

Treatment of uncomplicated type B aortic dissection

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Abstract Hospital mortality after the replacement of chronic type B aortic dissection is around 8–10% and adverse outcomes include paraplegia and stroke. However, the level of evidence for indication of thoracic endovascular aortic repair (TEVAR) for type B chronic aortic dissection is Class IIa. Results of the INSTEAD-XL trial have verified that preemptive TEVAR for uncomplicated type B aortic dissection improves prognosis. The indication for this procedure is reportedly a maximum aortic diameter >40 mm during the acute phase and a patent primary entry site in the thoracic aorta, while the optimal timing for TEVAR would be the subacute phase, from 2 weeks to 3–6 months after onset. Prevention of chronic type B aortic dissection with aneurysmal degeneration and attainment of aortic remodeling with preemptive TEVAR are needed to free patients from the need for long-term strict control of blood pressure and periodic follow-ups involving radiological exposure and to avoid the eventual need for extensive open surgery.

Keywords Aortic dissection · TEVAR · Uncomplicated dissection

Introduction

Elefteriades et al. [1, 2] introduced the complication-specific classification of acute type B aortic dissection. They encouraged establishment of a surgical approach

which is specific for the following complications: direct aortic replacement for rupture, acute expansion or impending rupture, and fenestration for vascular occlusion.

A recent publication about the long-term results of a randomized investigation of endovascular treatment for type B aortic dissection [3] has demonstrated the value of thoracic endovascular aortic repair (TEVAR), even for the treatment of “uncomplicated” type B aortic dissection.

All patients enrolled in the initial INSTEAD trial [4] were uncomplicated chronic dissection cases with no indication for surgery, the appropriate anatomic conditions for TEVAR, and with disease onset more than 2 weeks earlier so that early complications could be identified. Although the definition of early complications in this trial was not clear, rupture, organ ischemia, and refractory pain are usually recognized as the critical conditions for emergency treatment [2, 5]. For patients with uncomplicated chronic dissections, prevention of aortic death due to these complications was the aim of the treatment.

According to both the findings of the INSTEAD trial and Japanese guidelines, acute and chronic phases are categorized 2 weeks after the onset of type B aortic dissection. This definition has been widely accepted, because patients who need emergency surgical treatment for acute complicated type B aortic dissection almost always develop fatal complications during this period and are characterized by high in-hospital mortality [6–8]. As a result of recent considerations about the optimal period for the indication of safe and effective TEVAR for the treatment of uncomplicated type B aortic dissection, the “subacute” phase has been defined as the period between 2 and 6 weeks to 6 months after the onset of type B aortic dissection [8–13].

The indication of TEVAR for “uncomplicated” type B aortic dissection should be decided on the basis of a

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thorough understanding of the disease. The current strategy for uncomplicated type B aortic dissection is summarized in Fig. 1.

Before TEVAR came available, the “uncomplicated” type B aortic dissection was treated only medically. However, when the false lumen showed enlargement or aneurysmal degeneration occurred, surgical treatment was indicated. TEVAR has been recognized as the treatment of choice for chronic dissecting aneurysm, but its efficacy remains to be elucidated.

Recently, TEVAR is widely accepted as the optimal treatment for the acute/subacute phase of type B aortic dissection to attain aortic remodeling or to prevent enlargement of the dissecting aneurysm. It has therefore become necessary to distinguish patients who can be treated medically from those who should be treated with TEVAR.

In this review article, the best treatment option for uncomplicated type B aortic dissection is discussed.

Indication of TEVAR for acute/subacute uncomplicated type B aortic dissection

Kato et al. [14] reported on the use of minimally invasive treatment of type B aortic dissection with a prototype device for TEVAR in canine models. Eighteen years later, evidence of its clinical efficacy and safety, especially in a comparison with medical treatment, was demonstrated in an extended study, the INSTEAD-XL trial by Nienaber et al. [3].

In the initial INSTEAD trial, TEVAR did not improve 2-year survival or adverse event rates despite favorable aortic remodeling. In the INSTEAD-XL, TEVAR in combination with optimal medical treatment was shown to be associated with improved 5-year aorta-specific survival and delayed disease progression. The impact of this trial could be as major as to lead to a change from the usual

guidelines, which have recommended medical therapy as the basic treatment of uncomplicated type B aortic dissection [5], to a new strategy to always consider TEVAR first in the algorithm for evaluation and management of type B aortic dissection on the basis of categorization of the aortic dissection [15, 16].

The INSTEAD trial [4] does not specify any inclusion criteria for aortic diameter. However, in a study by Kato et al. [17], the predominant predictors for aortic enlargement in the chronic phase were found to be a maximum aortic diameter >40 mm during the acute phase and a patent primary entry site in the thoracic aorta. They showed that at 5 years patients with an aortic diameter of less than 40 mm could be expected to be free from aortic enlargement but that this applied to only 35% of patients with an aortic diameter of more than 40 mm. A recent report by Durham et al. [18] asserted that an increase in aortic growth of >5 mm in the maximal aortic diameter was observed in about half of the patients at 5 years, while 76% did not need intervention including TEVAR. They also reported that the only risk factor for aortic growth was an aortic diameter >35 mm at index presentation.

Many other predictors, both positive and negative, have been reported such as age, heart rate, Marfan’s syndrome, shape (elliptic or round), and diameter of the false lumen, site of entry, number of entries, level of fibrin/fibrinogen degradation products, and use of calcium-channel blocker. However, the predictors identified by Kato, which have been mentioned in several similar reports [19–23], are the simplest and can be detected early using only CT. These predictors contribute to the identification of patients with indications appropriate for TEVAR for uncomplicated type B aortic dissection with favorable prognosis, including complete thrombosis of the false lumen or the absence of or presence of only a partially thrombosed false lumen in combination with an aortic diameter less than that required for surgical indication.

However, although no data has been available for growth of the aorta in relation to the degree of thrombosis of the false lumen, partial thrombosis was found to be a significant independent predictor of mortality after medical management of type B aortic dissection [24]. Miyahara et al. reported that the presence of an “ulcer-like projection (ULP)”, which is the limited patency of the false lumen near the entry, affected late aortic dilation and late aortic events [25]. When indication for endografting is decided in terms of the interaction of operative risk and anatomical suitability [26], the presence of a partially thrombosed false lumen might be the optimal indication for TEVAR to attain closure of the entry because the length of the treatment is limited and there is a strong possibility of complete thrombosis (Fig. 2).

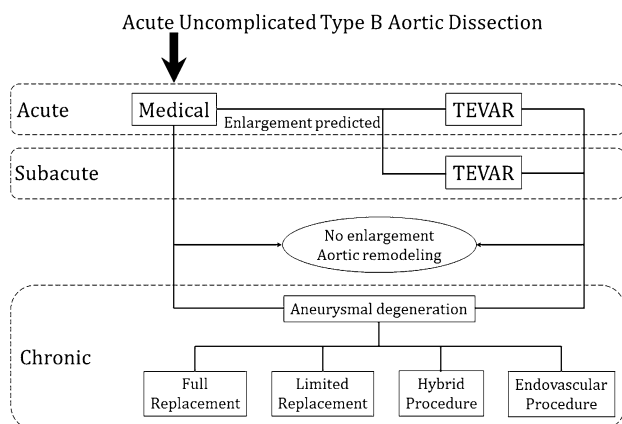


Fig. 1 Strategy for uncomplicated type B aortic dissection

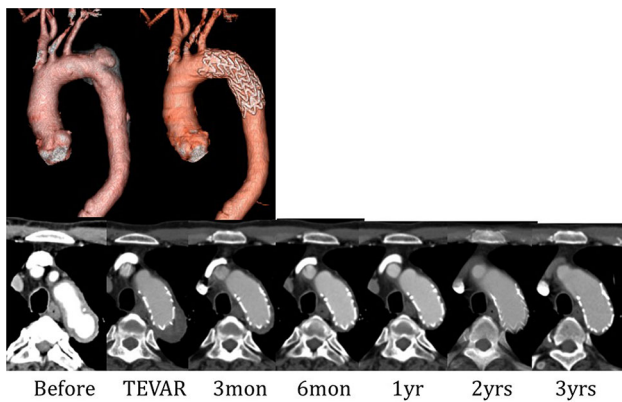


Fig. 2 TEVAR for ULP (ulcer-like projection). TEVAR was indicated for a 61-year-old male patient to close the entry with a limited patent false lumen near the entry 6 months after the onset of type B aortic dissection. Complete remodeling was observed 3 months after TEVAR

Optimal timing for TEVAR for acute/subacute uncomplicated type B aortic dissection

Historically, acute aortic dissection has been defined as occurring within 2 weeks from onset, whereas occurrence after 2 weeks is considered to be chronic dissection.

After the introduction of TEVAR to treat type B aortic dissection, Kato et al. first classified the phase of <14 days as acute, of 14 days–6 months as subacute, and of >6 months as chronic, and showed that TEVAR was most effective when the entry site was closed within 6 months after onset [27]. This specification of timing of TEVAR has been adopted by other studies [28–30].

IRAD Investigators [31] advocated a new temporal classification of acute dissection based on an analysis of survival curves whereby a dissection was not considered chronic until 30 days after symptom onset. Both a European expert interdisciplinary panel and the ACCF/AHA Guideline define acute dissection as occurring within 2 weeks of onset, subacute between 2 and 6 weeks, and chronic after 6 weeks [9, 32].

In addition, a definition of dissection acuity based on survival curves and aortic event rates as well as on its relationship with the response of the aorta in terms of remodeling to endovascular therapy has been considered mandatory [33]. The VIRTUE Registry enrolled patients with complicated acute (<15 days), subacute (15–92 days), and chronic (>92 days) type B aortic dissections [11]. Although the survival rates did not show any overall differences among the three groups, changes in the false lumen area of the acute and chronic, and the subacute and chronic groups showed significant differences but those for the acute and subacute groups did not. The authors concluded that the retention of aortic plasticity in the subacute group lengthens the

therapeutic window for the treatment of uncomplicated type B dissection.

As for the safety of the procedure, Desai et al. [34] analyzed the relationship between timing of TEVAR and associated complications for three groups: acute-early occurring within 48 h, acute-delayed between 48 h and 14 days, and subacute between 14 days and 6 weeks following presentation of type B dissection. No overall differences in late survival were found among the groups, but severe complications, such as in-hospital mortality, paralysis, stroke, renal failure, and retrograde type A dissection, were more frequent for the early-acute and delayed-acute patients than the subacute patients. Retrograde type A dissection tended to occur more frequently in the acute-early group.

The concept of a “subacute” phase of aortic dissection was not originally established for TEVAR, but it was found that such a phase, from 2 weeks until 3–6 months following presentation of type B aortic dissection [12], is optimal for TEVAR for uncomplicated type B aortic dissection.

Safety of preemptive TEVAR for uncomplicated type B aortic dissection

TEVAR for uncomplicated type B aortic dissection is preemptive and is not indicated for the prevention of an impending fatal complication. The safety of preemptive TEVAR is more critical and its indication is ideally limited to the patients whose disease is definitely expected to be complicated by an aneurysmal dilatation.

Retrograde dissection after TEVAR for uncomplicated type B aortic dissection should be avoided as it requires surgery for the aortic arch by means of a sternotomy and under cardiopulmonary bypass. In 2009, two reports were published which suggested that the use of a stent graft with a proximal bare spring was the cause of retrograde dissection after TEVAR [35, 36]. In the series covered by these reports, 50–60% of cases were treated with Talent (Medtronic, Minneapolis, MN). However, 5 years later, the MOTHER registry, which contains the results of several trials and institutional data for Talent and Valiant (Medtronic) revealed that the incidence of retrograde dissection was not significantly different for patients with proximal bare stent and nonbare stent endografts [37]. The comprehensive knowledge about the device used for TEVAR is essential, because not only the configuration of the proximal edge of stent grafts, bare stents, hooks, radial force, and shape of the edge, but also deployment systems vary considerably.

According to the MOTHER registry, retrograde dissection is done significantly more frequently in patients treated with a significantly oversized stent graft for acute and chronic aortic dissection. A binary logistic regression

analysis revealed that each 1% increase in oversizing above 9% led to an increase in the odds ratio for retrograde dissection by 1.14. The cohort for this study included patients with both aneurysm and dissection so that the limit for oversizing of the dissection was not clear. Nevertheless, a little oversizing as possible would be desirable to ensure the safety of preemptive TEVAR.

Desai and colleagues reported perioperative data showed that the occurrence ratio of any type of paralysis was 4.5–11.1% depending on the timing of TEVAR [38]. Similar percentages have been published [39–43], but all cohorts included patients with complicated type B aortic dissection. The percentages for uncomplicated type B aortic dissection therefore remain to be elucidated.

Intervention for chronic aortic dissection

TEVAR for acute/subacute uncomplicated type B aortic dissection may help avoid chronic complications, which may occur even after long-term strict medical management. However, for an accurate assessment of its value, the long-term results of both TEVAR and open surgery for chronic type B aortic dissection with aneurysmal degeneration should be taken into consideration.

Chronic type B aortic dissection is located mainly at the descending aorta, but extends to the arch with the entry near the left subclavian artery and/or to the thoraco-abdominal portion in case of DeBakey IIIb dissection. For replacement of the descending aorta, left thoracotomy and partial cardiopulmonary bypass or left heart bypass is essential. To treat lesions extending to the arch, hypothermic circulatory arrest [44] and retrograde cerebral circulation [45] are needed, while replacement of the thoraco-abdominal portion requires a spiral opening involving diaphragmatic incision and laparotomy, with careful attention to prevention of spinal ischemia being of the essence.

According to recent reports from major aortic surgery centers about the replacement of chronic type B aortic dissection, hospital mortality is around 8–10% [46, 47] and adverse outcomes include paraplegia and stroke. However, the same studies found that the survival rate after the postoperative period was equivalent to that of a normal population and that there was a high level of freedom from reoperation. Open replacement of dissected, aneurysmal segments of the descending thoracic and abdominal aorta thus remains the gold standard [48].

According to the Japanese guidelines, the level of evidence for indication of TEVAR for type B chronic aortic dissection is Class IIa [5]. In addition, open surgery or TEVAR to repair primary entry is the first principle for intervention of aortic dissection. Another principle specifically for TEVAR is that the landing zone for the stent graft must be a healthy section of the aorta. However, when it comes to TEVAR for type B aortic

dissection, the distal landing zone is the dissected portion of the aorta. While complete coverage of the dissected descending aorta is the rational procedure for expanding the true lumen and to close reentries, the possibility of spinal ischemia needs to be taken into consideration. Furthermore, when the dissection extends below the diaphragm, complete thrombosis of the false lumen is difficult to achieve by means of entry closure, especially if the orifice of the visceral artery originates from the false lumen.

Moreover, freedom from reintervention after TEVAR for chronic dissection is not satisfactory, especially when the dissection extends below the diaphragm [30, 49]. To obtain better results, new techniques such as the candy-plug [50] or knickerbocker [38] technique have been utilized but the long-term results remain to be investigated.

Conclusion

Prevention of chronic type B aortic dissection with aneurysmal degeneration and attainment of aortic remodeling with preemptive TEVAR are needed to free patients from the need for long-term strict control of blood pressure and periodic follow-ups involving radiological exposure and to avoid the eventual need for extensive open surgery.

Compliance with ethical standards

Conflict of interest The author declares that no conflict of interest exists.

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