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Consensus on the management of traumatic brain injury in older adults: Results from a Delphi study

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ABSTRACT

Introduction: As the world population is rapidly becoming older, the incidence of traumatic brain injury (TBI) is increasing among older adults with vast implications for brain health of older adults in Europe. Due to differences from younger patients, there are areas of uncertainty in the assessment, diagnosis and management of TBI in older adults.
Research question: To reach a consensus among experts on statements regarding the definition of old age, assessment, diagnosis and management of traumatic brain injury in older adults.
Materials and methods: A modified Delphi method consisting of two online rounds was organised, followed by an in-person meeting. Consensus was defined as >75 % agreement. In the second online round the experts were able to view their first assessment and the average of the group. Some statements were rephrased and presented again in the in-person meeting. Questions with numerical data could not be assessed by consensus and descriptive and non-parametric statistics were used to analyze them.
Results: Experts (n = 72), from different nationalities (Europe, United States, Latin America, Africa and Asia) and specialities (Neurosurgery, Emergency Medicine, Intensive care medicine) responded on 62 statements. Consensus was finally reached on 44 statements regarding the definition of older adulthood, as well as the assessment, surgical and intensive care management, discharge, and rehabilitation of patients.
Discussion and conclusions: This consensus reinforces the importance of this area for physicians and researchers interested in traumatic brain injury. It signals important areas of agreement as well as future topics for research and specific knowledge gaps.

1. Introduction

Traumatic brain injury (TBI) is a major cause of mortality and disability in all countries worldwide irrespective of their income and resource status(Global, 2019; Guan et al., 2023). The epidemiology of TBI has changed globally as a result of the demographic changes of our societies, with the proportion of the population above 65 years of age now accounting for around 20–30 % of the population in high-income

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countries(Majdan et al., 2016; Kureshi et al., 2021). The main cause of TBI in many countries has changed from traffic accidents to falls due to a higher proportion of older adults but also to the fact that older individuals engage more in recreational activities and live longer (Majdan et al., 2016; Lecky et al., 2021; Brazinova et al., 2021).

TBI in older adults is characterized by several differences with respect to younger patients. Older adults often have one or more comorbidities and are often on anticoagulants, beta-blockers or central nervous system-influencing drugs that predispose them to falls and worse traumatic intracranial haemorrhages(Munro et al., 2002; Gavrila Laic et al., 2023). Age has been a constant negative prognostic factor in many studies of TBI(Gómez et al., 2000), which may sometimes lead to an overly nihilistic approach to treatment (Skaansar et al., 2020; Tran et al., 2023). Older adults with TBI also present a diagnostic challenge as they generally have a higher initial Glasgow Coma Score (GCS) than younger patients presenting with a similar injury severity(Hachem and Bernstein, 2020). Older age is more often associated with the presence of post-traumatic intracranial lesions, but also with the development of new lesions or the progression of existing lesions over the course of time (Cepeda et al., 2015). Management of older adults is also difficult since their physiological reserve and recovery potential is reduced, and overall, there is lack of clear guidance in terms of intensive care or surgical management(Lenell et al., 2022). Due to their high number, the major burden of TBI care is now determined by the age group of older adults in many healthcare systems(Laic et al., 2022; Gómez et al., 2014; Maas et al., 2022)–(Laic et al., 2022; Gómez et al., 2014; Maas et al., 2022).

The Delphi process is a well-established method to reach a consensus when empirical evidence is not available to answer a particular question. Because of the magnitude of this healthcare problem, the EANS (European Association of Neurosurgical Societies) Trauma and Critical Care Section has decided to try to reach a consensus on relevant topics in the diagnosis, management and care of the older adults suffering TBI.

2. Methods

2.1. Study design

A 3-round modified Delphi study was conducted consisting of a 2-round online Delphi questionnaire followed by an in-person online consensus meeting between May 2023 and November 2024. The preliminary statements were drafted by a working group from the European Association of Neurosurgical Societies (EANS) Trauma and Critical care Section, composed of neurosurgeons, based on a literature review and internal group discussions. These statements were grouped in different subheadings covering different aspects of TBI definition, diagnosis and management. Participants' consent was obtained at the first round by explicitly acknowledging voluntary participation and use of the data collected.

2.2. Expert panel participants

Experts were recruited through the EANS Trauma and Critical Care Section, the Spanish Society of Neurosurgery (SENEC), the World Federation of Neurological Surgeons (WFNS) and the International Neurotrauma Society (INTS). Invitees had to be neurotrauma specialists with at least 5 years of work experience, either as neurosurgeon, intensivist or emergency physician. The panel was finally constituted by response to a small questionnaire including specific consent on data usage and participation. The panel was finally composed of 72 experts. Most of them were neurosurgeons (54, 75 %), followed by neurointensivists (15, 21 %) and emergency physicians (3, 4 %). Europe was the most common region of origin of the experts (59, 82 % of the experts), followed by North America (6, 8 %), Asia (4, 6 %), Africa (2, 3 %) and South America (1, 1 %).

2.3. Two round delphi questionnaire

Two iterative rounds of online questionnaires were distributed though the REDCAP platform. The experts were requested to rate their agreement with statements by means of a Likert scale from 1 to 8. Consensus was defined as >75 % agreement. Responses with >75 % agreement and statements with more than 75 % rating of the three lowest or three highest Likert scores in round 1 were resubmitted to the experts in the second round, with the option to agree or disagree (to confirm consensus). The statements with >50 % and ≤75 % rating of the three lowest or three highest Likert scores were resubmitted without change along with the average and personal scores (i.e. each participant can compare their individual scores with the averages of the group in order to stimulate agreement). If there was ≤50 % agreement, the statement was considered as resulting in no consensus.

For questions on age limits, results of round 1 presented a distribution without consensus being reached. The results were included in round 2 in order to aim for a narrower distribution.

2.4. Online consensus meeting

Following the second Delphi round, 15 statements ended in between no-consensus and consensus. In an online meeting, these statements were rephrased in an open discussion and immediately submitted to the panel for anonymous voting in favor or against the rephrased statement. Consensus was reached if 75 % of the attending panelists voted in favor.

2.5. Data processing, availability and statistics

Descriptive statistics were performed with SPSS software. Quantitative data were analyzed obtaining medians and interquartile (IQ) range. The effect of comorbidities in age definitions were analyzed using nonparametric tests (Wilcoxon Rank sum test). The data associated with the study are available from the corresponding author on reasonable request.

3. RESULTS

3.1. Delphi study process

In the first online round 72 experts evaluated 62 statements divided into different thematic areas corresponding to main areas of discussion on TBI in the older adults (Fig. 1). In this first offline round 19 statements reached consensus. A second round was then prepared in which 3 statements were rephrased for better understanding and experts were presented with their own personal scoring as well as the general scoring for each statement. All 72 participants from round 1 were invited to participate in round 2, of whom 67 participants completed the second round, in which the 62 statements were re-scored, and consensus was reached on 40 statements. An online meeting was organized in which 24 experts participated, and 15 statements in which consensus had not been reached were evaluated. Only three new statements reached consensus in this online meeting. A statement was rephrased in this meeting and a third round was organized to finally reach consensus in this final statement, so consensus was reached in 44 (71 %) of the original statements.

3.2. Results of the consensus process

The statements were organized by thematic areas. The statements and proposals and the proportion of agreement in the different rounds of the Delphi process are presented in Supplementary Table 1 and a summary of the different statements in which consensus was achieved is presented in Fig. 2.

The definition of old age should include calendar age, systemic comorbidity, frailty and the level of independence, as these factors

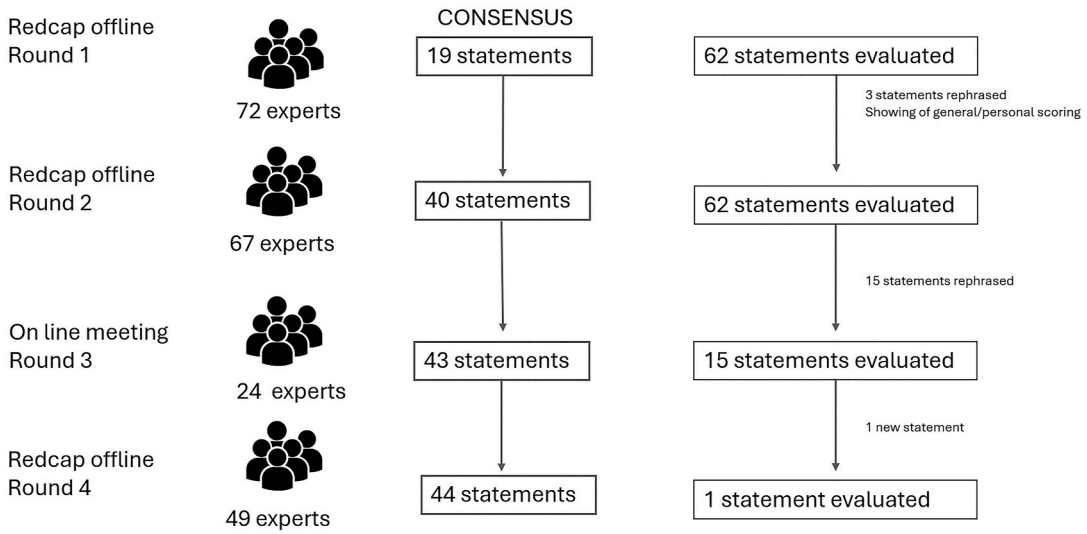


Fig. 1. Overview of the 4 round Delphi study process.

collectively influence the individual impact of ageing. The age at which experts define older adulthood is significantly modified by the presence of comorbidities (without comorbidities median age 75 years; IQ range = 70–80; with comorbidities median age 65, IQ range 65–70; $p < 0.001$) (Fig. 3). Regarding patient assessment there were doubts regarding the utility of GCS in older adults to determine the TBI severity and predict outcome. During final discussion, it was recognized that it would be ideal to have a modified scale that could differentiate dementia states from decreased levels of consciousness.

A frailty assessment tool seems necessary when assessing older adults suffering trauma and it would be desirable to have a specific, standardized and easy to use tool for this group of patients. Information regarding comorbidities and ongoing treatments should be obtained to better assess the patient's condition after TBI through interviews with relatives and consultation of general practitioner's notes. Neurosurgeons should be consulted for any older adult with proven TBI and traumatic Computerized Tomography (CT) abnormalities.

Experts agreed on the main clinical decision rules for the diagnostic management of mild TBI and CT prescription in older adults. However, the use of biomarkers to supplement these clinical decision rules is still a matter of debate, as there was agreement on the need for a clear guideline for the use of biomarkers as screening tools to guide CT prescription in this population. Experts disagreed in general on the readiness of biomarkers as guides for CT prescription or outcome prediction after mild TBI in this population.

In terms of neurosurgical treatment, the experts disagreed on the general application of the Brain Trauma Foundation guidelines for hematoma evacuation in older adults as in younger patients without exception. The experts signalled a more individualized approach by agreeing on a more conservative treatment of acute subdural hematomas in certain situations (assuming a stable Glasgow coma scale(GCS) > 12) and by agreeing on a less aggressive or more conservative approach in the neurosurgical treatment of older adults. There was agreement on deciding on whether to monitor or not intracranial pressure (ICP) depending on GCS as well as on CT scan findings of atrophy and mass effect. There was also agreement on discussing treatment withdrawal decisions with families in patients with relevant comorbidities or high preinjury frailty in whom poor outcome is strongly expected. There was no agreement regarding determining an age limit for craniotomy for hematoma evacuation, but experts agreed on the presence of an age limit regarding both primary and secondary decompressive craniectomy. This age limit was also significantly affected by the presence of comorbidities (Fig. 3).

Regarding management strategies, experts disagreed with repeating CT scan in all older adult TBI patients. However, the panel preferred a more individualized approach rather than general recommendations based solely on age. They emphasized that decisions on whether to repeat a CT scan should depend on several factors, including the patient's clinical condition, initial CT findings, and co-morbidities, rather than being driven by age alone. This individualized approach ensures that repeat imaging is conducted only when clinically justified, avoiding unnecessary procedures that may not benefit the patient. In general, the experts agreed on repeating CT scan in patients with significant post-traumatic changes (symptoms or neurological examination), all contusions and subdural hematomas, and even after minor clinical changes in patients on antithrombotics. Additionally, the panel noted that there remains significant uncertainty regarding the optimal timing for repeating a CT scan in older adults with TBI.

There was also agreement on stopping antithrombotics for any hemorrhagic finding, even minor, weighing severity of the CT findings and the reason for antithrombotic treatment. Although huge variability in hospital policies and organizational structures may exist regarding haematologist consultation, the panellists stressed the critical need for a standardized protocol for the reversal of anticoagulant treatment in older adult TBI patients. Given that many older adults are on anticoagulants, rapid and effective management of bleeding complications is crucial for patient outcomes. The panel strongly recommended that such protocols be readily available to all physicians involved in the care of older adult TBI patients, ensuring timely and consistent care.

There was disagreement on the administration of platelets to patients on antiplatelet agents with significant hemorrhagic findings and on reverting anticoagulation only when there is a need for surgery. For the management in the intensive care unit (ICU), there is agreement on maintaining the same thresholds for ICP and cerebral perfusion pressure (CPP) as in the younger patients, and there is also a need for individualized management based on autoregulatory status. Experts disagreed on avoiding inotropes in older adults. Individual clinical circumstances, including the patient's hemodynamic status and overall condition, should guide the decision to use inotropes rather than a blanket prohibition.

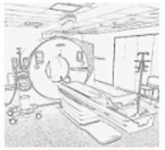
Experts agreed on specific discharge policies for older adults suffering from TBI, as there is consensus on discharging them to medical wards and other specialists as geriatricians should play a key role in post-acute care in older adults. Although older adults may have less potential to improve after TBI, there is consensus in the need for adapted rehabilitation in this population.

Chapter 1. Definition of old age

- In agreement:Definition of old age should include
  - Calendar age
  - Frailty
  - Comorbidities
  - Independence

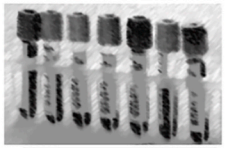
Chapter 2. Patient assessment

- In agreement:
  - Admission GCS is less predictable of outcome in elderly
  - A frailty assessment tool should preferably be used when assessing elderly trauma patients
  - A specific and easy to use frailty assessment tool should be developed for use in elderly trauma patients
  - Information on frailty/comorbidities and drugs should be seeked
  - A neurosurgcial consultation is required in every older patient with proven TBI and traumatic abnormalities.



Chapter 3. CT scan rules

- In agreement:
  - Following Canadian CT head rule for ordering a CT scan: Order a CT scan in every TBI patient older than 65 y or receiving anticoagulants
  - Following NICE rule for ordering a CT scan: order a CT scan in every TBI patient older than 65y or receiriving anticoagulants
  - Scandinavian guidelines for head injury: Order a CT scan in every TBI patient receiving anticoagulants or those patients older tan 65y and receiving antiplatelets.



Chapter 4. Biomarkers

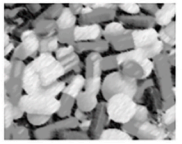
- In agreement:
  - A clear guideline for the use of biomarkers as screening tools to guide CT prescription is needed in elderly population.
- In disagreement:
  - Biomarkers are ready to be used as tools to guide CT prescription in elderly population
  - Biomarkers are ready to be used as outcome prediction tool in elderly population
  - UCH-L1 can be reliably used to avoid unnecessary CT in elderly population

Chapter 5. Surgical treatment

- In agreement:
  - In patients with thick subdural (more tan 1 cm width) hematoma and provided GCS remains stable above 12 evacuation is not urgently warranted
  - Less agressive (i.e. more conservative) treatment options can be safely adopted in elderly people
  - Decision for ICP monitor placement should depend on GCS as well as on CT scan findings atrophy and mass lesion.
  - In patients with relevant comorbidities or high preinjury frailty in whom poor outcome is expected, it is reasonable to discuss treatment withdrawal with the family
  - Age limits apply to primary and secondary decompressive craniectomy in elderly
- In disagreement: BTF surgical guidelines for hematoma evacuation apply as in younger patients without exception

Chapter 6. Repeat CT scan after TBI in the elderly

- In agreement:
  - Repeat CT scan: Should be performed witin 24 hours in significant postraumatic changes (symptoms or neurological examination)
  - Repeat CT scan: Should be performed within 24 hours in all contusions
  - Should be performed within 24 hours in all acute subdural hematomas
  - Should only be performed even in minor clinical changes when on antithrombotics
- In disagreement: Repeat CT scan: Should be performed in ALL elderly TBI patients (regardless of CT findings or antithrombotics)



Chapter 7.Stopping antithrpombotic treatment

- In agreement:
  - Stop them in any hemorrhagic finding even minor
  - Stopping antithrombotic treatment can be considered in elderly TBI patients even with minor CT findings, balancing severity of CT findings and the reason for antithrombotic treatment
- In disagreement:
  - Administer platelets to patients on antiplatelets with significant (i.e.: more than a small tSAH) hemorrhagic findings
  - Revert anticoagulation ONLY when there is a need for surgery

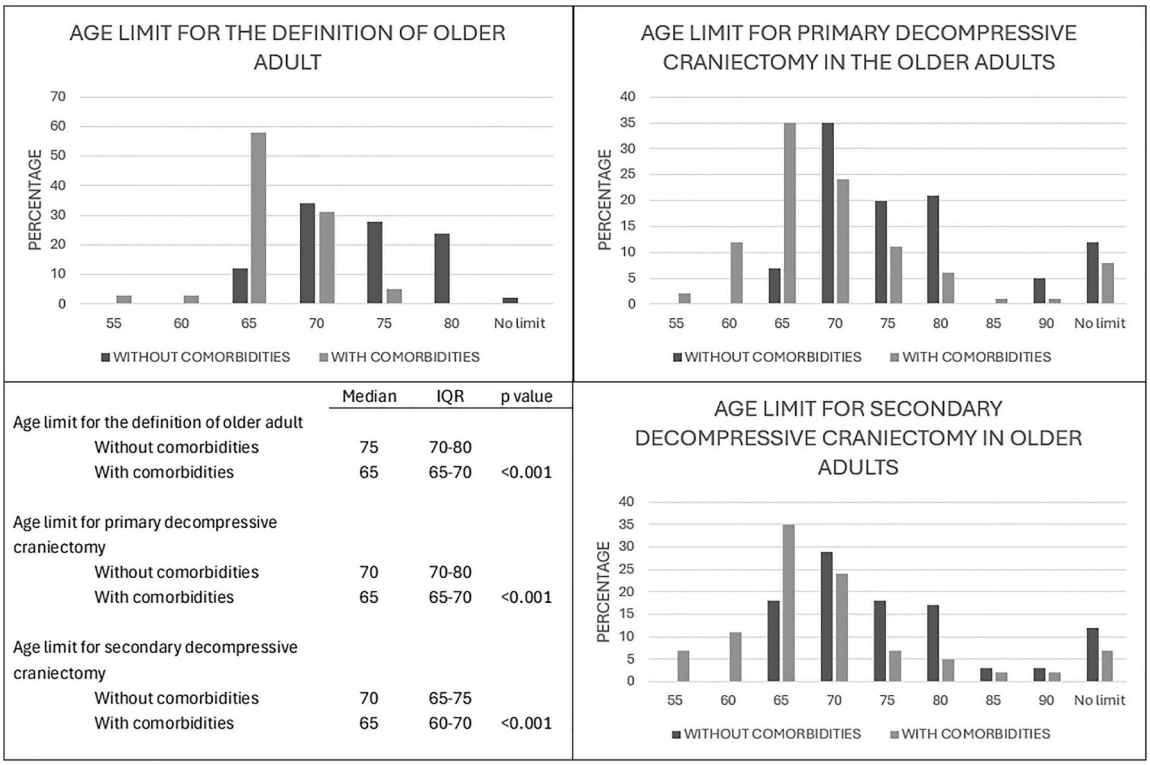
Chapter 8.ICU management of elderly TBI patients

- In agreement:
  - ICP target same as in younger
  - CPP target set at 60–70 mmHg
  - Individualize based on autoregulatory status
- In disagreement:
  - ICP target lower than in younger
  - CPP target set higher than 70
  - Avoid inotropes in the elderly

Chapter 9. Discharge and rehab

- In agreement:
  - Elderly patients should be discharged to medical wards as they need more medical support than neurosurgery
  - Although elderly patients may have less potential to improve after TBI there should be an adapted physical and cognitive rehabilitation program after TBI for this population
  - The geriatrician should play a key role in post-acute care in elderly patients with TBI

Fig. 2. Summary of statements in which consensus was obtained.



	Median	IQR	p value
Age limit for the definition of older adult			
Without comorbidities	75	70-80	
With comorbidities	65	65-70	<0.001
Age limit for primary decompressive craniectomy			
Without comorbidities	70	70-80	
With comorbidities	65	65-70	<0.001
Age limit for secondary decompressive craniectomy			
Without comorbidities	70	65-75	
With comorbidities	65	60-70	<0.001

Fig. 3. Quantitative age limits for definition of older adult age and surgical treatment.

4. Discussion

This study reflects the possibility of achieving consensus on 44 statements covering a wide range of aspects related to TBI in older adults by physicians with qualified experience. Consensus was reached in important areas in all proposed chapters, determining topics in which there is wide agreement and evidence in the literature, and others in which no clear consensus could be reached as there is no solid available evidence, identifying gaps of knowledge that will be topics for research and advancement in the near future.

Older age is difficult to define as ageing is a continuous process affected by individual circumstances, both biological and environmental (Partridge et al., 2018; Fjell et al., 2014). Therefore, individuals age at different paces. There was a clear consensus among experts in relation to the need of including these individual circumstances in the definition, including a chronological age, but adjusting it by the presence of comorbidities, poly-medication and frailty. Regarding age limits for decompressive craniectomy, 70 seemed the most accepted one. However, the age limit varies with an IQR of around 10 years among experts and is lowered by the presence of comorbidities, determining the need for an individualized approach for considering a person to be in the older adult group.

This individualized approach is logically translated into the assessment of any older adult being managed due to TBI and enhanced by the fact that older adults present with higher GCS scores than younger adults but have worse outcomes(Rau et al., 2017; Kehoe et al., 2016). Assessment of comorbidities and concomitant medications is essential, as well as frailty. Frailty is a consequence of low physical and cognitive reserve, making older adults more susceptible to the effect of illness (Zijlmans et al., 2021). Physical frailty, which involves functional status, is defined as an accumulation of deficits and biological indices related to lack of physical reserve across multiple organ systems and decreased resistance to stressors leading to an increased vulnerability to poor health outcomes(Sastry et al., 2022). There are different ways of combining physical frailty such as a) assessing a frailty phenotype based on characteristics such as physical activity, weight loss and/or muscle strength (Cheung et al., 2017); b) by assessing the accumulation of deficits, calculating frailty as the proportion of potential deficits an individual has (Tracy et al., 2020; Tang et al., 2022; Joseph et al., 2014); or c) combining different clinical features, functional characteristics, deficit accumulation and laboratory measures in a multidimensional construct (Galimberti et al., 2022). Due to the complexity of these measurements there is a need for an easy-to-use and universally standardized bedside instrument to assess this highly relevant characteristic. Although several frailty scales have been proposed, a simple and user-friendly tool that adjusts for age alongside modifiers such as comorbidities, frailty, and level of independence has not yet been validated for this population. However, several existing frailty assessment tools have shown predictive value when combined with age, comorbidity profiles, and neurological evaluations(Cray et al., 2025).

Older adults are more susceptible to intracranial bleeding, especially in the form of subdural hematomas due to shearing of cortical bridging veins even in the setting of minor trauma, favored by the loss of brain volume due to normal ageing and atrophy(Kerezoudis et al., 2020). In their initial assessment many older adults are under-triaged as GCS can underestimate the severity of intracranial hemorrhage due to brain atrophy(Skaansar et al., 2020; Kehoe et al., 2016). Therefore, there is a consensus in accepting all clinical decision rules that convey age as a risk factor for the development of intracranial lesions and prompting the need for CT prescription in the assessment of mild TBI in these patients (Stiell et al., 2001; Fournier et al., 2019; Vedin et al., 2021)–(Stiell et al., 2001; Fournier et al., 2019; Vedin et al., 2021). Blood biomarkers are promising tools to guide CT prescription after mild TBI. However, the role of these biomarkers, specifically Glial Fibrillary Acidic Protein (GFAP) and Ubiquitin Carboxy-terminal Hydrolase L1(UCH-L1) in older adults is still in debate, as their specificity decreases with age (Lagares et al., 2024; Calluy et al., 2024) and is unknown regarding neurological comorbidities and specific thresholds for this population are warranted (Lagares et al., 2023). Therefore, experts asked for specific guidelines for the use of these biomarkers and disagreed on their readiness for

diagnostic or prognostic management of these patients based on biomarkers results. When determining what kind of physician should oversee these patients, it was undetermined whether neurosurgery should be the specialty caring for these patients. However, a neurosurgical consultation should be sought in every older adult with proven TBI and traumatic intracranial abnormalities.

Lesion progression (increase in size of intraparenchymal hematomas or volume of subdural hematomas) is more frequent in aged patients (Cepeda et al., 2015). Both lesion presence and progression are additionally related to the high proportion of patients using antithrombotic medications in this population (Ziegenhain et al., 2021), as the rate of atrial fibrillation and other comorbidities that determine the use of these drugs increase with age. However, older adults are also at higher risk of thrombosis, as they exhibit greater coagulation and fibrinolytic abnormalities and present arterial and venous thrombo-embolisms more frequently than younger patients(Nakae et al., 2020). Both aspects determine the need for some guidance related to the need for repeating CT scan in the older adults (Fadzil et al., 2022), as well as when to stop and how and when to restart antithrombotic treatment, after TBI (Keirsey and Niziolek, 2025). There was consensus that a second CT scan is not mandatory in every older adult suffering TBI, as it would depend on the development of new neurological signs or symptoms or depending on the use of antithrombotics. Experts also acknowledged that certain lesions, such as contusions or acute subdural hematomas are more prone to increase in size and determine further deterioration of the patient, and that the use of antithrombotics is associated with a higher risk of lesion progression(Smith and Weeks, 2012). Though most experts agreed on stopping antithrombotics when facing any hemorrhagic finding on CT, even minor ones and not only when there is a need for surgery, there was some discussion related to the fact that ceasing this medication is not without risks of complications. Therefore, in the final round, a statement was added including the need for balancing severity of CT findings and the reason for antithrombotic treatment when stopping antithrombotic treatment. Following guidelines of use of antiplatelet medication experts disagreed in the use of platelet transfusion in patients with hemorrhagic CT findings in general, without the identifiable need for surgery.

Older adults typically face less aggressive surgical and ICU therapy (Skaansar et al., 2020). There is a double prejudice against performing surgical treatment in these patients. On the one side older age is a factor determining worse prognosis of patient after TBI and on the other (Naylor et al., 2022), surgery in older adultsis related to worse outcomes and increased number of complications(Kerezoudis et al., 2020). This consensus acknowledges these factors, as there is agreement on performing less aggressive treatments in these patients(Laic et al., 2022) and accepting that the Brain Trauma Foundation guidelines do not always apply to the older adults. There was also agreement on accepting that surgery can be delayed in patients with acute subdural hematomas while there are no signs of deterioration and in the stability of imaging findings. One of the major findings is that from the experts' perspective, there are no age limits for craniotomy. Several studies have already pointed out the possibility of achieving good results with surgical treatment in this population once they have been appropriately selected based on clinical situation, comorbidities and previous medications (Castaño-Leon et al., 2024; Merzo et al., 2016). However, more aggressive surgical treatments, i.e. primary and secondary decompressive craniectomy, are limited to younger patients, more even so in patients with comorbidities.

Regarding ICU management this consensus reflects actual knowledge. Though patients in this age group are less frequently monitored (Schupper et al., 2019), experts agreed on the need for adequately assessing the indication for monitoring in these patients and suggest tailoring this indication to patient's characteristics and image-based criteria. There is little evidence on the precise ICP or CPP thresholds in this population and therefore a consensus was reached to apply similar thresholds as in younger patients. Also, there was a suggestion from the experts on the individualized approach for the use of inotropes in the management of low CPP.

This consensus also acknowledges the need for adequate and adapted discharge policies for this group of patients. There is a need for adequate involvement of different specialists apart from neurosurgeons or intensivists, once patients are discharged from ICU or specialized care. There is consensus regarding transfer to medical wards and further involvement of geriatricians due to the presence of comorbidities and the demanding medical management of these patients. The need for coordinated multiprofessional involvement in the management of these patients and integrated team-based approaches has been recently highlighted(Depreitere et al., 2025). Experts also agree on the idea that the older brain still has a capacity for recovery post-injury, as there is agreement on sustaining rehabilitation therapy after injury.

This study presents several limitations. First, the expert panel was predominantly composed of European physicians, with limited representation from other continents and low- and middle-income countries. This imbalance may have constrained the diversity of perspectives and limited the generalizability of the consensus statements. Additionally, the selection of panelists primarily from leadership roles within neurotrauma societies may have introduced selection bias. Nonetheless, this composition represented the best feasible option after extensive outreach to multiple neurosurgical societies. Furthermore, differences in interpretation of survey items among experts may have contributed to inconsistencies or ambiguity in responses. To mitigate this, the study included rephrasing of statements between rounds and an online meeting that allowed open discussion among participants, aimed at enhancing clarity and consensus.

5. Conclusions and future directions

This consensus reinforces the importance of this area for physicians interested in traumatic brain injury. There are numerous areas of consensus and the level of agreement in many of them is high. Several areas of future research are highlighted such as: a)the effect of comorbidities and frailty assessment on establishing more a biological than a chronological age; b)biomarkers though promising still need to be refined in this population; c)there is a need for specific guidelines on stopping and restarting antithrombotics after TBI and d)there is need for evidence-based surgical and ICU management in this population and how to refine indications and managements strategies to improve outcomes. Well-designed and rigorous prospective studies are needed to better respond to these fundamental management questions. The management of these patients should be based on a multi-professional team-based approach and research in this area will surely benefit from this multifaceted view.

Author's contribution

AL, BD and NM conceived the study. AL, BD, NM, AMC, JPP, AY and SK provided input on the survey design and actively promoted the survey. AL and AMC collected and analyzed data. AL prepared figures and wrote a first manuscript draft, which was edited and reviewed by BD, NM, AMC, JPP, AY and SK. All authors reviewed the manuscript and provided feedback.

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Declaration of competing interest

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Appendix A. Supplementary data

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