



ADULT CARDIAC SURGERY:

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Midterm Outcomes of Rapid, Minimally Invasive Resection of Acute Type A Aortic Dissection in Octogenarians

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Background. We previously reported the development of a new surgical technique, called the “less invasive quick replacement” technique, for treating type A acute aortic dissection. This study examines the midterm outcome and postoperative quality of life of octogenarian patients who underwent less invasive quick replacement.

Methods. During the last 3 years, 27 patients underwent less invasive quick replacement. The average age of the patients at the time of onset was 81.7 years old. During open distal anastomosis with a rectal temperature of 28°C without any cerebral perfusion, circulating blood in the cardiopulmonary bypass circuit was warmed to 40°C. As soon as the distal anastomosis was completed, rapid rewarming was initiated by 40°C blood perfusion. We assessed the midterm outcomes in terms of survival and cardiovascular event-free rates, patency of the distal false lumen, aortic regurgitation, and cognitive disorders.

Results. The durations of circulatory arrest, cardiopulmonary bypass, overall operation, postoperative mechanical ventilation, and hospital stay were 18.7 minutes, 82.8

minutes, 143.4 minutes, 13.0 hours, and 12.2 days, respectively. Hospital mortality rate was 3.7% (1 patient). There were no incidences of brain damage, renal failure, or respiratory failure. At the time of this study, 25 of the patients were doing well and visiting the outpatient clinic, and 22 of them scored more than 20 points on the Mini-Mental State Examination, indicating no development of dementia. Midterm computed tomography scans detected the patent false lumen in 11.5%. No aortic regurgitation was found in the echocardiography. Actuarial survival and cardiovascular event-free rates at 3 years were 96.2% and 83.0%, respectively.

Conclusions. The less invasive quick replacement technique is safe and effective. It is a very attractive option that can contribute to maintaining a long-term good quality of life for octogenarians with type A acute aortic dissection.

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With the ever-increasing human lifespan, cardiovascular surgeons are faced with treating an increasing number of elderly patients. The efficacy of emergency surgical intervention for type A acute aortic dissection (AAD) is well accepted, but its role in the treatment of octogenarians with AAD remains unclear. Although octogenarians with AAD may survive because of advances in surgical techniques, anesthesia, and perioperative medical management, various complications such as renal and respiratory failure, stroke, or depression may occur associated with extensive surgical stress. Additionally, if a patient survives the surgery but subsequently becomes bedridden, the family may be severely stressed because they must continuously look after the patient [1]. Therefore, controversy still exists as to whether surgical intervention should be avoided for octogenarians.

Previously, we reported a new procedure called “less

invasive quick replacement” (LIQR), which uses moderate hypothermic circulatory arrest without cerebral perfusion followed by aggressive rapid rewarming to shorten the duration of brain ischemia, cardiopulmonary bypass (CPB), and overall surgery. All of the octogenarians we treated using this procedure have survived [2]. However, there is little information about the midterm outcome or postoperative quality of life of octogenarian patients who undergo emergency surgical intervention for AAD, because they have little chance of longer survival. The aim of this study is to examine the midterm outcomes of the octogenarians who have undergone LIQR for AAD at our hospital in terms of actuarial survival rate, cardiovascular event-free rate, cognitive disorders, presence of aortic regurgitation, and patency of the distal false lumen at the time of the present study.

Patients and Methods

Between January 2006 and June 2009, 33 octogenarians were referred to our hospital with AAD. Six patients did not undergo the surgical treatment because they had

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already been diagnosed with senile dementia of the Alzheimer's type and were bedridden in the care institution. Four patients died within 3 days after the onset. The emergency surgical intervention using LIQR for AAD was performed on 27 octogenarians. Individual consent for this study was obtained from all patients, and Institutional Review Board approval was provided before publication of this manuscript and reporting of the information.

Nineteen patients (70.4%) were female, and the average age was 81.7 ± 2.2 years, ranging from 80 to 88. Contrast computed tomography (CT) was performed for all patients as soon as they were referred to the hospital. Transthoracic echocardiography was then performed to detect pericardial effusion and assess aortic valve regurgitation (AR) and cardiac function. The contrast CT revealed a huge intramural hematoma in 12 patients (44.4%). Fifteen patients (55.6%) were in a preshock state (less than 80 mm Hg of systolic blood pressure) owing to cardiac tamponade. Four patients (14.8%) had mild AR. One patient required cardiopulmonary resuscitation, and another had blood acidosis as the result of liver and kidney failure when in shock.

Surgical Procedure

Cardiopulmonary bypass was implemented through femoral arterial cannulation. The ascending aorta was clamped and opened longitudinally. St. Thomas cardioplegic solution was selectively administered in both coronary arteries. During cooling, the aortic segment containing the intimal tear was resected and gelatin resorcin formalin glue was applied between the two dissected walls on proximal stumps of the aorta, and the aortic walls were reinforced by securing Teflon (Impra Inc, subsidiary of L.R. Bard, Tempe, AZ) felt strips both inside and outside the aorta. Circulatory arrest was then implemented at a rectal temperature of 28°C without any cerebral perfusion. The stump of the proximal arch was fixed in the same way. During open distal anastomosis, circulating blood in the CPB circuit was warmed to 40°C using a heat exchanger set to the maximum level and, except for the patient's head, the body was warmed using a hyper-hypothermia system, Medi-Term II (Gaymar Industries, Orchard Park, NY). Immediately after the completion of distal anastomosis, antegrade systemic circulation was established using a branch on the side of the Dacron (C.R. Bard, Haverhill, PA) prosthesis, and rapid rewarming was initiated by the perfusion of blood heated to 40°C. Tear-oriented replacement of the aortic segment containing the intimal tear was employed as much as possible. However, if the intimal tear was located in the distal arch to the descending aorta, the ascending aorta was only replaced. All patients were medically treated with calcium antagonist or beta-blocker after the surgery.

The mean length of follow-up was 26.4 months, ranging from 1 to 46. Follow-up information was obtained for all patients. At the time of this study, we evaluated the presence of postoperative AR and the patency of the distal false lumen using echocardiography and contrast

Table 1. Mini-Mental State Examination

Maximum Score	Score	
		ORIENTATION
5	()	What is the (year) (season) (day) (month)?
5	()	Where are we (state) (country) (town) (hospital) (floor)?
		REGISTRATION
3	()	Name 3 objects: 1 second to say each. Then ask the patient all 3 after you have said them. Give 1 point for each correct answer. Then repeat them until he learns all 3. Count trial and record.
		ATTENTION AND CALCULATION
5	()	Serial 7s. 1 point for each correct. Stop after 5 answers. Alternatively, spell "world" backward.
		RECALL
3	()	Ask for the 3 objects repeated above. Give 1 point for each correct.
		LANGUAGE
9	()	Name a pencil and watch (2 points) Repeat the following "No ifs, ands, or buts." (1 point) Follow a 3-stage command: "Take a paper in your right hand, fold it in half, and put it on the floor." (3 points) Repeat and obey the following: "Close your eyes." (1 point) Write a sentence (1 point) Copy design (1 point)

CT scan. The patients also completed the Mini-Mental State Examination (MMSE [Table 1]). The MMSE includes 11 questions, and requires only 5 to 10 minutes to complete. The best possible score is 30 points, and patients with an MMSE score of less than 20 points are diagnosed as suffering from dementia [3]. The actuarial survival and cardiovascular event-free rates were calculated using the Kaplan-Meier method.

Results

The intimal tear was located on the ascending aorta to the proximal arch in 20 patients (74.1%). In 7 patients, the intimal tear was found on the distal arch to the descending aorta. Ascending aortic replacement was performed for 17 patients (63.0%). Ten patients received proximal hemiarch replacement, because the intimal tear was located on the lesser curvature of the proximal aortic arch (37.0%). Average circulatory arrest, CPB, and overall operating time durations were 18.7 ± 5.3 minutes, 82.8 ± 11.8 minutes, and 143.4 ± 18.9 minutes, respectively (Table 2). The duration of postoperative mechanical ventilation and hospital stay were 13.0 ± 11.4 hours and $12.2 \pm$

Table 2. Durations for Procedures

Procedure	Duration
Circulatory arrest, minutes	18.7 ± 5.3
Cardiopulmonary bypass time, minutes	82.8 ± 11.8
Operating time, minutes	143.4 ± 18.9
Ventilation, hours	13.0 ± 11.4
Hospital stay, days	12.2 ± 3.7

3.7 days, respectively (Table 2). There were no incidences of postoperative brain damage, reexploration for bleeding, or acute renal failure, except for 1 patient who had a light case of pneumonia. The overall in-hospital mortality rate was 3.7% (1 patient). A 91-year-old man died of pneumonia at 41 months after surgery.

At the time of this study, 25 patients were well and visiting the outpatient clinic. Twenty-two patients scored more than 20 points when given the MMSE, indicating no development of dementia. The average score for the MMSE was 25.7 ± 5.1 points. None of the patients required the use of a wheel chair, and 15 patients (60%) were visiting the clinic without family support. Contrast CT scan revealed a total patent distal false lumen in 3 patients (11.5%) and a localized patent false lumen on the abdominal aorta in 10 (50%) of the 20 patients who underwent assessment by CT scan. Echocardiography during the present study revealed no AR in the 25 patients. Two patients were hospitalized for congestive heart failure at approximately 35 months after surgery. Actuarial survival (Fig 1) and cardiovascular event-free rates (Fig 2) at 3 years were 96.2% and 83.0%, respectively.

Comment

Octogenarians suffering from AAD often have a concomitant disease as well, such as renal insufficiency, chronic obstructive pulmonary disease, peripheral vascular disease, or degenerative cerebral disease [4]. Therefore, they may not be able to tolerate the aggressive surgical stress caused by deep hypothermia, long-term cerebral exclu-

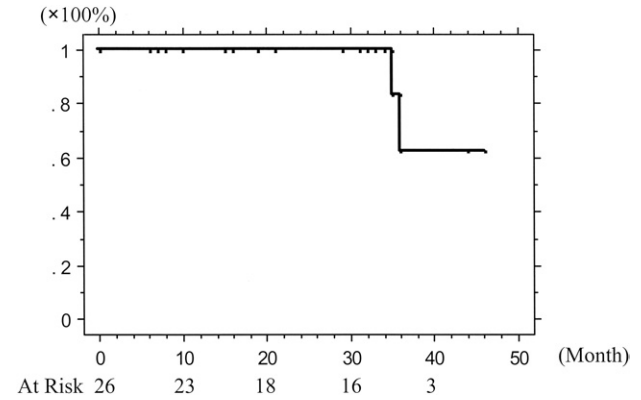


Fig 2. Cardiovascular event free rate: the cardiovascular event-free rate at 3 years was 83.0%.

sion, or CPB. Furthermore, a prolonged operation can increase the risk of mortality due to bleeding disorder, cerebral ischemia, infection, or multiple organ failure [5]. Therefore, particularly for octogenarians, performing surgery that generates minimum invasive stress is considered a key factor for saving lives and maintaining postoperative quality of life. In the aim to minimize operative time and postoperative complications, the LIQR technique reduces the rewarming and CPB periods. Piccardo and colleagues [6] conducted a multicenter study and recently reported that the surgical mortality of octogenarians with AAD was 45.6%, and that compassionate indication and total arch replacement are risk factors for in-hospital mortality. The same study also reported that patients who died during hospitalization were significantly more likely to have undergone a surgical procedure with a cardiocirculatory arrest time exceeding 80 minutes or CPB time exceeding 200 minutes [6]. Using the LIQR technique, moderate hypothermic (28°C) circulatory arrest without any cerebral perfusion for distal anastomosis was performed within 20 minutes, and the durations of the CPB and overall operation were approximately 80 and 140 minutes, respectively—notably quicker compared with the times reported in previous reports [6–8]. Therefore, LIQR can minimize the surgical stress by avoiding the need for deep hypothermia and long CPB times. The end results are a much lower mortality rate and reduced incidence of complications compared with recent studies reporting surgical mortality rates ranging from 45% to 61% [6, 7].

The LIQR technique provides an attractive early surgical outcome for octogenarians [2]. However, little information has been available for us in estimating how many octogenarian patients have returned to their preoperative living conditions. Rapid demographic aging around the world has important implications for health and social care. Cognitive decline and dementia have a high individual impact and are strongly age associated [9], so that their overall prevalence and social impact is increasing rapidly. A recent consensus report estimated that the number of people with dementia in the world will increase from 24 million to 82 million from 2000 to 2040 [10].

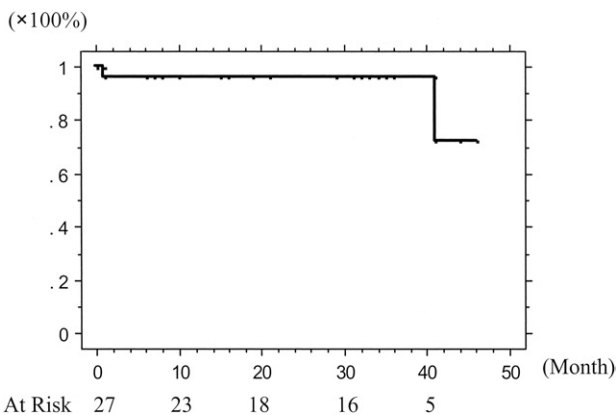


Fig 1. Actuarial survival rate: the actuarial survival rate at 3 years was 96.2%.

Even though LIQR can contribute to the survival of octogenarians, if there are complications such as dementia or becoming bedridden in the early postoperative phase, the patient's family might become severely stressed because of the increased burden of having to care for the patient and take them to the outpatient clinic.

In the present study, 60% of the patients were actually visiting the clinic without the assistance of other family members. However, cognitive assessment is a basic element for diagnosing dementia. The average score for the MMSE was 25.7 ± 5.1 points, and only 3 patients had signs of dementia. Even so, those 3 patients could still walk by themselves, visit the clinic with their family, and talk with us. That indicates that their mental and physical conditions are still sufficient for continuing an enjoyable lifestyle, and are at levels that family members are capable of coping with. We excluded the patients who already had senile dementia of the Alzheimer's type from the surgical indication. Therefore, in this series, there were no octogenarians who were sedentary before the onset of AAD. It is evident that LIQR provides a good postoperative quality of life at a level close to preoperative living conditions, even in the case of octogenarians. Preoperative clinical status is the most significant factor predicting in-hospital death, and in general, surgery should only be considered an effective treatment for patients with good preoperative clinical status. Medical treatment should be reserved for patients who have critical preoperative conditions [6, 7]. In the present study, however, even though the patients experienced preoperative shock or vital organs failure, their quality of life status is still good after surgical treatment by LIQR. We believe that emergency surgical intervention should be carried out for octogenarians regardless of their preoperative clinical conditions. However, it is still questionable as to whether or not surgery should be performed on elderly patients who have preoperative dementia or are bedridden.

Proximal aortic stamp fixation with the aid of biologic glue enabled us to preserve the native aortic valve whenever possible. The quality of the aortic wall adhesion by gelatin resorcin formalin glue may explain the absence of late AR in most patients, because the deformation of the aortic annulus could be repaired and the commissure support system could also be restored by adhesion of the dissected layers. In this series, 4 patients (14.8%) had mild preoperative AR, and although we did not replace the aortic valve, none of the patients required late aortic valve replacement nor did echocardiography at the time of this study show any AR. This represents a successful outcome, even if further attention is required in the future.

Postoperative patency and dilation of the false lumen are also important issues, as emphasized recently in several reports [11–14]. Kawahito and colleagues [15] reported that the mortality of elderly patients was 13%, and the major cause of early death was rupture of the residual false lumen in the aortic arch after ascending aortic replacement. However, extended operation is be-

lieved to be too risky for octogenarians. Several investigators advocate systematic extended or total aortic arch resection for the initial surgical management of AAD, irrespective of the location of the intimal tear [16, 17]. Although that provides satisfactory results, it is important to always remember that AAD is an inherently lethal condition, particularly for octogenarians. Such an extended approach increases the risk of complications in an operation that is already high risk.

Ehrlich and colleagues [18] reported that the site of the intimal tear does not influence the outcome, but the mortality rate is higher with more extensive resection. Piccardo and associates [6] also described total arch replacement in octogenarians as a risk factor for in-hospital mortality. In the present study, even though emergency intervention for primary tear excision was performed on octogenarians, as of this writing, none of the patients have returned to the hospital for secondary operations. Furthermore, the false lumen was patent in only 11.5% of the patients involved in our study. As mentioned earlier, this rate is quite acceptable compared with previous reports. David and colleagues [19] have reported that the prevalence of postoperative patent false lumen was reduced from 91% to 59% by the use of the open distal anastomosis technique. We believe that during the initial emergency operation for AAD, open repair and fixation of the distal aortic stump with gelatin resorcin formalin glue decreases the false lumen patency rate, and possibly improves prolonged survival [20]. In fact, we believe that the LIQR technique is the best emergency surgical procedure for octogenarians with AAD to repair the type A dissection to type B style. Previous reports state that the 3-year mortality of patients with a patent false lumen of type B dissection is just 10% to 20% [21, 22]. We also identified that the long-term survival rates at 5 and 10 years for the patients with type B dissection undergoing medical treatment were 89.4% and 71.8%, respectively, regardless of the false lumen status [23].

Stessman and colleagues [24] described that among patients who are physically active at the age of 78, the 8-year mortality was 26.2%, and at the age of 85, the 3-year mortality was 6.8%. Conversely, previous reports mention that the overall survival rate for the octogenarians with AAD undergoing emergency surgery is 39% at 1 year and 33% to 44% at 5 years [6, 7]. In the present study, even though the octogenarians experienced high-risk situations, the postoperative survival and cardiovascular event-free rates with good quality of life at 3 years were 96.2% and 83.0%, respectively, which were considered quite successful and attractive, particularly for octogenarians.

In conclusion, the LIQR technique is considered a safe and effective surgical treatment for patients with AAD. The recent emergency surgical aortic repair conducted using the LIQR technique to treat AAD has demonstrated satisfactory midterm survival rates, and enable patients, even octogenarians, to return to a quality of life status equivalent to that before the operation.

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INVITED COMMENTARY

The management of acute type A aortic dissection in octogenarians is problematic. Although the report by Piccardo and colleagues [1] probably overstates morbidity and mortality, most surgeons realize that surgical repair in this aged population carries significant morbidity and mortality. This report by Hata and colleagues [2] is therefore notable for several reasons:

- It appears to be a consecutive series that excluded 6 senile or bedridden patients.
- Institutional Review Board approval was obtained after conclusion of the series but before publication.
- Included were 12 patients with only a large intramural hematoma, and 4 patients had mild aortic valve regurgitation.
- The surgical procedure included femoral artery cannulation, clamping of the ascending aorta while the proximal aortic segment was repaired with gelatin resorcin formalin glue, circulatory arrest at 28°C without cerebral perfusion while warming the perfusate in the pump circuit to 40°C, and then recommencing bypass at 40°C after approximately 20 minutes.

- Management of the distal anastomosis was tear-oriented, with the ascending aorta replaced in 17 patients, and hemiarch repair used in 10.

The surgical results are remarkable: The hospital mortality was 3.7% (1 patient), with no instances of renal failure or brain damage. Total operating time was 143 minutes, with a cardiopulmonary bypass time of 83 minutes.

Certainly the rationale for shortening and simplifying the surgical procedure for a high-risk population is reasonable; however, the temperature management is controversial. Numerous authors have documented the mismatch between cerebral blood flow and cerebral metabolic rate for oxygen, both experimentally and clinically, [3, 4] which occurs during rewarming.

These excellent neurologic outcomes certainly challenge modern temperature management strategies, with most centers avoiding any perfusate temperature higher than 37.5°C or a temperature difference greater than 2°C between nasopharyngeal and perfusate temperatures. How then can we account for this discrepancy?