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Frailty assessment in vascular surgery and its utility in preoperative decision making

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ABSTRACT

The average patient requiring vascular surgery has become older, as life expectancy within the US population has increased. Many older patients have some degree of frailty and reside near the limit of their physiological reserve with restricted ability to respond to stressors such as surgery. Frailty assessment is an important part of the preoperative decision-making process, in order to determine whether patients are fit enough to survive the vascular surgery procedure and live long enough to benefit from the intervention. In this review, we will discuss different measures of frailty assessment and how they can be used by vascular surgery providers to improve preoperative decision making and the quality of patient care.

1. Introduction

As the US population ages, the burden of vascular disease requiring the attention of a vascular surgeon is expected to increase substantially. There are now more Americans aged 65 years and older than at any other time in US history. According to the 2010 US Census Bureau report, the proportion of the population older than 65 years of age is 13%, and is expected to grow to 21% by 2050 [1]. The mean age of patients that require vascular surgery management will also be expected to rise accordingly.

Older patients have a higher prevalence of major arterial problems commonly encountered by vascular surgeons. This includes an increased risk of carotid artery stenosis (CAS), aortic aneurysmal disease, and peripheral arterial disease (PAD) [2]. Aortic aneurysmal disease diagnoses among older patients, in particular, have risen steadily with the utilization of widespread screening and better imaging modalities [3]. Fowkes et al report that the global prevalence of PAD increased by 23.5% in older adults between 2000 and 2010 and will continue to rise without preventive measures [4].

Clearly, it is critical for vascular surgeons to understand the management of vascular disease in older patients. During the preoperative period, providers must assess the trade-off between the procedure risk and preserving long-term health. Although many patients with vascular disease have compelling and urgent symptoms that merit immediate treatment, the role of vascular surgery is often designed to enhance lifestyle or prevent future events. For example, asymptomatic carotid stenosis is treated to prevent future stroke, asymptomatic abdominal aortic aneurysms (AAA) are treated to prevent future rupture, and claudication is treated to improve patient's lifestyle. In these situations, it is imperative that the patient be fit enough to survive the procedure and live long enough to enjoy the predicted benefits of a successful vascular intervention. Assessment of frailty has emerged as a key measure to evaluate the fitness of surgical patients during preoperative decision making.

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2. The concept of frailty

Frailty has been conceptually defined as "a multidimensional syndrome of loss of reserves (i.e. energy, physical ability, cognition, or health) that gives rise to vulnerability to adverse events" [5]. It can be thought of as a loss of physiologic resilience and implies that biological and chronological age may differ considerably. Frailty can also be viewed as a loss of organismal complexity [6]. A system's complexity is defined by the number of possible different responses to a given stimulus. The healthy, nonfrail human body can sense many different changes in its basal state and respond accordingly with appropriate variations in precision and intensity. In contrast, frail patients have a limited repertoire of responses to various stressors because they consume large amounts of energy to maintain homeostasis.

Frailty is associated with limited energy reserves and ability to respond to stress, such as surgery [5]. In their basal state, frail patients function near the limit of their physiological reserve and approach a threshold where they cannot absorb further stress without decompensation. When these patients are stressed, however, they tend to lose higher-order functions first, such as bipedal ambulation or instrumental activities of daily living. This includes cognitive activities that allow them to live independently, such as medication compliance, money management, or shopping. Frail patients are constantly at risk for an "avalanche-like destruction of the organism" when stress overwhelms compensatory mechanisms leading to more deficits and increasing frailty [7]. These patients can seem deceptively stable yet deteriorate unexpectedly and catastrophically with even minor illness (eg, urinary tract infections), much less major vascular procedures.

Severe frailty is a condition that most experienced clinicians can recognize qualitatively. These assessments are expressed euphemistically by statements such as: "She doesn't pass the eyeball test" or "He wouldn't survive a haircut." However, there is a need to objectify frailty assessment because the thresholds for "I know frailty when I see it" or "looks older than stated age" can differ significantly between practitioners. As stated here, most frail patients live close to the limit of their physiologic reserve and are at high risk for decompensation with surgical interventions. Therefore, it is necessary to identify and measure frailty during the preoperative period, especially when contemplating an elective vascular surgery procedure.

3. Objective models of frailty

Efforts to define frailty using objective and precise criteria have followed two basic and not necessarily mutually exclusive approaches: the Phenotypic Method and the Accumulated Deficits Model [5,8]. These frailty measurement schemes were originally developed to predict mortality or need for institutionalization in community-living geriatric subjects, but more recently have been adapted to the clinical setting, including preoperative assessment. We will review these established models for frailty assessment along with their relative strengths and limitations.

3.1. *Frailty as a phenotype*

The Phenotypic Method is most closely associated with the work of Fried et al and the development of the Hopkins Frailty Score [8]. This model focuses on recognition of somatic or physical characteristics that define frailty and includes the following main domains: unintentional weight loss, self-reported exhaustion, weakness as measured by grip strength, slow walking speed, and low physical activity (Table 1). In community-living subjects 65 years and older participating in the Cardiovascular Health Study, frailty was defined as three or more of these five elements. In comparison, patients with one to two positive domains were defined as being in a pre-frail state and robust subjects had a score of zero. Significant differences in mortality rate were observed between all three frailty categories and were apparent as early as 24 months after study entry. Moreover, the mortality differences between frail, pre-frail, and robust groups increased with time [8].

More recently, there have been attempts to define frailty using other modes of phenotypic assessment. This includes assessment of nutritional status using laboratory values (eg, serum albumin or pre-albumin levels) or triceps skin fold thickness [9]. Sarcopenia is also a physical manifestation of frailty, and can be measured using various methods including computed tomography (CT) measurement of psoas muscle size [9]. Given that many patients receive an abdominal CT scan before vascular surgery, morphometric analysis of lean muscle size can potentially serve as a valuable preoperative measure of frailty.

3.2. *Frailty as an accumulation of deficits*

An alternative approach to assessing frailty is the Accumulated Deficits Model that originated from the Canadian Study

Table 1 – Operationalizing a phenotypic model of frailty.

Characteristic	Criteria
Shrinking: weight loss, sarcopenia	Baseline: >10 lb lost unintentionally in prior year
Weakness	Grip strength: lowest 20% (by sex, body mass index)
Poor endurance; exhaustion	"Exhaustion" (self-report)
Slowness	Walking time/15 feet: slowest 20% (by sex, height)
Low activity	Kcal/week: lowest 20% males: <383 kcal/week females: <270 kcal/week

Positive for frailty phenotype: ≥3 criteria present; intermediate or pre-frail: one or two criteria present.
Adapted from Fried et al [10], with permission.