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Measuring frailty in the older surgical patient: the case for evidence synthesis

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The surgical population is ageing and within that population patients are becoming frailer. The number of patients more than 75 yr old undergoing surgery in the UK increased from 544 998 in 1999 to 1 012 517 in 2015. It is estimated that by 2030, one-fifth of people aged 75 yr and older will undergo surgery each year.[1] A systematic review of studies in general surgery patients reported prevalence estimates ranging between 31.3% and 45.8% for pre-frailty, and 10.4% and 37.0% for frailty.[2] In a meta-analysis of 35 studies of major abdominal surgery, frailty was associated with an increased risk of postoperative major morbidity (odds ratio [OR] 2.56), short-term mortality (OR 5.77), and long-term mortality (hazard ratio 2.71).[3] Studies and meta-analyses consistently report an association between frailty and adverse outcome after surgery, but show considerable variation in the estimates of absolute and relative risks associated with frailty (heterogeneity), such that pooled risk estimates must be interpreted with considerable caution. In a systematic review that included data from nine studies of general surgery using a variety of frailty assessment tools it was not possible to produce a relative risk estimate for 90-day mortality because of the variation between studies.[2] A systematic review that examined the association between the frailty phenotype (described in more detail below) and outcome after surgery identified 12 relevant studies. Despite the restriction to a single measure of frailty, there was marked variation across studies attributable to factors including geographical location, type of surgery, study sample size, and type of complication.[4]

Thus, whilst studies consistently report an association between frailty and adverse outcomes, the strength of this association is not certain. Here we discuss the complexity of assessing frailty and highlight the uncertainty around the best tool for frailty assessment in surgical patients. We make the case for a formal evidence synthesis on frailty scores as a prelude to national or ideally international harmonisation.

Definition of frailty

Clinicians may believe that they can recognise frailty when they see it. This does not offer a rigorous clinical definition to direct clinical management and inform research. Frailty is often used by busy clinicians as a shorthand term to describe the vulnerable older patient. This prevents more considered thought about an important patient phenotype with incompletely understood aetiology and natural history for which there is wide variation in diagnostic criteria.

The shared central notion about frailty is of an older person who is at heightened vulnerability to adverse health status change.[5] Clegg and colleagues[6] define frailty as: ‘ … a state of increased vulnerability to poor resolution of homoeostasis after a stressor event, which increases the risk of adverse outcomes, including falls, delirium, and disability.’ The context of the definition makes clear that it refers to the older patient. However, younger adults can fulfil the criteria for frailty. In a multicentre Canadian study 28% of adults aged under 65 yr old admitted to ICUs were identified as frail.[7]

The terms frailty, comorbidity, and disability are often used interchangeably. They are distinct entities which require different interventions.[8] Disability is difficulty in carrying out the essential activities of everyday living. Comorbidity is the presence of two or more medically diagnosed diseases. In the current discussion we will focus only on frailty.

Over the past two decades two main constructs for the identification of frailty have emerged: the frailty phenotype and the accumulation of deficits. The frailty phenotype views frailty as a syndrome akin to a disease state. The accepted features of the phenotype are unintentional weight loss, self-reported exhaustion, weakness, slow walking speed, and low physical activity.[9] The phenotype omits cognitive and psychosocial features, both of which are associated with adverse health outcomes.[5] It also reflects a particular stereotype of frailty and does not address the older person who is both obese and frail and who may have worse health outcomes than a frail underweight individual. The accumulation of deficits model regards frailty as a burden of risk factors predisposing towards adverse events. The more deficits that a person has, the frailer they are. This approach forms the basis of the Clinical Frailty Index which was developed using data from the Canadian Study of Health and Ageing (CSHA).[10] Ninety-two items representative of deficits relevant to frailty were identified from the CSHA dataset. These included diseases, symptoms, signs, abnormal test results, and disabilities. The frailty index was defined as the ratio of the number of deficits present to the total number on which information was available. Subsequent studies from the same group indicated that indices using between 30 and 70 deficits are reliably associated with adverse health outcomes.[11]

Descriptions of frailty often focus on the loss of muscle or sarcopenia associated with the condition. Frailty and sarcopenia are distinct entities. Sarcopenia is defined as a progressive and generalised skeletal muscle disorder that involves the accelerated loss of muscle mass and function.[12] Frailty represents decreased reserve and dysregulation across multiple physiological systems of which the musculoskeletal is only one. To paraphrase Fried and colleagues,[8] frailty is the aggregate risk resulting from age or disease-associated physiologic accumulation of subthreshold deficits affecting multiple physiologic systems.

Assessment of frailty

Comprehensive Geriatric Assessment (CGA) is the established approach to the clinical assessment of older people. It is a specialist assessment that addresses medical conditions, psychological and cognitive status, and functional capacity. In hospital it is generally led by an older care physician and

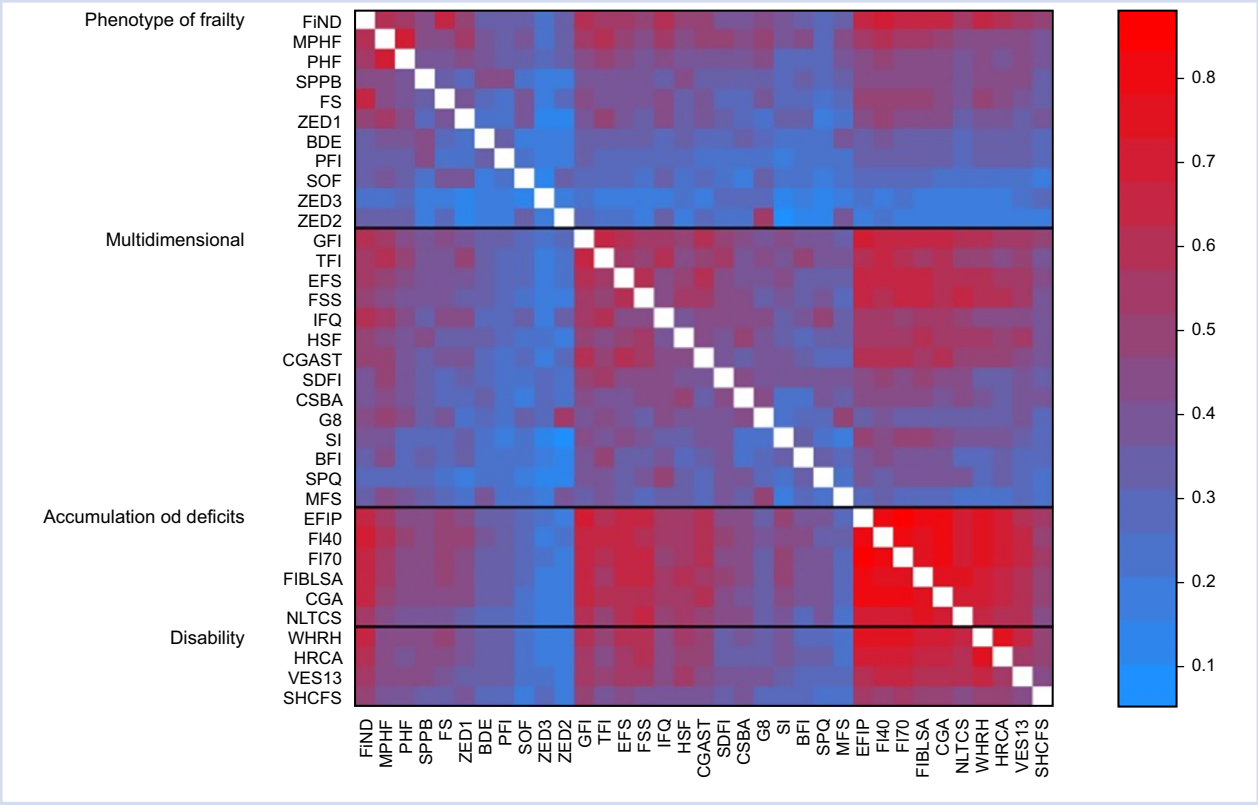

Fig 1. Agreement (calculated with Cohen's κ) between pairs of frailty scores (595 combined pairs of scores) among participants in wave 2 of the English Longitudinal Study of Ageing, 2004–2005. The plot is sorted by frailty model and then from highest (red) to lowest (blue) median value of Cohen's κ coefficient. BDE, Beaver Dam Eye Study Index; BFI, Brief Frailty Index; CGA, Comprehensive Geriatric Assessment; CGAST, Comprehensive Geriatric Assessment Screening Tests; CSBA, Conselice Study of Brain Aging Score; EFIP, Evaluative Frailty Index for Physical Activity; EFS, Edmonton Frail Scale; FI40, 40-item Frailty Index; FI70, 70-item Frailty Index; FIBLSA, Frailty Index Beijing Longitudinal Study of Ageing; FiND, Frail Non-Disabled (FiND) Questionnaire; FS, Frail Scale; FSS, Frailty Staging System; G8, G-8 geriatric screening tool; GFI, Groningen Frailty Indicator; HRCA, Hebrew Rehabilitation Center for Aged Vulnerability Index; HSF, Health Status Form; IFQ, Inter-Frail Questionnaire; MFS, Modified Frailty Score; MPHF, Modified Phenotype of Frailty; NLTCS, National Long Term Care Survey Frailty Index; PFI, Physical Frailty Index; PHF, Phenotype of Frailty; SDFI, Static/Dynamic Frailty Index; SHCFS, Canadian Study of Health and Aging Clinical Frailty Scale; SI, Screening Instrument; SOF, Study of Osteoporotic Fractures; SPPB, Short Physical Performance Battery; SPQ, Sherbrooke Postal Questionnaire; TFI, Tilburg Frailty Indicator; VES13, Vulnerable Elders Survey; WHOAFC, World Health Organization Assessment of Functional Capacity; WHRH, WHOAFC and self-reported health; ZED1, Zutphen Elderly Study (Physical Activity and Low Energy); ZED2, Zutphen Elderly Study (Physical Activity and Weight Loss); ZED3, Zutphen Elderly Study (Physical Activity and Low BMI). Reproduced with permission from Aguayo and colleagues.[14]

delivered by a multidisciplinary team that may include specialist nurses, physiotherapists, occupational therapists, and social workers.[6] The strength of CGA is that it supports care planned around the specific needs of the patient. The challenge CGA brings is the resources, time, and specialist older care skills needed for its delivery.[13] It sets the context against which frailty assessments must be judged.

Many frailty scores have been described, but they are far from consistent in their identification of the condition. Aguayo and colleagues[14] identified 67 scores described between 1970 and 2015. They were able to apply 35 of these to a dataset containing information on 5377 patients. Fig. 1 shows the frequent and often substantial disagreement between these scores.

It is beyond the scope of this editorial to describe and compare the performance the various frailty measurement instruments used in the perioperative setting. Indeed, it is our contention that this work needs to be undertaken in systematic and rigorous evidence synthesis. It is informative to give a brief overview of frailty instruments commonly encountered in studies of surgical patients. These include the Edmonton Frail Scale (EFS), the Clinical Frailty Scale (CFS), and a number of electronic frailty indices. The EFS is based on key aspects of CGA. Ten domains are assessed and the patient is rated on a scale ranging from 0 to 17 where 17 is most frail. In a study in which the EFS was administered by lay research assistants, the assessment generally took less than 5 min and had good interrater reliability and internal consistency.[15] The CFS aims to capture the frailty or otherwise of a person in a single numeric score between 1 (very fit) and 9 (terminally ill).[16] Its brevity has led to its widespread use in clinical practice. The authors of the judgement-based CFS suggested that it is better suited to use by clinicians with experience in the care of older people. It has been shown to be correlated with clinical

outcomes, although in many of these studies the scoring has been undertaken by specialist physicians or trained staff.[17]

Frailty scoring can be automated within electronic patient records by identifying codes for conditions related to frailty and using these to generate a score. This approach underpins the Electronic Frailty Index (eFI), based on the deficit accumulation model of frailty, which has been implemented in primary care records in the UK.[18] A similar approach has been taken to produce an index for use with the US National Surgical Quality Improvement Program (NSQIP) database. This maps 11 items recorded in the NSQIP dataset to 16 deficits.[19] Whilst the index is strongly associated with postoperative mortality, it is dominated by variables recording comorbidity. This is even more the case with an abbreviated index designed for use with the revised NSQIP database. This index includes only five variables covering five deficits.[20]

In summary, there are many instruments for the diagnosis and measurement of frailty. These take a range of approaches. The content of the scores reflects the information available in the setting for which the score was developed. Many are validated for use in a specific setting, but it is not clear that they are reliable in another environment or are equivalent for the diagnosis of frailty.

Specific challenges in the surgical setting

Data on a broad range of comorbidities are collected in the preassessment clinic. These may be used to estimate perioperative risk using validated scores.[21] A frailty instrument should add value to the information available from existing risk scores. It should inform the assessment of the risk *vs* benefits of surgical intervention.[22] Recent work suggests that some frail patients may experience an early increase in disability after surgery but a significant longer-term reduction in disability.[23] Frailty scoring to support prehabilitation may require an instrument that identifies individuals who could benefit from cardiovascular or resistance exercise.[24] Multidisciplinary Proactive Care of Older People Undergoing Surgery (POPS) services are now an integral part of perioperative care in many centres.[25] An instrument for screening patients for referral to a POPS service should have good sensitivity so that frail patients are not missed while lower specificity and a moderate false positive rate may be acceptable.

Conclusions

The wide adoption of the concept of frailty attests to its usefulness in the management of surgical patients. However, there is no single set of agreed criteria for the diagnosis of frailty. An individual may be identified as frail by one measurement instrument but not by another. In both clinical practice and research, the diagnosis of frailty is frequently driven by the information that is most easily collected rather than a rigorous consideration of what should define the condition. Some frailty assessment tools, such as that designed for use with the NSQIP database, are only applicable in the perioperative setting. Others, such as the EFS and the eFI, are used across many clinical settings. Tools for use with surgical patients must be validated against postoperative outcomes but the ideal is surely a universal definition of frailty applicable across all specialities. There is a need for formal evidence synthesis with the following objectives: to identify tools which have a robust methodological underpinning and truly assess frailty; to determine the robustness of studies showing an association between frailty and perioperative outcome; and to identify frailty tools for use in the perioperative setting or make recommendations for the development of such tools.

We owe it to our patients to evaluate the available tools with more rigour, to develop new tools if needed, and to achieve national and international consensus on the assessment of frailty in surgical patients and in the wider population.

Authors' contributions

Fulfilled the requirements of the International Committee of Medical Journal Editors and contributed equally to the writing and revision of the article: all authors.

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Declarations of interest

SJH is a board member and director of the *British Journal of Anaesthesia*. SN declares that she has no interests to declare.

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