Chapter 33
Surgical Treatment of Thoracic Aortic Disease in the Elderly

Arnar Geirsson

Abstract Management of thoracic aortic diseases remains complex but has made tremendous progress over the last decades. Although thoracic aortic diseases affect patients of all ages, the older age group predominates. Clinical decision making can be particularly challenging in the elderly patients whether being an elective circumstances for asymptomatic aneurysm evaluation or under emergent situation in patient presenting with aortic emergencies such as aortic dissection or degenerative aortic aneurysm rupture. Even under the best circumstances, the operations are associated with well-know set of complications and risk of mortality that is generally higher than other operations performed by cardiothoracic surgeons. Advances both in surgical techniques, intraoperative management, and postoperative care have reduced both mortality and morbidity in recent years in all age groups. Concomitant with that increasing number of elderly patients are being evaluated and undergo complex aortic operations. This chapter will focus on the surgical treatment of thoracic aortic disease as it pertains to the elderly patients. It will not attempt to address the general management of multiple thoracic aortic syndromes that the cardiothoracic surgeon faces in detail but instead highlight studies that specifically refer to the elderly patients and the specific and unique issues that relate to that group of patients. This includes decision making in the elderly patient presenting with symptomatic and asymptomatic thoracic aortic aneurysm, acute aortic dissection, as well as addressing the issue of use of endovascular treatment of thoracic aortic aneurysm in the elderly.

Keywords Aortic disease • Thoracic aortic aneurysm • Aortic dissection • Penetrating atherosclerotic ulcer • Intramural hematoma • Ascending aorta • Descending aorta • Hypothermic circulatory arrest • Aortic surgery • Emergency surgery

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Cardiovascular Surgery in the Aging Population

The absolute and relative number of the older population continues to rise in the US and the developed countries. The group that has experienced the most rapid change in numbers are individuals aged 85 years and older. Over the last century, their number increased 34-fold from 122,000 in the year 1900 to 4.2 millions in the year 2000. It is projected that by 2050 this group will have reached 20.9 million individuals. The life expectancy of elderly individual also continues to increase. In 1900, an 85-year old individual had a life expectancy of 4.0 years. According to the most recent census data, the life expectancy of a 75-year old male or female is 10.8 and 12.8 years, respectively. For an 85-year old, the life expectancy is 6.1 years for males and 7.2 years for females [1, 2]. Comprehensive knowledge of patient life expectancy is extremely important part of clinical decision making when taking care of the elderly patient. The main goals for surgical interventions for aneurysm disease should be to prolong life, alleviate symptoms, and/or improve quality of life. There are numerous studies that have demonstrated acceptable perioperative risk in elderly patients undergoing other cardiovascular operation than on the thoracic aorta. These studies have demonstrated that although the elderly patient undergoing coronary artery bypass grafting, valve surgery and abdominal aortic aneurysm repair are at slightly higher risk of complication and require longer hospital stay compared with younger patients, the long-term survival normalized and becomes similar to the general population [3–6].

Aneurysmal Disease of the Thoracic Aorta

The prevalence and incidence of thoracic aortic disease is increasing both as a result of aging of the population and more frequent use of CT scans and echocardiography for diagnosis of various conditions. There are limited number of population studies to accurately determine the incidence of

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both thoracic aortic aneurysm and aortic dissection. The most contemporary data originates from nationwide population-based study from Sweden. The incidence of thoracic aortic disease diagnosis (aneurysm and dissection) in men rose by 52% from 10.7 per 100,000 per year in 1987 to 16.3 per 100,000 per year in 2002. In women the incidence was lower but also increased 28% from 7.1 per 100,000 per year in 1987 to 9.1 per 100,000 per year in 2002. Relative risk of diagnosis of thoracic aortic disease was strongly correlated with age. The mean age was 70 years for the whole registry but the median age decreased from 73 years in the 1987–1990 period to 71 years in the 1999–2002 period ($p < 0.0001$). The annual incidence of operative intervention also increased over the study period by sevenfold in male and 15-fold in women [7]. The overall incidence of thoracic aortic aneurysm in Olmsted County in the period of 1990–1994 was 10.99 per 100,000 per year compared with the 1951–1955 period when the incidence was 2.41 per 100,000 per year [8]. Increased awareness of aneurysmal disease and improved diagnostic tools account for large portion of the earlier increase in incidence but there is indication that the true incidence of thoracic aortic aneurysm is increasing because of the increasing age of the population.

Size of the thoracic aortic aneurysm is the strongest predictor for complication such as dissection, rupture, or death. This has been well defined by the Yale Center for Thoracic Aortic Disease. In their database, the average growth rate is 0.12 cm per year (0.10 for ascending aorta and 0.30 for descending aorta) [9]. The median size at the time of rupture or dissection was 6.0 cm for ascending aneurysm and 7.2 cm for descending aortic aneurysm. Once the size of an ascending aneurysm reached 6.0 cm, the risk of rupture or dissection increased by 32.1% points. For descending aneurysm, there was 43.0% increase in risk once aneurysm reached 7.0 cm in size [10]. Once the size of thoracic aortic aneurysm (both ascending and descending) reaches 6.0 cm in size the average yearly rate of rupture or dissection is 6.9%, and the average yearly risk of death becomes 11.8% with 5-year survival of only 56%. Patient who underwent elective operative repair restored life expectancy to normal [11]. Based on these findings, the current size recommendations for operative intervention is 5.0–5.5 cm for ascending and 6.0–6.5 cm for descending aneurysm in asymptomatic patients. Patients with connective tissue disorder such as Marfan disease are at increased risk of complication and should be offered operation when ascending aorta or root aneurysm reaches 4.5 cm. Patients with strong family history or aneurysm associated with bicuspid aortic valve are also at increased risk and should be considered for operation once aorta reaches 5.0 cm. Aneurysm growth of more than 1 cm/year, pain consistent with rupture or unexplained by other causes are also considered indications for surgery. The data for saccular aneurysm generally located in the descending aorta are not as clear but sac with over 2 cm and total diameter more than 5 cm are considered indications for surgery. These recommendations should certainly be extended to elderly patients but individual approach is paramount. Risk of aneurysm rupture, dissection, or death have to be weighed against the risk of perioperative death and complications as well as the overall expected long-term survival. This is particularly important in patients who have asymptomatic thoracic aneurysm where prolonging patient survival should be the primary goal.

Surgery of the Ascending Aorta and Aortic Arch

Aneurysmal surgery of the ascending aorta and aortic arch generally requires the use of profound hypothermic circulatory arrest to perform a direct open repair. These complex operations are associated with significant morbidity such as stroke and neurological dysfunction and significantly higher mortality rates compared with other cardiac operations. Debates have arisen whether these operations should be offered to the elderly patient. Age has been identified to be an independent risk factor for stroke and transient neurological dysfunction defined as postoperative confusion, agitation, and transient delirium in patient undergoing hypothermic circulatory arrest [12, 13]. Age above 60 has also been defined as a risk factor for death or permanent neurological injury in same series [12]. The Swedish heart surgery registry of patients undergoing operations on the ascending aorta found that age (HR = 1.05), aortic dissection (HR = 1.54), emergency operation (HR = 2.80), coronary artery bypass grafting (HR = 2.03), postoperative stroke (HR = 1.84) and postoperative renal failure (HR = 2.45) were all independently associated with surgical mortality. Only age was an independent but a weak risk factor associated with long-term mortality with HR = 1.06 per 1 year increment [14]. A large Japanese series demonstrated that early mortality, postoperative stroke, transient neurological dysfunction, and respiratory complication were all higher in patient over the age of 70. That series included all types of thoracic aortic operations and demonstrated that emergency operations were associated with very high mortality rates [15]. However, majority of studies that have specifically addressed the use of hypothermic circulatory arrest in the elderly demonstrate favorable outcomes. However, these studies are all retrospective, contain few cases, and probably are affected by significant selection bias where preferably "good risk" elderly patients were offered operation but others excluded and therefore not studied further. Incidence of stroke was between 8 and 20% and early mortality was between 5 and 16% [16–18]. Only one of the studies demonstrated increased risk of stroke compared with younger patients or elderly patients undergoing other cardiovascular operations [17], while other demonstrated the protective role of retrograde cerebral perfusion

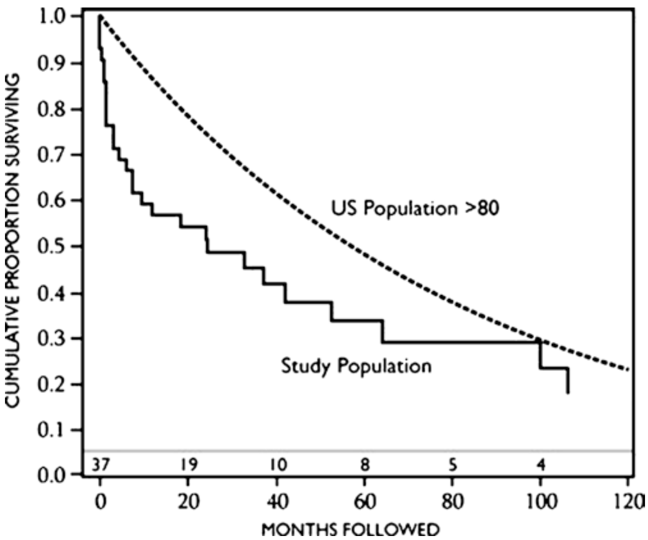

Fig. 33.1 Survival analysis of octogenarians undergoing ascending and transverse aortic arch repair compared to the US population. Survival in the study population was 56% vs. 86% ($p=0.02$) at year 1, 48% vs. 76% ($p=0.03$) at year 2, 36% vs. 48% at year 5, and 20% vs. 20% at year 10 ($p=0.10$) (reprinted with permission from Shah et al. [18], Copyright Elsevier 2008)

as an adjunct during hypothermic circulatory arrest [18]. Predictors of stroke in octogenarians were prior history of stroke and increased cardiopulmonary bypass time, while predictors of early mortality included low glomerular filtration rate, long cardiopulmonary bypass time, and emergency operations. Long-term survival in these elderly patients did not differ from age-matched US population (Fig. 33.1) [18]. It is therefore safe to conclude that elective operations on the ascending aorta and aortic arch can be safely performed with the use of hypothermic circulatory arrest in octogenarians with acceptable morbidity and mortality.

Surgery of the Descending and Thoracoabdominal Aorta

Operative repair of the descending aortic and thoracoabdominal aortic aneurysm remain highly complex and associated with numerous significant complications and high mortality. Operative mortality for open repair of descending aortic aneurysm is between 2.8 and 8.8% in contemporary series where incidence of spinal cord ischemia was 2.6–2.7% [19, 20]. For thoracoabdominal repairs, the incidence of spinal cord ischemia is higher between 3.8 and 9.5%, and perioperative mortality has remained mostly unchanged between 5.0 and 8.2% for years in experienced centers despite improvements in operative techniques and perioperative care [21, 22]. In addition to spinal cord ischemia with resulting paraplegia both pulmonary and renal complication are common and when they occur they are associated with significant increase in postoperative mortality. Various operative strategies and adjuncts are used in attempt to decrease complication aimed most specifically to decrease complication of spinal, renal, and visceral ischemia. Cerebrospinal fluid drainage, reimplantation of critical spinal arteries, neuromonitoring (evoked-potential), epidural cooling, moderate hypothermia, visceral and renal perfusion, and atriofemoral bypass have all been demonstrated to be beneficial adjuncts in these complex operations. Most recently introduction of endovascular approaches have demonstrated improved short-term outcome in high-risk patient, although long-term outcome is not clear (see Endovascular treatment of thoracic aneurysmal disease).

There are only few numbers of studies specifically addressing open surgery of descending thoracic and thoracoabdominal aneurysm in the elderly. Huynh et al. described their experience of 56 patients between the ages of 79 and 88 years at the time of surgery who underwent replacement of the descending aorta or thoracoabdominal aorta. The cohort had significant number of comorbidities including hypertension (61%), chronic obstructive pulmonary disease (23%), coronary artery disease (23%), congestive heart failure (5%), history of cerebrovascular disease (20%), diabetes (9%), or chronic renal insufficiency or dialysis (5%). Patient with at least one of the three factor, emergent presentation, diabetes, or congestive heart failure, were categorized as high risk and had 50% 30-day mortality compared with 17% in group of patients considered low risk. Age was not a risk factor by univariate analysis. However, there was only comparison within the group of elderly patients (79–88 years). Importantly, the 5-year actuarial survival was 48% [23]. The Baylor group presented their data comprising of 39 octogenarians undergoing thoracoabdominal aortic aneurysm repair ranging from 80 to 89 years of age. They also had significant preoperative risk factors including hypertension (61%), chronic obstructive pulmonary disease (36%), coronary artery disease (33%), renal occlusive disease (31%), aneurysm rupture (18%), renal insufficiency (15%), diabetes (9%), history of cerebrovascular accident (5%). They had excellent results with in-hospital mortality of only 10.3% and all patients with ruptured aneurysm survived to discharge. There was fairly high rate of postoperative complication including paraplegia (5.1%) all occurring in Crawford extent III aneurysm, cerebrovascular accidents (5.1%), renal failure (18%), pulmonary complications (36%), and cardiac events (18%). Univariate risk factors predictive for death were tracheostomy, myocardial infarction, and hemodialysis. The median length of stay was 15 days with a range of 10–86 days. The 5-year actuarial survival was 50% demonstrating that despite long and complicated hospital stay the long-term outcome is quite acceptable [24]. Although these studies demonstrate that thoracic and thoracoabdominal operations can be performed with moderate operative risks of mortality when performed in the elective setting they are all results from high volume aortic surgery centers and may not properly represent the true operative outcome. Information from the National Inpatient Sample database report a staggering 22.3% overall mortality for thoracoabdominal aneurysm repair, with higher-volume centers and surgeons having much improved results [25]. Also state-wide registry demonstrates that the early mortality underestimates that long-term risk of thoracoabdominal repair where the 1-year mortality rates following elective operation was 34.7% in 70–79 years old and 40% in 80–89 years old. If emergency operation was performed, the long-term outcome was markedly worse with 62.4% one-year mortality in 70–79 years old and 68.8% in the oldest group (Fig. 33.2) [26]. Emergency surgery in this population of patients is associated with very high risk of stroke and mortality especially when hypothermic circulator arrest is required (Fig. 33.3) [16, 23]. It brings up the issue whether open operative treatment should be offered in the emergency setting for ruptured descending or thoracoabdominal aortic aneurysm in this patient group and argues for earlier elective operative repair. Quality of life following these complex operations is important to address but currently there are no good data available regarding quality of life of elderly patients surviving complex descending thoracic or thoracoabdominal aneurysm repair.

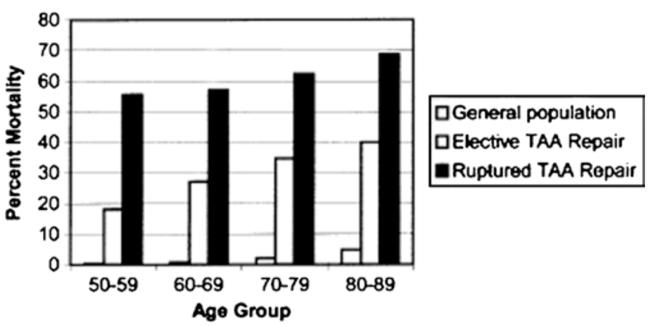

Fig. 33.2 One-year mortality following operative treatment of elective or ruptured thoracoabdominal aortic aneurysms (TAA) compared to the general population. The results are stratified into groups by increasing decade of life. Data are from the National Vital Statistic report (reprinted with permission from Rigberg et al. [26] Copyright Elsevier 2006)

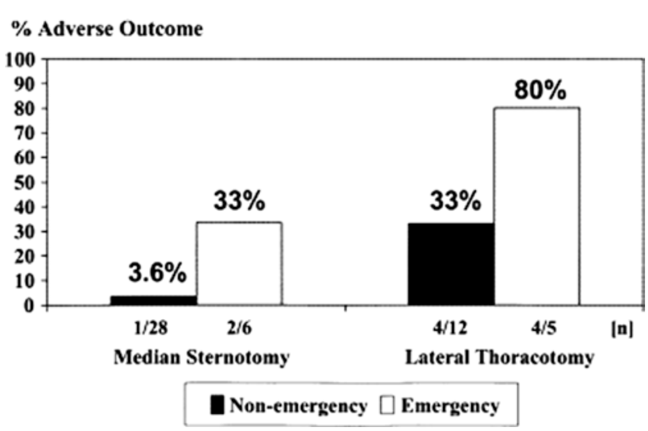

Fig. 33.3 The risk of adverse outcome (death or permanent stroke) in octogenarians following aortic surgery requiring hypothermic circulatory arrest was highest in patients undergoing lateral thoracotomy and emergency surgery (reprinted with permission from Hagl et al. [16], Copyright Elsevier 2001)

Penetrating Atherosclerotic Ulcers

Penetrating atherosclerotic ulcers are caused by rupture of an atherosclerotic aortic plaque that results in initial hematoma formation and then ulcer formation between the media and the adventitia. It is most commonly located in the descending aorta and can be associated with both intramural hematoma and localized type B dissection. It is generally an indicator of severe atherosclerotic disease of the aorta and frequently more than single ulcers are noted. The proper treatment of penetrating atherosclerotic ulcer has been debated and pendulum has swung between operative and nonoperative management. Two large centers have presented opposite school of thoughts. Investigators at Yale presented their series of 26 patients where more than one-third presented with rupture and two thirds underwent surgery. Early rupture was especially high when associated with intramural hematoma but also later complications such as aneurysm formation and rupture where also high [27]. On the contrary, the Mayo Clinic group presented a series where majority of patients were managed medically with success [28]. It is not clear what explains these differences expect a possible difference in patient characteristics where the Yale group were all symptomatic and had much higher incidence of ascending aortic ulcers. Also no incidental atherosclerotic ulcers were included in that study. So management needs to be individualized both in respect to patient comorbidities and characteristics of the ulcers. Symptomatic penetrating ulcers, atherosclerotic ulcers with surrounding hematoma or with evidence of enlargement or impending rupture should be managed operatively. Patients at high-risk for surgery can probably be managed medically with anti-impulse therapy and close radiographic follow-up. Surgical treatment consists of either open operative repair with replacement of aortic segment containing the ulcer or endovascular stent grafting that has shown promise especially when the aortic ulcer is localized [29].

Aortic Dissection Syndromes

Aortic dissection is characterized by separation of the aortic intima and adventitia to various extents. Generally the initiating event is a hypertensive episode resulting in primary intimal tear. The inflow of blood then propagates the dissection both proximally and distally creating a false lumen that communicates with the true aortic lumen at one or more secondary intimal tear sites. Stanford type A involves the entire aorta (DeBakey type I) or only the ascending aorta up to the level of the aortic arch (DeBakey type II). The tear is most commonly in the ascending aorta or proximal arch. Stanford type B involves dissection in the descending thoracic aorta extending into abdominal aorta where the primary tear is in the proximal descending aorta. Risk factors for aortic dissection include hypertension, thoracic aortic aneurysm, atherosclerotic disease, bicuspid aortic valve, aortic coarctation, and connective tissue disorders such as Marfan syndromes [30].

Acute Type A Aortic Dissection

Acute type A aortic dissection remains one of the most challenging diseases the cardiothoracic surgeon faces. In the early days of cardiac surgery, early mortality without surgical treatment was considered to be 1–2% per hour with less than 10% surviving 3 days [31]. Current operative mortality ranges from 12.7 to 32.5% while in-hospital mortality for nonoperative treatment is 58% [32–36]. Therefore, all patients presenting with acute type A aortic dissection should be considered for operative intervention. Probably the most contentious issue that has been extensively investigated in the elderly undergoing cardiac surgery is the appropriateness of surgical intervention for acute aortic dissection. Most of the literature focuses on acute type A aortic dissection, and several groups have reported dismal surgical outcomes in octogenarians, while others have reported acceptable results. Arguing against offering operation for type A dissection in octogenarians, Neri et al. reported on 24 patient aged 80 years and older with intraoperative mortality of 33% and overall hospital mortality of 83%. All patients who survived the operation had one or more postoperative complication, and the mean hospital stay was 37 days and no patient survived beyond 6 months [37]. Piccardo et al. reported on 57 consecutive octogenarians that underwent operation for type A aortic dissection with 45.6% in-hospital mortality and 5-year survival of 44% [38]. Japan contains one of the largest proportions of the elderly population in the world and have demonstrated remarkably good surgical results. Shiono et al. reported on 24 octogenarians where hospital mortality was only 13% but significantly higher than the 6% mortality seen in patients younger than 80 years of age. The same goes with 5- and 10-year survival that was significantly lower in octogenarians, 55 and 42%, respectively, than in the younger age group of 83 and 73%, respectively. However, age over 80 was not an independent risk factor on univariate or multivariate analysis [39]. In an attempt to address the issue of quality of life following repair of type A dissection, another Japanese report described the results of 58 octogenarians. Thirty patients (Group I) underwent emergency operation, while 28 patients (Group II) did not undergo and operation and were treated conservatively according to patient or family wishes. Hospital mortality was very acceptable of 13.3% in group I while 60.7% of group II died in the hospital. Ten of the patients in group I remained either bedridden or highly dependent on assistance or care following discharge from the hospital. There was no difference in actuarial 5-year survival between operated and conservatively treated cases [40]. The study concluded that emergency surgery can be performed with acceptable hospital mortality; however, surviving patients are at high risk of complications, dementia, depression, and immobility, and operative intervention does not improve long-term survival, which needs to be addressed in discussing treatment options with patient and family. The International Registry of Acute Aortic Dissection (IRAD) database has reported on the difference in outcome of patients 70 years or older and patients younger than 70 years. Elderly patient had higher incidence of diabetes, prior cardiac surgery, hypertension, atherosclerosis, iatrogenic dissection, and preexisting ascending aortic aneurysm. They were less likely to present with typical symptoms of acute onset of chest or back pain. In the database only 64.4% of elderly patients underwent surgical intervention. Reasons for nonoperative management included comorbid conditions, age, patient refusal, and intramural hemotoma. In-hospital mortality was significantly higher in the elderly cohort, 42.8% vs. 28%. Interestingly, medically managed patients had mortality of only 52.5% similar to the operated group. Age >70 was identified to be an independent predictor of mortality by multivariate analysis. The study concluded that age alone should not be used as a sole criterion to exclude patients from undergoing repair of type A aortic dissection [41]. Other studies describe in-hospital mortality of 17.6–37.3% in patients aged 70 and older following operation for acute type A dissection [42–44].

So should the elderly patient be offered an operation when he/she presents with acute type A dissection? The general answer should be yes if preexisting comorbidity and clinical presentation are not considered to present a prohibitive operative risk. The rational for offering operation for acute type A dissection in octogenarians is primarily that age is not a strong risk factor for mortality. Therefore, age per se should not be the primary factor determining whether operation should be offered or not. The condition of the patient at the time of presentation is the primary determinant of mortality regardless of age. Patients with evidence of circulatory collapse indicating rupture, pericardial tamponade, and coronary malperfusion are at high risk for mortality. Patients with evidence of malperfusion syndromes especially cerebral malperfusion (stroke and coma) but also mesenteric, renal, and limb malperfusion in addition to require prehospital endotracheal intubation are at even higher risk especially when combined with circulatory collapse [42, 45, 46]. Although it would be justifiable to offer an operation for young patient with those devastating preoperative complications, it will probably not benefit the elderly patient.

Preexisting medical conditions have not been shown to be a significant risk factor for mortality following type A dissection repair. However, dementia, immobility, advanced heart failure, or cancer should probably be considered relative contraindications for operative intervention and in such cases conservative treatment should be considered. There is wide variability in the short-term survival in published series on operative repair for type A dissection in the elderly ranging from 13.3 to 83%. The reason for this is probably multifactorial but could include difference in operative technique and perioperative management but more likely reflect selection bias where some institutions do not offer operation for the very elderly or cases that are considered hopeless and are therefore not represented in the series and data not collected on those patients. On the contrary, other institution may be more aggressive and not deny anyone an operation and therefore accept higher mortality rates. Surgeons should attempt to analyze the data at their own institutions relevant to operative outcome in this patient population to come to a conclusion what should be the acceptable and expected short-term survival at their hospital. Guidelines or specific policies can be helpful in establishing standard of care at that institution. They will also help to resolve ethical dilemma in certain cases and assist both patients and family in decision making regarding quality at end of life care and acceptance of death and dignity at the end of life. Obviously any guidelines should serve as such and allow certain flexibility that is bidirectional [47].

Principles of operative treatment for type A dissection should not be different in elderly patients than younger patients. Resection of the primary tear with replacement of the ascending aorta or hemiarch under hypothermic circulatory arrest is not associated with higher risk of stroke or early mortality in octogenarians and in conjunction with aortic valve resuspension or composite root replacement offers the optimal operative strategy [18].

Acute Type B Aortic Dissection

Type B aortic dissection originates in the proximal descending aorta and most commonly dissects distally into the abdominal aorta. Majority of the patients presenting with type B aortic dissection are 60 years and older. The prominent symptom is severe back pain of sudden onset. Neurological deficits either due to spinal cord ischemia or limb ischemia can occur in up to 8.1% of cases and pulse deficit occurs in 20.3% [48]. The largest study investigating clinical features and outcome of type B aortic dissection in the elderly comes from the IRAD group. Majority of patients had history of hypertension and presence of atherosclerosis, diabetes, and prior aortic aneurysm were more common in the elderly cohort. Elderly patients were less likely to have a patent false lumen and higher incident of periaortic and intramural hematoma. Compared with the younger age group the elderly were more likely to be treated medically, and they had lower incidence of pulse deficiency. However, they had higher incidence of hypotension and shock. In-hospital mortality was 1.7-fold higher in the elderly patient where hypotension or shock, any branch vessel involvement, and periaortic hematoma were independent predictors of early mortality. These three clinical factors were used to stratify the risk of mortality where presence of hypotension or shock was associated with the highest in-hospital mortality of 56%. Any branch vessel involvement had mortality of 28.6%, and patients with periaortic hematoma had 10.5% mortality rate. Patients without any of those factors had very low risk of mortality (Fig. 33.4) [48]. Contemporary management of type B dissection includes the use of intravenous beta-blockers as first line agents that aims to reduce the dP/dT and calcium channel blockers as the second line agents. Sodium nitroprusside should be avoided since it can result in shunting negatively affecting spinal perfusion.

Surgery in acute type B dissection is indicated for patients with persistent symptoms despite medical treatment, further expending false lumen, impending rupture, or malperfusion syndrome (visceral, spinal, or lower extremity). Traditional surgical options include open replacement of the descending aorta or distal aortic arch and fenestration procedure. Open procedures for type B dissection are associated with high rate

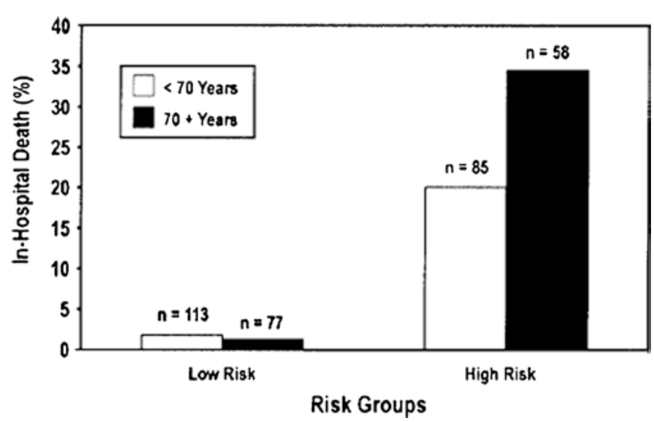

Fig. 33.4 Risk stratification of patients with type B dissection younger and older than 70 years of age for in-hospital mortality in low and high-risk groups. High-risk patients are those with hypotension or shock, any branch vessel involvement, or periaortic hematoma. Low-risk patients are those without these three risk factors (reprinted with permission from Mehta et al. [48], Copyright Elsevier 2005)

of complications and mortality. The IRAD database reported in-hospital mortality of 29.3% and new neurological deficits of 23.2% that included 9.0% stroke, 7.5% coma, and paraplegia 4.5%. Visceral ischemia and acute renal failure occurred in 6.8 and 21.3% of cases, respectively. Independent predictors of surgical mortality were age <70 (OR = 4.32) and preoperative shock or hypotension (OR = 6.05) [49]. More recently stenting of branch vessels and/or proximal aorta with endovascular grafts have been introduced and seem to provide favorable initial outcome [50].

Intramural Hematoma of the Thoracic Aorta

Intramural hematoma is considered as a subgroup of the dissection syndromes, although the pathophysiology is not well defined. Its definition and distinction from aortic dissection is bleeding and thrombus in the aortic wall without direct communication with the true lumen of the aorta. It is thought to involve rupture of vasa vasorum resulting in hematoma propagating between intimal and adventitial layers. However, some argue that it more likely involves a primary intimal dissection tear that does not propagate toward a secondary distal tear resulting in thrombosed false lumen. The ability to differentiate between those two depends on the sensitivity of imaging modality used. Clinically presentation of intramural hematoma may be very similar to acute dissection and treatment should be based on location of the hematoma (Stanford A or B). Type A located in the ascending aorta have better outcome if operated on, while type B can be treated medically [51]. There is very limited data regarding management of intramural hematoma in the elderly. A report reviewing the literature of 11 cases of octogenarians with intramural hematoma was reported to have favorable prognosis when treated medically for both type A and type B location supporting that conservative treatment is justified in that age group [52].

Endovascular Treatment of Thoracic Aneurysmal Disease

Traditional open replacement of the aneurismal thoracic aorta is extremely durable and has excellent long-term outcome. As outlined earlier that approach carries a well-defined risk of morbidity and mortality. In an attempt to develop less invasive approaches and possibly decrease the incidence of early complications endovascular treatment with covered stent was introduced in the mid 1990s [53]. Since then thoracic endovascular aneurysm repair or stent grafting has become commonplace and used for almost any of the thoracic aortic syndromes with the exception of ascending aneurysm and extensive thoracoabdominal aneurysms. It offers the benefit of excluding the aneurysm from the pressurized lumen of the aorta without the physiological complications of thoracotomy and aortic crossclamping. Stent grafting has allowed treatment of aneurysm in patients who are considered too high risk for open repair and are associated with improved short-term outcomes. There have been considerable concerns regarding the long-term durability of aortic stent grafts and currently there are no long-term data available. Another drawback is the risk of endoleaks and need for follow-up imaging for unforeseeable future [54].

There are no randomized controlled trials available to appropriately answer which approach is better. Both metaanalysis and population-based analysis of endovascular vs. open thoracic aortic aneurysm repair suggest that endovascular thoracic aortic aneurysm repair is safe in the short-term, associated with fewer cardiac, respiratory and hemorrhagic complications and require shorter hospital stay [55, 56]. A metaanalysis of 17 studies totaling 1,109 patients demonstrated that there was significant reduction in early mortality (OR = 0.36) and major neurological events (OR = 0.39), and there was no difference in major reintervention rates [56]. A population-based analysis of 1,030 patients undergoing open repair and 267 patients undergoing stent grafting of thoracic aortic aneurysm used data from the Nationwide Inpatient Sample. The stent graft group had higher rates of comorbid conditions but the rate of any complication and length of stay was significantly higher in the open group. However, there was no difference in early mortality, which was 7.7% in the stent graft group and 6.4% in the open repair group [55].

It has generally been assumed that the patient groups that would benefit the most from endovascular repair would be high-risk patients for open repair. This would primarily be patients with comorbid conditions such as chronic obstructive lung disease, heart disease, and peripheral vascular occlusive disease as well as elderly patients. The mid-term result of the initial stent graft series from Stanford demonstrated quite dismal long-term prognosis of 31% in group of patients that were considered inoperable by open techniques arguing that those patients are probably best served by nonoperative management [57]. More recent data of high-risk patients where nearly half of patients were over 80 years of age indicate that endovascular treatment improves early and intermediate-term survival up to 36 months when cumulative survival becomes similar for both group (Fig. 33.5) [58]. These results suggest that endovascular treatment in high-risk patients should be viewed as palliative therapy aimed mainly for symptomatic relief.

There are relatively few publications addressing the use of endovascular repair in the elderly. It can be performed safely in octogenarians with acceptable short and mid-term results [59, 60]. Data from the Arizona Heart Institute of

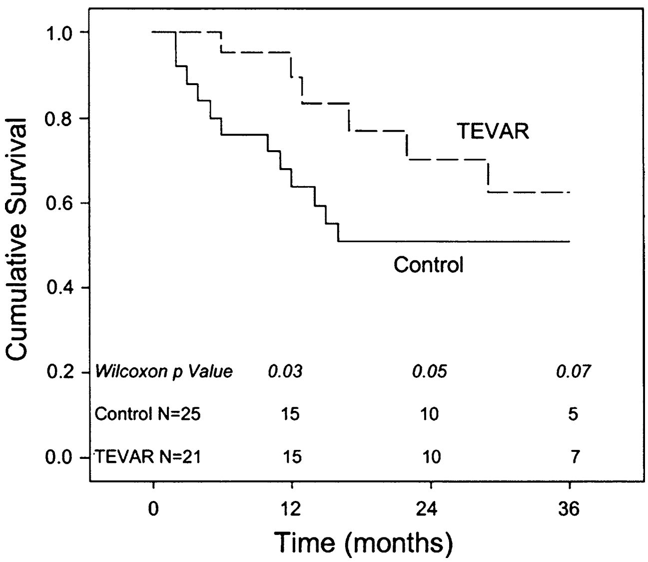

Fig. 33.5 Survival analysis in high-risk groups demonstrates that endovascular thoracic aortic repair (TEVAR) results in an early-term to intermediate-term survival advantage compared with nonoperated group (control). The long-term survival is not significantly different (reprinted with permission from Patel et al. [58], Copyright Elsevier 2007)

44 patients with mean age of 84 years demonstrated that there was no difference in complication rates in octogenarians and younger patients. Survival was similar in early and mid-term follow-up and it was not until after 5 years following the treatment that the group diverged and survival of the older group decreased [60]. There is only one publication specifically comparing open vs. endovascular repair of the descending aorta in patient older than 75 years of age. The study included 41 patients undergoing open repair and 52 patients undergoing endovascular repair. The endovascular group was older, 80.6 years vs. 76.9 years, had more significant comorbidities, where 80.8% of them were prospectively identified as too high risk for open repair. The 30-day mortality appeared higher in the open group 17.1% vs. 5.7% but was not significant ($p=0.1$). Composite end-point of 30-day mortality, stoke, paralysis, or dialysis was similar between the two groups as well as the 4-year survival [61]. The conclusion to be drawn from studies of endovascular repair in high-risk patients and the elderly is that endovascular repair can be safely performed in those patient groups with acceptable rates of complications. There is improved short and mid-term survival but no difference in long-term survival.

Palliative Care in Elderly Patients with Terminal Thoracic Aortic Condition

The decision when not to offer an elderly patient an operation for a thoracic aortic condition generally falls on the shoulder of the cardiovascular surgeon in situations of emergency conditions such as acute type A aortic dissection, frank rupture, or contained rupture of descending aortic aneurysm. It is often an easier decision for the surgeon and also the patient and the family to consent for an operation rather than elect for nonoperative management. Negative operative outcome is then attributed to patient preoperative condition but affected individuals "feel better" that they gave their elderly family member a chance. Denying patient treatment may bring up ethical concerns from both the patient and surgeon. Obviously, the surgeon has to give their own consent to accept and endure the responsibility of their recommendations and decisions in and out of the operating room. It is important to inform the family that side effects of surgery can be associated with degrading and disabling effect as well as pain. It is also important to be fluent in the current literature and operative outcomes to properly explain to patient and relative the expected outcome of surgery as has been attempted in this chapter. Acute type A dissection without symptoms of malperfusion or hypotension/shock has similar outcome in the young and the elderly, and unless there are prohibitive comorbidities, patient should be offered surgery. However, emergent operations of the thoracoabdominal aorta have extremely poor outcome and generally should not be offered unless the elderly patient is highly functional and with minimal comorbidities. Certainly respect of patient wishes or written advance directives is paramount in emergency situations. Sudden change in patient condition especially when patient is incapacitated tends to push family toward operative intervention that sometimes goes against patients own wishes. The ethical values and principles that need to be applied in those circumstances are respect, beneficence, discernment, and justice [62]. Once a decision has been made not to offer patient operative treatment, patient comfort and dignity at end of life is paramount. Anti-impulse therapy should be given in addition to opioids for pain relief if needed. Some individual patients will survive toward improved clinical condition or even to hospital discharge. In those circumstances, caution should be applied when reconsideration of management strategy is suggested. Although it has not been studied specifically, it is unlikely that operative risk changes significantly in the course of few days or even weeks.

Conclusion

Surgical treatment of thoracic aortic disease has changed dramatically over the last two decades both with respect to outcome and operative strategies. This has occurred concurrently with increased number of elderly patients undergoing those complex operations. Although few studies have indicated that older age as a categorical variable is a predictor of survival, old age should not be the main factor determining appropriateness of operative treatment for thoracic aortic conditions. When age is analyzed as a continuous variable, it is actually a very weak independent predictor of operative outcome when compared with other comorbidities and clinical presentation. Most elective operations can be safely performed in the elderly with acceptable short-term complication and return to normal life expectancy. Emergency operations such as repair of acute type A dissection should generally be performed but emergency treatment of descending aortic conditions remains associated with high morbidity and needs to be individualized. Endovascular treatment of thoracic aortic condition is promising but will need further evaluation prior to be considered as the standard of care in the elderly patient.

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