACs < 36 h from last dose (assuming `normal´ renal function, i.e. eGFR > 60 $ml.min^{-1}.1.73\ m^{-2}$). Around two-thirds of panellists also agreed that general anaesthesia could reasonably be administered < 24 h after surgery (based on moderate consensus).
4 It is generally reasonable to consider recommencing DOACs (considering blood loss and haemoglobin) within 48 h of hip fracture surgery.

What other guideline statements are available on this topic?

There are several guidelines that consider the management of DOACs around the time of anaesthesia and surgery, including the *Guideline for the management of hip fractures* [1]; *American Society of Regional Anesthesia and Pain Medicine regional anaesthesia in patients receiving antithrombotic or thrombolytic therapy* guidelines [2]; *European Heart Rhythm Association practice guide on the use of non-vitamin K antagonist oral anticoagulants in patients with atrial fibrillation* [3]; *Interventional spine and pain procedures in patients on antiplatelet and anticoagulant medications* [4] representing guidelines from the American Society of Regional Anesthesia and Pain Medicine, European Society of Regional Anaesthesia and Pain Therapy, American Academy of Pain Medicine, International Neuromodulation Society, North American Neuromodulation Society and World Institute of Pain; *Perioperative management of antithrombotic therapy: an American College of Chest Physicians clinical practice guideline* [5]; and *Recommendations from the International Consensus Meeting: Venous thromboembolism (ICM-VTE): Trauma* [6].

Why were these consensus statements developed?

The purpose of the consensus statement is to draw from a synthesis of available evidence, and from expert opinion, best practice approaches for managing patients with hip fracture who are taking DOACs pre-operatively. The consensus statement aims to contribute to improving the health-related quality of life (HRQoL) of older adults after hip fracture and healthy ageing post-fracture. The consensus statement was developed based on the principles of collaborative involvement across multidisciplinary teams.

How and why does this statement differ from existing guidelines?

Previous guideline statements that considered DOACs did not consider all peri-operative aspects of hip fracture treatment addressed here [1] or were not specific to hip fracture [2–7]. This consensus statement promotes a standardised approach to treatment for patients with hip fracture taking DOACs, facilitating the best possible health outcomes across the globe.

Introduction

As the worldwide population ages, the number of fall-related hip fractures among older adults is increasing and is estimated to rise to 6.26 million by 2050 [8]. A fractured hip is one of the most serious fall-related injuries for an older adult, as it can reduce mobility, independence and overall quality of life [9]. Many factors can affect recovery and return to mobility after a hip fracture, but hip fracture surgery within 1 or 2 days of admission has been shown to be an important contributor to a lower risk of mortality [10, 11], complications and hospital duration of stay [12–16]. Hip fracture clinical care guidelines generally advocate hip fracture surgery within 24–48 h of hospital admission [17–19].

As the number of older adults increases, the incidence of morbidity and mortality from thrombotic disorders or atrial fibrillation, such as stroke or myocardial infarction, is also rising [20]. These arterial and venous thromboembolic disorders are increasingly being managed with DOACs [20, 21], due to ease of administration and, unlike vitamin K antagonists, they do not require regular monitoring [22]. Since 2017, the dispensing of DOACs has surpassed warfarin in the USA and UK [23, 24]. Considering that most people taking DOACs are aged ≥ 65 y [23] and up to 40% of patients with a hip fracture are taking anticoagulation [25], not having a reversible drug available for DOACs (except dabigatran) may influence the management following hip fracture. For some older adults taking a DOAC, a delay in

performing hip fracture surgery to allow medical optimisation may be necessary to reduce intra- and postoperative blood loss [26] and to deliver safe regional anaesthesia [27]. However, currently, there is an absence of consensus regarding the management of patients with a hip fracture taking DOACs [3, 22, 28–30], with conflicting evidence as to whether delaying surgery provides a health benefit [31].

For this consensus statement, DOACs refer to a class of oral anticoagulants that directly inhibit a single target and have similar clinical properties (e.g. rivaroxaban; apixaban; edoxaban; betrixaban; and dabigatran). The mechanism of action of either factor Xa inhibitors (i.e. rivaroxaban; apixaban; edoxaban; and betrixaban) or direct thrombin inhibitors (i.e. dabigatran) is used when it is clinically important to distinguish between the DOAC medications.

Methods

This consensus statement development was guided by the Fragility Fracture Network (FFN) Hip Fracture Audit Special Interest Group which convened a hip fracture and DOAC working group. The working group piloted a series of questions related to hip fracture treatment and DOACs at an interactive workshop at the 2022 FFN Global Congress in Melbourne, Australia. A two-round modified Delphi study with an international group of experts was then conducted to identify where there was (and was not) consensus on the management of patients with hip fracture taking DOACs. The consensus document was then finalised with a virtual workshop involving the hip fracture and DOAC working group and presentation at an interactive workshop regarding the consensus statements at the FFN Global Congress in Oslo, Norway, in October 2023. Ethical approval was obtained from the Macquarie University Ethics Committee.

The FFN includes health professionals and other stakeholders with an interest in reducing the burden of fragility fractures and enhancing care quality for patients. The hip fracture and DOAC working group included experts from a range of backgrounds who had either authored publications on hip fracture and DOAC use and/or were involved in the development of clinical guidelines or protocols related to hip fracture care and/or were directly involved in the peri-operative management of patients with a hip fracture. The specialities represented on the hip fracture and DOAC working group included: geriatrics; orthopaedics; orthogeriatrics; anaesthesia; internal medicine; peri-operative medicine; and epidemiology.

The hip fracture and DOAC working group, informed by systematic reviews [31, 32], literature reviews [28, 29] and related clinical practice guidelines [1, 3, 5, 33], developed a core set of 10 themes and questions regarding the management of patients with a hip fracture taking DOACs (online Supporting Information Appendix S1, Table S1). Delegates at the FFN Congress in October 2022 who attended an interactive workshop on hip fracture care and DOACs responded to the questions and provided their opinions on the management of patients with a hip fracture taking DOACs during the workshop. The responses of the workshop attendees (online Supporting Information Appendix S1, Figures S1–S10) were used to inform a two-round modified Delphi study.

A total of 111 international experts who were clinicians experienced in managing patients with a hip fracture were identified from a range of sources, including the FFN, professional associations and professional networks of clinicians who manage patients with hip fracture and were invited to join a panel and participate in a two-round modified Delphi study. Participation was voluntary and anonymous. Experts were also able to forward the survey link to colleagues involved in hip fracture care management. The modified Delphi study was conducted during 2023 and was used to identify where there was (and was not) consensus on the themes and statements relating to the management of patients with a hip fracture taking DOACs pre-operatively, an approach adopted by WikiGuidelines [34].

In stage 1, the modified Delphi consisted of 10 themes and 20 questions, and panellists were asked to select a response from a list of choices that most corresponded with their opinion regarding the clinical management of patients with a hip fracture and who were taking DOACs. Panellists were also provided with an option to include the key factors that led to their selection and to provide any further comments. A threshold of eGFR > 60 $ml.min^{-1}.1.73\ m^{-2}$ was used for the modified Delphi survey to represent patients who would have adequate function to clear a DOAC [35]. Stage 1 was designed to obtain feedback regarding the management of patients with a hip fracture taking DOACs and was conducted during March–April 2023. Sixty-one experts completed stage 1 (36%) and 21 additional experts provided responses. Panellists worked across 16 countries and seven specialities (online Supporting Information Appendix S2).

During stage 2, feedback was provided to the expert panellists from stage 1 in the form of a summary of responses to the stage 1 questions and the relevant literature. In stage 2, the modified Delphi consisted of three themes and 22 questions. Panellists were asked to provide a response from a list of choices that most corresponded with their opinion regarding the clinical management of patients with a hip fracture taking DOACs. Panellists were provided

with an option to include key factors that led to their selection and to provide any further comments. Forty-four experts completed stage 2 (72%) (online Supporting Information Appendix S3).

At the conclusion of stage 2, a summary of the panel responses was provided to the hip fracture and DOAC working group and it reviewed the panel consensus on each question and the commentary regarding their selection. Consensus among panellists was identified a priori and was considered to be high, moderate or low when the proportion of all ratings was ≥ 70%, 50–69% and < 50%, respectively [36]. High to moderate consensus were considered acceptable to make consensus statements regarding the care of patients with a hip fracture taking DOACs. While panel consensus was reported for each question, the rationale and all pros and cons reported by the panellists were considered as these statements may relate to practising in different clinical, geographical and resourced environments.

To finalise the consensus statements, virtual discussion took place during July 2023 with the hip fracture and DOAC working group members to discuss panellist responses to each question. The consensus statements were then presented for discussion and finalisation at an interactive workshop at the FFN Global Congress in October 2023 in Norway (online Supporting Information Appendix S4). The consensus statements, their methods and the results of each development stage, along with the supplementary material was reviewed and supported by the WikiGuidelines steering group as being consistent with the WikiGuidlines charter guidelines principles [34].

Results

The panellists from stages 1 and 2 of the modified Delphi study responded to nine questions regarding the management of patients with a hip fracture taking DOACs during four phases of care: presentation (nerve block); pre-operative (timing of surgery); intra-operative care (anaesthesia); and postoperative (recommencing DOACs). There was insufficient evidence from published research to provide definitive evidence-based statements for each management principle. The available evidence is summarised and the majority opinion of the panellists is provided as the consensus approach. Any areas of contention regarding the consensus principle identified by panellists were recorded and summarised (online Supporting Information Appendix S5, Table S8). Recommendations from existing guidelines either explicit for hip fracture management or surgical care for patients taking DOACs are summarised in online Supporting Information Appendix S6, Table S9.

Question 1: For patients who present with a hip fracture and are receiving a DOAC should a peripheral nerve block be performed on presentation?

There was not enough evidence to indicate the best time interval between the last dose of a DOAC and a peripheral nerve block for patients with a hip fracture. There was one prospective pilot study of 69 patients taking apixaban or rivaroxaban presenting to a regional trauma centre in Israel: 19 patients were treated with an ultrasound-guided femoral nerve blockade and 50 were treated with conventional analgesics [37]. There was no significant difference between the nerve block and conventional analgesia in the number of major bleeding events (47% vs. 54%); blood transfusion rates (26% vs. 20%); change in haemoglobin levels compared with baseline (2.2 $mg.dl^{-1}$ vs. 1.9 $mg.dl^{-1}$); hospital duration of stay (6 days vs. 6 days); rate of re-operation (0% vs. 0%); wound hematomas (0% vs. 0%); wound infection (11% vs. 6%); delirium (26% vs. 22%); sepsis (5% vs. 14%) or 30-day mortality (5% vs. 12%) [37].

There was high consensus (n = 31, 70.5%) among panellists that a peripheral nerve block could be reasonably performed on presentation for patients with hip fracture who were receiving a factor Xa inhibitor. There was moderate consensus (n = 26, 59%) for performing a peripheral nerve block on presentation when a patient was receiving a direct thrombin inhibitor.

Consensus statement 1: Peripheral nerve blocks can reasonably be performed on presentation for patients with a hip fracture who are receiving a DOAC.

This consensus statement considered the potential risks of bleeding after administering a peripheral nerve block weighed against the potential risk of uncontrolled pain or adverse effects of opioid analgesia [7]. By administering a peripheral nerve block early, there is a theoretical increased risk of bleeding. However, this risk is likely to be small and needs to be weighed against the benefits of a nerve block which are proven to reduce pain on movement within 30 min of block placement, risk of delirium and probably also reduce the risk of pulmonary infection and time to first mobilisation [38].

Question 2: For inpatients who require hip fracture surgery and were receiving a DOAC, how long from last dose should surgery be delayed?

There was no evidence to indicate if hip fracture surgery for patients taking DOACs could reasonably be delayed, including for different types of hip fracture surgery. Sixteen retrospective cohort [22, 39–53] and four case–control

studies [54–57] report the type of hip fracture surgery performed for patients taking DOACs.

In a retrospective cohort study of the Danish Multidisciplinary Hip Fracture Registry (103,299 patients with a hip fracture, n = 1063 taking DOACs), there were no significant differences in all-cause 30-day mortality for patients taking DOACs compared with patients taking vitamin K antagonists or antiplatelet drug (11.3% vs. 10.8% vs. 12.7%, respectively) (hazard ratio 0.88, 95%CI 0.75–1.03) [25]. For patients taking DOACs and who had surgery > 36 h after last dose, the adjusted hazard ratio indicated no detrimental effect (0.70, 95%CI 0.54–0.91) [25]. Similarly, Krespi et al. performed a retrospective cohort study of 171 patients with a hip fracture who underwent surgery 24 h, 24–48 h and 48 h after last DOAC dose [47]. They found no significant differences between groups in terms of 30-day mortality (3.1% vs. 4.3% vs. 13.0%); 90-day mortality (0% vs. 3.2% vs. 6.5%); 90-day venous thromboembolism (0% vs. 1.1% vs. 0%); haemoglobin change (3.79 $g.dl^{-1}$ vs. 3.33 $g.dl^{-1}$ vs. 3.06 $g.dl^{-1}$); packed red cell administration (15.6% vs. 14.0% vs. 13.0%); 30-day readmission (3.1% vs. 14.0% vs. 8.7%); and 90-day readmission (9.4% vs. 8.6% vs. 0%). The authors suggested that surgical delay should be avoided.

In a retrospective cohort study, Levack et al. compared 133 patients who underwent hip fracture surgery within 24 h and > 24 h of last DOAC dose, and found no significant difference in overall complications (35.1% vs. 48.4%) or transfusion rates (37.8% vs. 45.3%) [39]. In a retrospective cohort study, King et al. compared 17 patients who had surgery < 48 h (early DOAC group) and 11 patients who had surgery > 48 h after last DOAC dose (late DOAC group) [46] with 56 patients who were not taking DOACs and who had surgery within 48 h (non-DOAC group) [46]. There were no significant differences between the early DOAC, non-DOAC and late DOAC groups in terms of in-hospital mortality (0% vs. 5.4% vs. 9.1%); 30-day mortality (0% vs. 5.4% vs. 9.1%); or wound infection (5.9% vs. 1.8% vs. 9.1%). There were significant differences in 90-day mortality between the early and late DOAC groups (0% vs. 36.4%, respectively), but not between the early DOAC (0%) and non-DOAC groups (0% vs. 8.9%, respectively). The authors suggested that the taking of DOACs is not a reason to delay surgery [46].

In a prospective study of 120 patients with a hip fracture, Aziz et al. found a significant difference in blood transfusion rates between patients taking DOACs according to three hospital protocols: wait for 24 h from last DOAC dose before surgery; measure DOAC levels and proceed to surgery once below the threshold of < 50 $ng.ml^{-1}$; and wait 48 h from last DOAC dose before surgery [30]. The packed red cell transfusion rates were 24%, 40% and 27%, respectively.

In a retrospective cohort study of 755 patients with a hip fracture, Goh et al. identified no significant differences in incidence of venous thromboembolism for patients taking DOACs who had surgery < 24 h and ≥ 24 h compared with standard care with low-molecular-weight heparin (LMWH) (0% vs. 1.2% vs. 1.3%, respectively; p = 0.94) [53]. There was also no significant difference in all-cause 30-day mortality.

Considering the type of hip fracture surgery, a retrospective cohort study of 320 patients having hip fracture surgery (n = 54 taking DOACs), found that when patients had been operated on within 24 h, blood loss through drainages and red blood cell transfusion were not significantly different between type of surgery (i.e. dynamic hip screw, hemiarthroplasty, total hip arthroplasty or proximal femoral nail anti-rotation) in patients taking DOACs or warfarin [58].

A retrospective case–control study of 63 patients taking DOACs and 62 patients not taking a DOAC or warfarin, examined whether waiting for the elimination of a DOAC had an effect on the amount of peri-operative bleeding [55]. An adjusted analysis of peri-operative change in haemoglobin concentration found that surgery which used a combination of sliding hip screw and intramedullary nail was associated with a greater haemoglobin drop compared with the use of sliding hip screws alone. There was no significant difference in haemoglobin concentration change for hemiarthroplasty, intramedullary nail or total hip replacement compared with sliding hip screws. Schermann et al. [51], in a retrospective cohort study that included 89 patients using DOACs (n = 60 patients had a closed reduction and internal fixation and n = 29 had hemiarthroplasty) found time to surgery was significantly longer for closed reduction and internal fixation for patients taking DOACs compared with patients who were not (mean (SD) 40 (26.9) h vs. 31 (22.2) h, respectively). There was no difference in time to surgery for patients who had a hemiarthroplasty and were taking DOAC compared with those who were not (mean (SD) 42 (27.3) h vs. 37 (25.8) h, respectively).

There were varied opinions among panellists regarding patients receiving a factor Xa inhibitor and the length of time that surgery could reasonably be delayed from last dose. Panellists specified surgery could reasonably be delayed 12–24 h (n = 16, 37%); < 12 h (n = 13, 30%); > 24–36 h (n = 9, 21%); or > 36–48 h (n = 5, 11%). Overall, there was high consensus among panellists (n = 38, 86%) for conducting hip fracture

surgery within 36 h from last dose for patients who were receiving a factor Xa inhibitor. In terms of considering a time period < 36 h, there was moderate consensus among panellists (n = 29, 66%) for conducting hip fracture surgery within 24 h from last dose for patients who were receiving a factor Xa inhibitor. There were also varied opinions among panellists when considering patients who were receiving a direct thrombin inhibitor and the length of time that surgery could reasonably be delayed from last dose. Panellists specified that surgery could reasonably be delayed for < 12 h (n = 13, 30%); 12–24 h (n = 12, 27%); > 24–36 h (n = 9, 21%); or > 36–48 h (n = 8, 18%). Overall, there was high consensus among panellists (n = 34, 77.3%) for conducting hip fracture surgery within 36 h from last dose for patients who were receiving a direct thrombin inhibitor. In terms of considering a time period < 36 h, there was moderate consensus among panellists (n = 25, 57%) for conducting hip fracture surgery within 24 h from last dose for patients who were receiving a direct thrombin inhibitor.

Consensus statement 2: Hip fracture surgery can reasonably be performed for patients who were taking a DOAC within 36 h from last dose.

When conducting hip fracture surgery within 36 h from last dose for patients taking a DOAC, each patient's circumstances need to be considered. The consensus statement has considered the risks of bleeding at the time of fracture and time of surgery and the overall risks and benefits of expediting or delaying surgery. Practice is varied worldwide which has enabled results of different approaches to be published and considered, although overall the quality of evidence is low. A more conservative approach delaying surgery to allow `DOAC clearance´ risks the complications of delaying surgery while earlier surgery potentially could increase bleeding risk at the time of surgery. The consensus statement balances these competing risks. One approach could be to consider if higher than expected blood loss for a patient could lead to an additional risk (e.g. because their baseline haemoglobin level is marginal or if a patient has increased cardiovascular risk factors that may lead to decreased end organ perfusion and organ dysfunction (e.g. cerebral ischaemia)). Elimination of a DOAC is dependent on renal function, which would need to be considered. Dabigatran is 80% cleared by the kidneys, compared with 50% for edoxaban, 33% for rivaroxaban and 25% for apixaban. Considering the elimination half-life of DOACs (i.e. 12 h for factor Xa inhibitors and 15–17 h for a direct thrombin inhibitor), there would be < 25% of circulating active drug in the plasma when conducting hip fracture surgery within 36 h from last dose. For most patients, the benefits of early hip fracture surgery are evident and well-known [28].

Question 3: In patients who require hip fracture surgery and are receiving a DOAC, how long should a multidisciplinary team wait before giving a general anaesthetic (assuming normal renal function, i.e. eGFR > 60 $ml.min^{-1}.1.73\ m^{-2}$)?

AND

Question 4: In patients who require hip fracture surgery and are receiving a DOAC, how long should a multidisciplinary team wait before giving a spinal anaesthetic (assuming normal renal function, i.e. eGFR > 60 $ml.min^{-1}.1.73\ m^{-2}$)?

There was no evidence to indicate a specific time interval to general or spinal anaesthesia after the last dose of a DOAC for patients with a hip fracture as there have been no studies specifically investigating this outcome. One retrospective cohort study of 314 patients (47 patients taking DOACs and 267 not on anticoagulants) identified that patients taking DOACs who had neuraxial anaesthesia had a significantly longer time to surgery compared with those who had general anaesthesia (35 h vs. 22 h; p < 0.001) [59]. In addition, patients who were taking DOACs who had neuraxial anaesthesia compared with general anaesthesia did not have a significantly longer hospital duration of stay (7.1 d vs. 6.1 d; p = 0.1). One retrospective cohort study of 133 patients taking DOACs found that for patients who had surgery within 24 h compared with surgery > 24 h, general anaesthesia (89.2% vs. 71.6%) was more common, with fewer neuraxial (5.4% vs. 22.1%) or regional (0% vs. 17.9%) anaesthetic techniques [39].

There were varied opinions among panellists as to how long the multidisciplinary team could reasonably wait before giving general anaesthesia to patients with normal renal function who were taking a factor Xa inhibitor: 15 panellists (34%) specified < 12 h; 13 panellists (30%) specified 12–24 h; and 11 panellists (25%) specified > 24–36 h. Overall, there was high consensus among panellists (n = 39, 89%) to reasonably consider waiting < 36 h before giving general anaesthesia to patients receiving a factor Xa inhibitor. In terms of considering a time period < 36 h, there was moderate consensus among panellists (n = 28, 64%) to consider waiting < 24 h before giving general anaesthesia to patients receiving a factor Xa inhibitor. There were also varied opinions from panellists as to how long a multidisciplinary team could reasonably wait before giving

general anaesthesia to patients with normal renal function receiving a direct thrombin inhibitor: panellists indicating wait times of < 12 h (n = 15, 34%); 12–24 h (n = 11, 25%); or > 24–36 h (n = 10, 23%). Overall, there was high consensus among panellists (n = 36, 82%) to reasonably consider waiting < 36 h before giving general anaesthesia to patients receiving a direct thrombin inhibitor. In terms of considering a time period < 36 h, there was moderate consensus among panellists (n = 26, 59%) to consider waiting < 24 h before giving general anaesthesia to patients receiving a direct thrombin inhibitor.

Consensus statement 3: General anaesthesia could reasonably be administered for hip fracture surgery in patients who were taking a DOAC < 36 hours from last dose (assuming `normal´ renal function, i.e. eGFR > 60 ml.min^{-1}.1.73m^{-2}). Around two-thirds of panellists also agreed that general anaesthesia could reasonably be administered < 24 h after surgery (based on moderate consensus).

When conducting hip fracture surgery for patients taking a DOAC, each patient's circumstances need to be considered when deciding on mode of anaesthesia. Studies such as REGAIN [60], the RAGA randomised trial [61] and ASAP-2 [62] have not shown spinal anaesthesia to be superior to general anaesthesia for hip fracture surgery when considering peri-operative health outcomes, such as mortality, postoperative delirium or ambulation. The positive health outcomes of expedited hip fracture surgery, however, are well established. Without proven benefits of spinal over general anaesthesia, patients without medical comorbidities which would favour neuraxial anaesthesia, such as pulmonary complications, could reasonably receive expedited surgery within 36 h under general anaesthesia.

There were varied opinions among panellists as to how long a multidisciplinary team could reasonably wait before giving spinal anaesthesia to patients with normal renal function taking a Xa inhibitor. Panellists indicated a wait of > 48 h (n = 21, 48%), 24–36 h (n = 17, 39%) or > 36–48 h (n = 4, 9%). Overall, there was low consensus among panellists as to the amount of time a multidisciplinary team could reasonably wait before giving spinal anaesthesia to patients receiving a Xa inhibitor.

Varied opinions were also obtained from panellists as to how long a multidisciplinary team could reasonably wait before giving spinal anaesthesia to patients with normal renal function taking a direct thrombin inhibitor, with less than half of the panel (n = 20, 46%) agreeing that a surgical team could reasonably wait > 48 h before giving a spinal anaesthetic. Other wait times were 24–36 h (n = 12, 27%) and > 36–48 h (n = 3, 67%). Overall, there was low consensus among panellists as to the amount of time a multidisciplinary team could reasonably wait before giving spinal anaesthesia to patients receiving a direct thrombin inhibitor. No consensus statement could be made regarding how long a multidisciplinary team could reasonably wait from last dose before giving a spinal anaesthetic to patients who were taking a DOAC (assuming normal renal function i.e. eGFR > 60 ml.min^{-1}.1.73 m^{-2}) who required hip fracture surgery. The potential risk of spinal anaesthesia, such as epidural or vertebral canal haematoma, versus benefit, such as patients with pulmonary or airway considerations, needs to be considered for each patient. However, this special interest group acknowledges that selected patients may benefit from expedited surgery under spinal anaesthesia and national guidance from the UK advocating this after 24 h [1].

Question 5: In patients who had a DOAC interruption for hip fracture surgery, when should a patient recommence a DOAC (considering expected low blood loss and stable haemoglobin)?

There was no evidence to indicate a specific time interval after surgery when patients with a hip fracture could reasonably recommence taking DOACs. The *Royal Berkshire NHS Foundation Trust Perioperative Management of DOACs: Protocol* [63] specifies commencing LMWH ≥ 6 h postoperatively and to check haemoglobin on day 1. If creatinine clearance ≥ 50 ml min^{-1} and there are no concerns over wound ooze, then the DOAC can be restarted 48 h postoperatively, and prophylactic LMWH stopped. If creatinine clearance < 50 ml.min^{-1} then clinicians should liaise with the orthogeriatric team as DOACs are contraindicated in severe chronic kidney disease. If there are no concerns over wound ooze, the anticoagulant of choice should then be started 48 h postoperatively and prophylactic LMWH stopped.

There were varied opinions among panellists as to when a patient could reasonably recommence a DOAC after hip fracture surgery. Panellists specified that a DOAC could reasonably be recommenced within > 24–36 h (n = 22, 50%); within 48 h (n = 14, 32%); or within > 36–48 h (n = 6, 14%). Overall, there was high consensus among panellists (n = 36, 82%) that a patient could reasonably be recommenced on a DOAC within 48 h. In terms of considering a time period < 48 h, there was moderate consensus by the panel (n = 22, 50%) to reasonably consider recommencing a patient on a DOAC > 24–36 h.

Consensus statement 4: It is generally reasonable to consider recommencing a DOAC (considering blood loss and haemoglobin) within 48 h of hip fracture surgery.

The potential risk of bleeding and local wound complications should be individually assessed and balanced against potential thromboembolic risk. Prolonged DOAC interruption could increase risk of arterial or venous thromboembolism. For patients at highest risk, such as those with recent stroke, deep vein thrombosis or pulmonary embolism, recommencing DOACs within a shorter time period and/or a prophylactic dose of LMWH on postoperative day 1 could be considered.

Discussion

These consensus statements are designed to inform multidisciplinary team care of patients with a hip fracture and who were taking DOACs before their injury. The consensus statements should be applied in conjunction with any existing national or local facility-based hip fracture care pathways, protocols and guidelines, and considering the individual circumstance of the patient, with the aim of ensuring a high quality of care for patients with a hip fracture and who are taking DOACs.

The literature reviews conducted for the development of the consensus statements highlighted the lack of definitive research evidence regarding patients taking DOACs and hip fracture care. Whether a delay to surgical intervention for patients with a hip fracture taking DOACs is justified needs evidence from robust population-based studies [1, 28]. In particular, further research is needed to quantify whether time periods < 36 h from last dose could be considered for peripheral nerve blocks, general or spinal anaesthesia, and hip fracture surgery without compromising patient outcomes. There is also a need for pragmatic investigation of the use of reversal agents for DOACs prior to hip fracture surgery [64] and their impact on patient outcomes and treatment costs. To aid population-based studies of health outcomes of patients with hip fracture taking DOACs, it is recommended that hip fracture registries consider recording information on DOACs and, potentially, use of any reversal agents. Research is currently being undertaken as part of the Hip and femoral fracture Anticoagulation Surgical Timing Evaluation (HASTE) study in the UK [65] which may be able to provide further insight regarding the management of patients taking DOACs.

From the literature reviews, inconsistent approaches in the measurement and assessment of patient health outcomes were identified, leading to heterogeneity and difficulties in comparing patient outcomes across studies. Inconsistencies across studies were particularly identified in the measurement of blood loss and type of postoperative complications examined. Information was often absent regarding the amount of time prior to surgery that DOAC use ceased and the type of anaesthesia used during surgery. It is recommended that standard definitions and approaches to the measurement of patient outcomes be developed.

The hip fracture and DOAC working group encourage wide dissemination of this consensus statement and, as such, have published the consensus statement as open access. The working group also encourage dissemination of the consensus statement through professional networks and have developed a summary infographic (online Supporting Information Appendix S7, Figure S29) outlining the key consensus statements to aid distribution and a decision flow chart to aid implementation into practice (online Supporting Information Appendix S7, Figure S30).

There are several limitations associated with the development of the consensus statements. The lack of high-quality population-based studies on the management and outcomes of patients with a hip fracture taking DOACs led the working group to rely largely on the opinions of expert panellists to develop the consensus statements. While expert panellists were invited from all continents, we did not obtain responses from the African region, and responses were generally obtained from panellists from high-income countries. Therefore, the consensus statements may not be suitable for implementation in low-resource settings. Consensus was not achieved for how long a multidisciplinary team could reasonably wait from last dose before giving a spinal anaesthetic to patients who were taking a DOAC and further research in this area is required to inform practice. The consensus statements did not specifically address patients who experience specific comorbid conditions, such as chronic kidney disease, which will affect decision-making around hip fracture care (e.g. consideration of patients with poor renal function on admission).

Each consensus statement will need to be considered specific to each individual patient's treatment. It is recommended that a review of the consensus statements be conducted following new research that addresses the knowledge gaps regarding the management to patients with a hip fracture and who are taking DOACs.

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Supporting Information

Additional supporting information may be found online via the journal website.

Appendix S1. 10th Global FFN Congress 2022: Management of hip fracture patients taking DOACs workshop.

Appendix S2. Modified-Delphi round 1 survey.

Appendix S3. Modified-Delphi round 2.

Appendix S4. 11th Global FFN Congress 2023: Finalising a consensus statement on the principles for management of hip fracture patients taking direct oral anticoagulants.

Appendix S5. Consensus statements for the management of hip fracture patients taking DOACs.

Appendix S6. Summary of guideline recommendations.

Appendix S7. Dissemination and implementation.