Surgical Critical Care for the Trauma Patient with Cardiac Disease

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KEYWORDS

• Geriatric trauma • Preexisting cardiac disease • Shock • Targeted resuscitation
• Myocardial ischemia • Cardiogenic shock • Blunt cardiac injury • Arrhythmias

KEY POINTS

- Effects of aging on cardiac performance include naturally occurring structural and functional changes of the aging heart as well as pathology associated with aging, including ischemic heart disease, arrhythmias, and valvular disease.
- Shock is defined by inadequate delivery of oxygen and nutrients required for normal cellular function. Differential diagnosis in the immediate postinjury period includes hemorrhagic shock, traumatic shock, and primary myocardial dysfunction.
- Targeted assessment of perfusion and resuscitation is essential in the management of any injured patient but is particularly important in the geriatric trauma patient with preexisting cardiac dysfunction.
- Management of cardiac dysfunction in the trauma patient includes an appreciation of the inherent effects of trauma on cardiac function as well as treatment of myocardial ischemia and infarction, cardiogenic shock, blunt cardiac injury, and arrhythmias.

INTRODUCTION

Evolution of Trauma Epidemiology in the United States: Geriatric Trauma and Preexisting Cardiac Disease

The elderly population is rapidly increasing in number. By 2040, more than 82 million Americans will be over age 65.[1] More Americans are living into their eighth and ninth decades and lead active lives, making them susceptible to injury. A minor injury in a young patient without cardiac disease can quickly overwhelm the cardiac reserve of an elderly patient, leading to significant physiologic derangement. The challenge to

Disclosure Statement: The authors have nothing to disclose.

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Anesthesiology Clin 34 (2016) 669–680
http://dx.doi.org/10.1016/j.anclin.2016.06.004 **anesthesiology.theclinics.com**

all team members caring for the elderly is to rapidly identify underlying cardiac disease and intervene in a manner that limits the duration of myocardial oxygen supply–demand imbalance.

Effects of Aging on Cardiac Performance

Structural and functional changes of the aging heart

Aging produces many structural and functional changes in the heart. Myocytes decrease in number and are replaced with extracellular collagen matrix, resulting in decreased compliance of the ventricles. The number of sinoatrial (SA) node cells decreases, such that a 75-year-old man has only 10% of the SA nodal cells that he had at age 20. Therefore, conduction abnormalities and a prolonged PR interval are common. Stiffening of the aorta leads to uncoupling from the ventricle, increasing afterload and leading to myocardial hypertrophy and septal thickening. The net result is a stiff ventricle that fills more slowly, relying on atrial contraction in late diastole rather than passive early diastolic filling. A decrease in the average heart rate is compensatory, so that stroke volume is preserved at rest. In the absence of physiologic stress, these changes are imperceptible.[2]

Exercise tolerance significantly declines with aging. Maximum oxygen consumption decreases by 50% from age 20 to age 80. Structural changes play a role, but the transition to a hyposympathetic state accounts for much of this decline. In spite of an increase in circulating catecholamines, the cardiac response to adrenergic stimulation is blunted, because there are fewer adrenergic receptors in the aged heart. SERCA2 is an intracellular pump that facilitates the reuptake of calcium into the sarcoplasmic reticulum and is downregulated in the elderly. This results in prolongation of the cardiac action potential and compounds the diminished lusitropic state. Moreover, derangements in the myocyte–calcium interaction diminish intrinsic cardiac contractility.[3]

Pathology associated with aging: preexisting cardiac disease

Ischemic heart disease Although mortality from ischemic heart disease in the United States has decreased by 50% from its peak in 1963, it remains the leading cause of death in Americans.[4] Atherosclerosis creates fixed defects of the coronary arteries, limiting the ability to increase blood flow at times of increased myocardial demand, and creates an oxygen supply–demand imbalance, diminished cardiac reserve, and demand-related ischemia. Improved prevention and treatment of ischemic heart disease have dramatically reduced mortality, but survivors of ischemia are left with diminished cardiac reserve, a significant physiologic burden for those who sustain traumatic injuries.

Arrhythmias Atrial fibrillation, supraventricular tachycardia, and ventricular ectopic beats are more common in elderly patients. The incidence of atrial fibrillation is 10 times higher in those over age 65 compared with the general population. In the setting of decreased ventricular compliance and the increased importance of organized atrial contraction to maintain stroke volume, atrial fibrillation can cause significant degradation of cardiac output, which compounds the physiologic burden in the elderly trauma patient.

Valvular disease Nkomo and colleagues[5] reported an 8.5% incidence of valvular disease in patients aged 65 to 74 years and an 13.2% incidence in patients over age 75. This was associated with a 14% increase in mortality at 5 years compared with those without valvular disease. Mitral regurgitation (MR) and aortic regurgitation (AR) were more common than aortic stenosis (AS) in this study. However, AS is especially