MENTORS IN ORTHOPEDICS

SUMMARY OF THE 2021 INTERNATIONAL CONSENSUS MEETING ON VENOUS THROMBOEMBOLISM

https://doi.org/10.71165/a7vn-456e

AUTHORS

Graham S. Goh - Rothman Orthopaedic Institute, Philadelphia, United States of America
Javad Parvizi - Rothman Orthopaedic Institute, Philadelphia, United States of America

SUMMARY

Background: Venous thromboembolism (VTE), encompassing deep vein thrombosis and pulmonary embolism, remains a significant cause of morbidity, mortality, and increased healthcare costs following orthopedic surgery. Despite existing protocols, optimal prophylaxis remains controversial due to the competing risks of thrombotic events and major bleeding complications, alongside a lack of standardized, subspecialty-specific risk stratification tools.

Objective: This article details the methodology and clinical recommendations of the inaugural International Consensus Meeting (ICM) on VTE, aimed at establishing evidence-based standards for VTE prevention across all orthopedic subspecialties.

Key Points: Utilizing a formal Delphi process involving 570 global delegates, the ICM evaluated 200 clinical questions. Key findings include the emergence of low-dose aspirin as a safe, effective, and cost-efficient prophylactic agent for total joint arthroplasty, even in high-risk cohorts. The consensus highlights the necessity of incorporating wound complications and bleeding risks into future personalized risk-scoring models. Subspecialty-specific guidance was developed for trauma, sports medicine, spine, pediatrics, and oncology, addressing variables such as weight-bearing status, immobilization, and surgical duration. While potent anticoagulants like low-molecular-weight heparin remain indicated for multi-trauma patients, routine prophylaxis is often unnecessary for low-risk procedures in hand and sports surgery.

Conclusion: The ICM on VTE provides a comprehensive, peer-reviewed framework to standardize perioperative care. By addressing subspecialty-specific nuances and prioritizing agents with favorable safety profiles, these guidelines aim to reduce VTE incidence while minimizing anticoagulation-related adverse events and establishing a legal standard of care in orthopedic practice.

KEYWORDS

Venous Thromboembolism; Arthroplasty, Replacement, Hip; Arthroplasty, Replacement, Knee; Aspirin; Consensus

THE PROBLEM

Venous thromboembolism (VTE) can be a deadly complication in hospitalized patients undergoing major surgery. This clinical entity comprises two interrelated conditions: deep vein thrombosis (DVT) and pulmonary embolism (PE). Patients undergoing orthopaedic surgery are believed to be at high risk of VTE [1,2]. Approximately 1 in 71 patients undergoing total knee arthroplasty (TKA) and 1 in 167 undergoing total hip arthroplasty (THA) develop a VTE within 30 days after surgery [3]. Similarly, the cumulative incidences of VTE were shown to be 0.73% within 30 days and 0.83% within 31–365 days among hip fracture patients, compared to 0.05% and 0.43% in the general population [4]. In addition to its wide-reaching impact on patient morbidity and mortality, VTE imposes a major economic burden on healthcare as adjusted mean costs across a 5-year period have been estimated to be 1.5-fold higher for patients with VTE related to hospitalization following major surgery as compared to hospitalized controls [5].

DELVING INTO THE UNKNOWN

The medical community has been searching for the most effective VTE prophylactic agent. In the 1970s pharmacological agents such as heparin were introduced for VTE prophylaxis, which appeared to make a difference to the rate of DVT and VTE-related mortality [6]. While there is an overall consensus that a prophylactic agent for VTE for patients undergoing orthopedic surgery is needed, the ideal agent that can accomplish this feat while not causing additional issues such as bleeding and associated mortality remains unknown.

In addition to the uncertainty surrounding the prevention and management of VTE, fundamental questions regarding the etiology, risk factors, pathophysiology and diagnosis of VTE remain unanswered. For instance, different orthopaedic procedures carry different risk profiles for VTE due to variation in procedure-related factors such as operative time, type of anesthesia, extent of tissue dissection or trauma, site of surgery, and surgical technique –– this complex interplay between these risk factors has been termed 'thrombotic potential'. However, the precise quantification of VTE risk for each individual procedure as an independent risk factor remains unknown.

Moreover, there is currently no validated risk score that can be applied across all orthopaedic subspecialties. Most studies concerning risk scores have originated from joint replacement literature and used similar risk factors to classify patients into high- or low-risk [7,8]. Furthermore, all existing scores did not take into consideration the risk of wound complications or major bleeding events–– an adverse event of anticoagulation that is undoubtedly as important as the complication it is intended to prevent. Finally, the impact of risk stratification on patient outcomes and clinical decision-making (e.g. choice of anticoagulation) remains largely unexplored, especially since the assumption that "high-risk" patients require more aggressive anticoagulation has been questioned recently [9]. With advances in the field of machine learning and emerging institutional data demonstrating the effectiveness of less potent anticoagulants for "high-risk" patients, it is evident that a more personalized approach to risk stratification will be the next frontier in VTE prevention. Instead of classifying patients into high- or low-risk groups, it may be more appropriate to report the specific probability of thrombosis versus bleeding for individual patients and allow shared decision-making with regards to the optimal chemoprophylaxis based on the assessment of what is an "acceptable" risk to the patient.

CURRENT TRENDS IN VTE MANAGEMENT

In recent years, there has been an increasing trend, at least in North America, towards the use of aspirin as the main modality for VTE prophylaxis following joint replacement. According to a 2020 survey of practice trends among members of the American Association of Hip and Knee Surgeons (AAHKS), 95% of surgeons now use aspirin in combination with mechanical measures for VTE prophylaxis, which has grown substantially from 20% in 2009 [10]. A variety of reasons account for the increasing popularity of aspirin as a chemoprophylactic agent. In addition to its proven efficacy, aspirin is inexpensive [11], well-tolerated, and does not require routine blood monitoring [12]. Importantly, multiple studies have shown that aspirin is similarly effective in preventing VTE while decreasing the incidence of postoperative complications compared to more potent anticoagulants [13–15]. These benefits include decreased rates of heterotopic ossification [16], knee manipulation for stiffness [17], periprosthetic joint infections [18] and mortality [19]. The most important advantage of aspirin over other potent anticoagulants has been purported to be the reduction in major or clinically relevant bleeding. Multiple studies have shown that patients receiving aspirin have reduced blood loss, transfusion rates and incidence of persistent wound drainage, and others have demonstrated a lower incidence of major bleeding events compared to other chemoprophylaxis options [20–25]. Mounting evidence in support of aspirin has culminated in the endorsement of aspirin as a safe and effective VTE prophylactic agent in the most recent clinical practice guidelines of the American Academy of Orthopaedic Surgeons (AAOS) [26] and American College of Chest Physicians (ACCP) [27].

THE INTERNATIONAL CONSENSUS MEETING

As the annual volume of major orthopaedic procedures continues to grow, updated guidance on the perioperative management of these high-risk patients has become increasingly essential. Despite the availability of multiple guidelines from national societies, it is noted that majority are not specific to orthopaedic surgery or limited to a specific surgical procedure (e.g. total hip and knee replacement), and published recommendations are often contradictory amongst different societies. Others have failed to account for important variations in geographic and racial predisposition to VTE. Importantly, nearly all published guidelines have formulated recommendations by including only high-quality evidence, which were often industry-funded trials as part of regulatory requirements for clearance of newer anticoagulant agents. While these studies were adequately powered to compare the incidence of distal DVT detected on imaging, they often did not evaluate symptomatic VTE or fatal PE as endpoints, which are arguably the bigger concern for patients and physicians [28]. Moreover, as with existing risk stratification tools, many of these guidelines have been criticized for overlooking complications that arise as a result of administration of chemoprophylactic agents (e.g., bleeding, wound-related complications, infection, and mortality) [29], which inevitably create an immense burden on the healthcare and lead to substantial morbidity and mortality.

To address the limitations of existing guidelines, the inaugural International Consensus Meeting (ICM) on VTE was held virtually in 2021, convening experts from across the globe to generate consensus guidelines based on the established Delphi method, as in prior ICM activities. The first step was the selection of 570 international delegates from 68 countries and 135 societies (Table 1).

Society Name
American Association of Hip and Knee Surgeons (AAHKS)
American Society for Regional Anesthesia (ASRA)
American Academy of Orthopaedic Surgeons (AAOS)
American Society for Surgery of Hand (ASSH)
American Society of Anesthesiologists (ASA)
American Society of Shoulder and Elbow Surgeons (ASES)
American Venous Forum (AVF)
American Orthopaedic Foot & Ankle Society (AOFAS)
American Orthopaedic Society for Sports Medicine (AOSSM)
Argentine Association of Orthopedics and Trauma (AAOT)
Asia Pacific Arthroplasty Society (APAS)
Asia Pacific Knee Society (APKS)
Australian Knee Society
Australian Orthopaedic Association
Australian Orthopaedic Foot & Ankle Society
Austrian Society of Orthopaedics
Azerbaijan Orthopedic Society
Bahrain Sports Medicine and Science
Belgian Hip Society
Belgian Orthopaedic Association
Belgian Shoulder and Elbow Society
Bolivia Orthopaedic Society
Brazil Society of Angiology and Vascular Surgery (SBACV)
Brazilian Association for the Study of Implants and Osteoarticular Infections
Brazilian Society of Orthopedics and Traumatology (SBOT)
British Orthopedic Foot and Ankle Society (BOFAS)
British Hip Society
British Knee Society
Bulgarian Orthopedic Association
Canadian Orthopaedic Association (COA)
Cervical Spine Research Society (CSRS)
Chilean Society of Hip Surgery
Chinese Orthopedic Association (COA)
Colombian Orthopedic Association
Croatian Orthopedic Association
Danish Orthopaedic Society (DOS)
Dutch Federation of Medical Specialists
Ecuador Orthopedic Association (SEOT)
Egyptian Orthopedic Association
Emirates Orthopedic Society
European Federation of National Associations of Orthopaedics & Traumatology (EFORT)
European Hip Society (EHS)
European Knee Society (EKS)
European Musculoskeletal Oncology Society
European Society for Regional Anesthesia (ESRA)
European Society for Sports Traumatology Knee Surgery and Arthroscopy (ESSKA)
European Venous Forum
European Foot and Ankle Society
French Orthopedic Society
German Orthopedic and Trauma Society
German, Austrian, Swiss Society of Thrombosis and Haemostasis
Hellenic Association of Orthopaedic Surgery & Traumatology Nomination
Hellenic Hip Society
Hellenic Knee Society
Hellenic Orthopaedic Association
Hong Kong Orthopaedic Association
Hungarian Orthopaedic Association
Indian Orthopaedic Association
Indonesian Hip and Knee Society
Indonesian Orthopaedic Association
International Hip Society (IHS)
International Musculoskeletal Society (IMS)
International Society for Hip Arthroscopy (ISHA)
International Society for Limb Salvage (ISOLS)
International Society on Thrombosis and Haemostasis (ISTH)
Iranian Orthopaedic Association
Irish Orthopaedic Association
Israeli Orthopaedic Association
Italian Hip Society
Italian Orthopedic Association
Italian Society on Thrombosis and Hemostasis
Japanese Orthopaedic Association
Jordan Orthopedic Association
Kenyan Orthopedic Association
Korean Orthopaedic Association (KOA)
Kuwait Orthopedic Society
Lebanese Orthopedic Association
Lithuanian Society of Orthopedics and Traumatology
Lumbar Spine Research Society (LSRS)
Malaysian Orthopaedic Association
Mexican Federation of Orthopedics and Traumatology
Mexican Hip Society
Mexican Orthopedic Association
Musculoskeletal Tumor Society (MSTS)
National Institute for Health and Care Excellence
Netherlands Orthopaedic Society
New Zealand Hip Society
New Zealand Orthopaedic Association (NZOA)
Nigerian Orthopedic Association
North American Spine Society (NASS)
Norwegian Orthopaedic Association
Orthopaedic Society of Oman
Orthopedic Trauma Association (OTA)
Osteosynthesis and Trauma Care Foundation (OTC)
Pakistan Orthopaedic Association
Pan Arab Orthopaedic Association
Panamanian Society of Orthopedics
Pediatric Orthopaedic Society of North America (POSNA)
Peruvian Orthopedic Association
Philippine Orthopaedic Association (POA)
Polish Orthopaedic Association
Polish Society of Phlebology
Portuguese Society of Orthopaedics and Traumatology (SPOT)
Portuguese Society of Sport Medicine (SPAT)
Puerto Rico Orthopedic Association
Pulmonary Embolism Response Consortium (PERT)
Romanian Society of Orthopedic and Traumatology (SOROT)
Royal College of Orthopedic Surgeons of Thailand (RCOST)
Russian Orthopaedic Society (ROA)
Saudi Arabian Orthopaedic Association
Scoliosis Research Society (SRS)
Serbian Orthopedic Association
Société Internationale de Chirurgie Orthopédique et de Traumatologie (SICOT)
South African Orthopaedic Association (SAOA)
Spanish Arthroscopy Association (AEA)
Spanish Hip Society
Spanish Knee Society (SEROD)
Spanish Orthopedic Society (Sociedad Española de Cirugía Ortopédica y Traumatología) (SECOT)
Spanish Osteosynthesis and Trauma Care Foundation
Swedish Orthopaedics Association
Swiss Society of Orthopaedics and Traumatology
Taiwanese Orthopaedic Association
Thai Orthopedic Association
The American Knee Society
The Hip Society
Turkish Society of Orthopedics and Traumatology (TOTBID)
Ukrainian Orthopedic Association
Uruguay Orthopedic Association
Venezuelan Society of Orthopedics and Traumatology (SVCOT)
Vietnam Orthopaedic Association (VOA)
European Bone and Joint Infection Society

Physicians from various specialties were invited, including hematology, cardiology, internal medicine, anesthesia and orthopaedic surgery. Each delegate was then asked to send 5-10 clinical questions pertaining to the diagnosis or management of VTE. The 670 questions collected were evaluated for their clinical relevance and duplicates were removed. The remaining 200 questions were then rewritten according to the Delphi method. Each question was assigned to at least 2 delegates based on their published expertise or research interests. Delegates were subsequently tasked to perform a systematic review of the literature and synthesize the best available evidence to answer their assigned clinical question. The search strategy for the literature review was built with assistance from a group of medical librarians, including the Cochrane group. Thousands of publications were reviewed and screened according to inclusion and exclusion criteria. After 6 months of literature review, a recommendation and rationale was drafted for each question based on the included articles and extracted data. The strength of the recommendation was evaluated using the American Academy of Orthopedic Surgeons (AAOS) Clinical Practice Guideline and Systematic Review Methodology v3.0. The draft documents were then sent to one or two other delegates to review and critique. The documents were also posted on the ICM website for other delegates and the public to view. Any comments obtained during the review process was shared with the authors and incorporated in the revised documents. The revised documents were then sent to each Section Editor for further review, editing and finalization. As part of the Delphi requirement, recommendations for each question were voted on by the respective subspecialist delegates through an online voting system. Questions in the General section were sent to all delegates. Voting results were then incorporated into the document.

Over a period of 1 year, the final consensus document containing all published work related to VTE in orthopaedics was prepared according to the Delphi method and finalized. The ICM on VTE consensus document was recently published in The Journal of Bone & Joint Surgery in March 2022 (https://jbjs.org/collection.php?id=19). The document is also currently undergoing translation into various languages by international delegates and national societies across the globe.

In order to ensure that the consensus recommendations stayed relevant to orthopaedic subspecialists practicing in various fields, the document produced from the inaugural ICM on VTE was divided into various sections based on subspecialties within orthopedics: General [30], Foot & Ankle [31], Hand & Wrist [32], Hip & Knee [33], Oncology [34], Pediatric [35], Shoulder & Elbow [36], Spine [37], Sports [38] and Trauma [39]. Highlights of the inter-delegate discussions, synthesized evidence and consensus recommendations are summarized and presented herein.

In the ICM-VTE General section [30], Shohat and colleagues (Question 24) reviewed the literature on risk stratification and identified 7 different risk scores for VTE. Importantly, of the 10 articles meeting inclusion criteria, 8 involved total joint arthroplasty (TJA) patients, whereas only 1 involved lower extremity trauma patients and 1 involved foot and ankle patients. Only 1 study evaluated patients prospectively and was hence able to take into account the influence of chemoprophylaxis [40]; external validation was lacking for all studies. Another limitation of all but 2 of the available risk scores was the inclusion of PE and DVT (proximal and distal) as one combined outcome. Given the increasing evidence suggesting that PE and DVT are two distinct entities [41], individual risk factors may need to be weighed differently with respect to each entity. Finally, one major limitation common to all of the current scoring systems was the failure of these scores to account for major bleeding events or wound complications. As clinical decisions pertaining to a patient's VTE risk may also affect bleeding risk (Question 25), it was widely agreed that future risk scoring systems should also incorporate the risk of major bleeding events and wound complications.

Another topic that received much attention during the ICM on VTE was the topic of distal DVT. Most delegates agreed that the risk of propagation of distal DVT to the lungs was uncertain following lower limb arthroplasty (Question 28). Majority of the literature pertaining to the natural history of VTE evaluated cases of unprovoked DVT or provoked DVT in the setting of prothrombotic risk factors–– the pathophysiology of which differs greatly from the provoked postoperative DVT. As such, it was apparent that robust evidence on the causal relationship between DVT and PE was lacking in orthopaedic surgery. Regarding the management of distal DVT, the workgroup recommended that isolated distal DVT could either be treated immediately upon diagnosis with aspirin, or monitored by holding anticoagulation and only treating progression to proximal veins or if PE was identified (Question 30 and 31). However, given that majority of the literature evaluating the treatment of distal DVT was non-orthopaedic and non-surgical including mixed diagnoses and levels of comorbidity [42], the risk of over-treatment with anticoagulation in the postoperative setting was nonetheless emphasized. These recommendations were echoed in the document on the treatment of soleal vein thrombosis after orthopaedic surgery (Question 31).

Other pertinent areas of debate during the meeting included various surgical practices and their relationship with postoperative VTE risk. Sousa et al. discussed the use of lower limb tourniquets in orthopaedic surgery, recommending that there was insufficient evidence to draw the association between tourniquet use and the risk for postoperative VTE (Question 18). The authors found high-level evidence showing the lack of a relationship between the two [43–46]. Moreover, a systematic review and meta-analysis of foot and ankle procedures demonstrated limited evidence for increased risk of VTE with the use of a tourniquet. Despite limited evidence on tourniquet use as a risk factor, the authors noted that the tourniquet duration did influence the risk of VTE [47–49], although they qualify that the relationship between tourniquet time and operative time was often difficult to separate and the duration of tourniquet use varied widely among surgeons (i.e. whole procedure vs. cementation only). Another topic of contention was the use of PMMA cement (Question 22). Kwong and colleagues found that the use of polymethyl methacrylate (PMMA) cement influenced the risk of subsequent embolization, some of which were labeled as VTE. Although PMMA cement and its component parts have not been demonstrated to be thrombogenic in vitro, clinical studies have identified embolic phenomenon associated with the use of PMMA

bone cement in spine [50–53], arthroplasty [54–56], and trauma literature [57]. Notwithstanding, it was agreed that surgical technique, anatomic location and patient selection likely played a pivotal role in the mitigation of VTE risk when using PMMA cement.

In the Hip & Knee section [33], it was not surprising that the topic of the optimal VTE prophylactic agent for TJA received the most attention. Tarabichi et al. performed a Network Meta-Analysis comparing the various chemoprophylactic agents and included all studies from Level I to Level IV, concluding that low-dose aspirin was the most efficacious agent [58–62]. In the same analysis, it was found that rivaroxaban exhibited slightly lower rates of VTE when compared to aspirin in Level I studies as only 4 such studies included aspirin, none of which directly compared aspirin to rivaroxaban [58,60,63,64]. Overall, the findings of the ICM delegation were consistent with a recent meta-analysis of randomized controlled trials (RCTs), which demonstrated that there was no difference in risk of developing VTE in patients receiving aspirin versus other anticoagulants following TJA [65]. Despite a 20% disagreement, a consensus statement was reached, which recommended low-dose aspirin as the most effective and safest agent for VTE prophylaxis in TJA, even in moderate- to high-risk patients (Question 3). Goh et al. further noted that the risk of VTE was increased in patients undergoing simultaneous bilateral TKA (Question 4) and THA (Question 5). While there was a paucity of evidence on the optimal prophylactic agent following bilateral procedures, there was also emerging evidence to suggest that aspirin was a viable option in bilateral TKA [66,67] and bilateral THA [68].

The use of pneumatic compression devices (PCD) in ambulatory THA and TKA was also a topic of discussion (Question 13). While delegates noted that PCDs were effective following inpatient TJA when used concurrently with chemoprophylaxis, there was limited data on the effectiveness of PCD in outpatient TJA. Moreover, a few studies demonstrating concerns with PCD compliance in the ambulatory setting have been published, with the notion that some patients may not be compliant with the use of these devices following discharge from hospital [69].

In the Trauma section [39], ICM delegates recommended that low-molecular-weight heparin (LMWH) should be used as the most optimal agent for patients with multiple orthopaedic injuries (Question 1), while IVC filters should be reserved for patients who cannot receive any form of prophylaxis or patients undergoing urgent surgery [70–72]. The use of mechanical prophylaxis without chemical prophylaxis in the absence of contraindication to chemical prophylaxis was not recommended in light of the evidence reviewed [73,74]. The appropriateness of aspirin for the prevention of VTE in hip fracture patients undergoing hemiarthroplasty or THA was also discussed (Question 10). Hip fracture is one of the most common orthopaedic conditions worldwide, which is associated with an elevated risk of VTE [75,76]. Based on recent multi-institutional data [77], delegates eventually came to consensus that low-dose aspirin could be a safe and effective agent for VTE prevention in this patient population. Another highlight from the discussions was the management of patients with immobilization of the lower extremity who did not require surgery (Question 7). Despite several meta-analyses supporting the effectiveness of thromboprophylaxis in VTE prevention [78,79], delegates recommended against the routine use of agents due to the fact that majority of included studies were powered for asymptomatic DVT, as detected on routine ultrasound screening, versus the clinically important symptomatic VTE.

In the Foot & Ankle section [31], several important gaps in the literature on VTE prophylaxis and management were noted. In the area of diabetic foot ulcer (DFU) management, delegates did not find any evidence to determine whether a diabetic patient undergoing ulcer debridement required VTE prophylaxis (Question 1), although it was recognized that these patients were at an increased risk of developing VTE in part due to comorbid conditions and frequent hospitalization for acute medical conditions and surgery [80–82]. Another area that was lacking in evidence was the selection of VTE prophylaxis based on weight-bearing status after foot & ankle surgery (Question 3). Sherman et al. recommended that the risk of VTE would be mitigated if load-bearing of the operative limb was

greater than 50%, although no additional conclusions could be made regarding the selection of chemoprophylaxis based on the available literature.

In the Hand & Wrist section [32], the main topic of discussion pertained to discerning which type of surgeries should be considered 'major' in terms of VTE risk (Question 1). It was agreed that surgeries involving general anesthesia for >90 minutes, surgeries requiring bedrest or limited ambulation postoperatively, and surgeries involving replantation or free vascularized tissue transfer should be considered major in Hand Surgery. However, the delegates acknowledged that due to the extremely low incidence of VTE following hand surgery [83], current recommendations were largely based on expert opinion. In the same vein, a strong agreement was reached on the recommendation that the VTE prophylaxis was not required in patients undergoing wrist and finger surgery in the absence of risk factors (Question 2 and 3).

In the Sports Medicine section [38], delegates recommended that patients undergoing lower extremity sports procedures with weight-bearing restrictions or limits on ambulation should be considered 'major' in regards to VTE risk (Question 1). It was further recommended that this at-risk population should routinely receive VTE prophylaxis unless they were at a high risk of bleeding (Question 3). Given the rapid increase in the utilization of hip arthroscopy in recent years [84,85], specific recommendations were made for this patient population (Question 5). Griffin et al. performed a comprehensive review of the literature and found a VTE incidence of 0.2%–9.5% following hip arthroscopy. One systematic review [86] explored the role of chemoprophylaxis in this population, including aspirin (ASA), low-molecular-weight heparin (LMWH) and other unspecified agents in their analysis. The authors reported a pooled VTE rate was 2.0% in patients with prophylaxis compared with 3.6% in those without–– a difference which was not statistically significant. Due to the low risk of VTE, the delegates ultimately recommended against the routine administration of VTE prophylaxis for patients undergoing hip arthroscopy. Despite the diverse nature and severity of lower extremity orthopaedic sports procedures, it was agreed among most delegates that the overall VTE risk was very low and hence ICM recommendations were largely based on limited evidence and expert opinion.

In the Shoulder & Elbow section [36], Egol et al. stated that there was a risk of VTE, and hence need for prophylaxis, in patients undergoing upper extremity surgery who required extended period of immobilization (Question 4), based on several published case reports and the 2018 guidelines published by the National Institute for Health and Care Excellence (NICE) [87]. However, the degree of risk associated with type and duration of immobilization, as well as the optimal method of prophylaxis could not be determined based on current literature. The need for VTE prophylaxis following arthroscopic stabilization procedures was also another area of discussions (Question 9). Despite the limitations of the literature, it was recommended that due to the increased risk of VTE in Latarjet surgery compared to open or arthroscopic Bankart surgery, pharmacological prophylaxis should be considered for these patients. However, the delegates qualified that the majority of studies were conducted on patients undergoing an open Latarjet/Bristow procedure, hence these recommendations may not apply to a cohort of arthroscopically treated patients.

In the Spine section [37], delegates came to a consensus that there was no role for routine screening for DVT in the preoperative or postoperative period for patients undergoing spine procedures (Question 1). Doppler ultrasonography surveillance was, however, recommended in high-risk patients who are older with a history of prior spine injury, prior VTE, malignancy, cervical spondylotic myelopathy, or non-ambulatory status. The timing of commencement of VTE chemoprophylaxis was another topic of discussions (Question 4). In view of the concern regarding the risk of hematoma, which could lead to cord compression and neurological sequelae, delegates proposed that VTE chemoprophylaxis should be started within 24-48 hours following elective lumbar fusions, and within 48 hours in patients considered to be at risk of bleeding. The lack of prospective data on this subject was nonetheless emphasized. Finally, perioperative bridging therapy for patients on chronic anticoagulants was not

recommended in view of recent data from randomized double-blinded trials (Question 9). Delegates found that despite the higher risk of major bleeding, this practice was not superior to placebo in preventing thromboembolic events following cessation of anticoagulation prior to spine surgery.

In the Oncology section [34], delegates agreed that patients that undergo prophylactic fixation of malignant bony lesions or treatment of pathological fracture had a high risk of developing VTE and required chemoprophylaxis of some sort (Question 1). Similarly, patients undergoing sarcoma surgery were believed to carry a high risk of VTE. As such, chemoprophylaxis comprising either LMWH or aspirin was recommended in this population (Question 3).

In the Pediatrics section [35], it was widely acknowledged that the risk factors for VTE were largely similar to those in adult patients (Question 1), although certain VTE risk factors reported in adult literature (e.g., smoking) were likely to be less prevalent in children, and vice versa (e.g., congenital thrombophilia). Goh et al. suggested that the incidence of pediatric VTE is bimodal (highest incidence rates in infants and adolescents [88]) and the most common risk factors in pediatric orthopaedic patients included trauma, infection, cancer, clotting disorders, and a personal or family history of VTE [89–91]. However, due to the low incidence of VTE in the pediatric population, no standardized risk-stratification tools have been developed to weight and assess these risk factors (Question 2). Considering the rarity of VTE events in healthy pediatric and adolescent patients undergoing elective orthopaedic procedures, early ambulation and/or mechanical intermittent devices were recommended as sufficient modalities for the prevention of VTE (Question 7 & 8).

SETTING THE STANDARD OF CARE

The issue of VTE prophylaxis after orthopaedic procedures has been the subject of discussions inside and outside courtrooms. Numerous lawsuits are filed on an annual basis against the medical community whenever a patient undergoing an orthopaedic surgical procedure develops VTE. The perennial question within the courtroom is whether the standard of care related to the issue was followed by the defending physician. However, questions on what constitutes the “standard of care” for VTE prophylaxis following orthopaedic procedures remain unanswered. Medical malpractice lawyers widely acknowledge that the jury ultimately determines whether the standard of care was followed. Notwithstanding, the jury obtains assistance from experts on both sides of the case who make arguments on how the physician violated or upheld the standard of care. These experts, in turn, point to the presence of clinical practice guidelines (CPGs).

While there is a strong argument that, CPGs are often used as a sword rather than a shield in the courtroom, this does not take into consideration the events that occur before the case reaches the courtroom–– Cases are often rejected by attorneys in the event that there are strong CPGs in place that would protect the physician in court. Similarly, physicians’ attorneys may use CPGs to file dispositive motions that dismiss cases before they get to court.

The current consensus document on VTE was produced by experts from across the globe. Delegates were selected using a rigorous process and specialties beyond orthopaedic surgery such as hematology, anesthesia, cardiology, internal medicine, infectious diseases, oncology, and other fields were well-represented in the delegation. The development of the consensus document also followed an established and respected Delphi method, which minimizes the potential for bias. Content was reviewed by numerous experts in the field and recommendations underwent a thorough scientific peer-review process imposed by the most reputable orthopaedic journal in the world–– the Journal of Bone and Joint Surgery. Finally, the current document is believed to be generalizable and

relevant to most orthopaedic practitioners, as for the first time, guidelines covered all subspecialties within orthopaedics. After careful legal evaluation, it is hoped that the consensus document will help to set the "standard of care" in VTE prophylaxis in the field of orthopaedic surgery.

FUTURE DIRECTIONS

The incidence of VTE after major orthopaedic surgery has remained relatively stable over the past two decades [3,92]. Similarly, the rate of symptomatic or fatal PE has remained unchanged despite the use of potent anticoagulation [93,94]. Given the relatively stable rate of VTE, which is approximately three times lower than the rate of clinically important bleeding [28], research on the optimal prophylaxis has now been directed towards pharmacological agents that are comparably effective and concurrently minimize the risk of adverse events [20,24,29]. Over the past decade, aspirin has emerged as a promising first-line chemoprophylaxis option for majority of patients undergoing orthopaedic procedures, with ample evidence supporting its efficacy, excellent safety profile and peripheral benefits. With the trend towards personalized medicine, it was unanimously agreed that future research should focus on the development of individualized risk calculators and prediction models that will enable clinicians to select the optimal VTE prophylaxis strategy that is tailored to the specific needs of each patient. The inaugural ICM on VTE strived to address as many clinical questions based on the available literature, although there is still much work to be done. This was a monumental task that could not have been completed without the sacrifice and dedications of many experts across the world. We are hopeful that the generated work will serve our patients and our community for years to come.