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# Emergency TEVAR for Complicated Acute Type B Aortic Dissection

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## 1. Introduction

Non-complicated type B aortic dissection has been managed by conservative treatment at least in the acute phase. However, complicated acute type B aortic dissection, such as rupture or visceral ischemia secondary to malperfusion, has required emergency open surgical management. Despite recent advance of open surgery and perioperative managements, early results of emergency surgery has been reported to be still unsatisfactory with high mortality rate of 30 - 40 % and morbidity (Fattori R, et al., 2008, Svensson LG, et al., 2008). Since more than a decade ago, percutaneous trans-catheter intervention has contributed as an emergency treatment in order to salvage ischemic visceral organs including leg ischemia secondary to acute aortic dissection (Midulla M, et al., 2011). However, bare stent placement at occluded artery or catheter fenestration of intimal flap to ameliorate organ ischemia do not change a situation of dissected aorta itself.

From the point of view as a mechanism of complications secondary to type B aortic dissection, stent-grafting to close an primary entry at the descending thoracic aorta seems rationale, especially in the acute phase, because most complications secondary to acute aortic dissection are caused by an increased blood flow in a false lumen. Recently, the attempt of an application of elective thoracic endovascular aortic repair (TEVAR) for non-complicated acute type B aortic dissection to close a primary entry during relatively early phase to improve long-term results have been reported. A benefit of TEVAR for non-complicated type B was currently not confirmed. Furthermore, procedure-related complications made early results of TEVAR even worse than those of conservative management (Nienaber CA, et al., 2009). Although INSTEAD trial was not able to show a usefulness of TEVAR in the acute phase for patients with non-complicated acute type B aortic dissection, it showed that the thrombo-occlusion rate of a false lumen in the descending thoracic aorta was more than 90 % when a primary entry was closed by a stent graft in the early phase. This evidence suggests that TEVAR can manage lethal complications secondary to acute type B aortic dissection with a high success rate. In such a critical situation of complicated acute type B aortic dissection, the procedure-related complication rate which INSTEAD trial reported, might be considered to be negligible. Currently, a non-randomised clinical trial entitled "Evaluation of the clinical performance of the Valiant Thoracic Stent Graft with the captivia delivery system (Valiant Captivia) for the treatment of acute, complicated type B aortic dissections" has been going to confirm a

safety and an effectiveness of emergency TEVAR for acute complicated type B aortic dissection since 2010. This study will provide a promising early and mid-term results of emergency TEVAR for acute aortic dissection by 2017.

There are some questions regarding TEVAR for aortic dissection, especially in the acute phase. A proximal bare stent of stent graft to increase a graft stability and radial force of proximal end of stent graft probably should increase a risk of new intimal tear at the aortic arch or the ascending aorta, which causes retrograde type A aortic dissection as a potentially lethal complication. Although we have no experience of retrograde type A aortic dissection following 21 emergency TEVAR for complicated acute aortic dissection, Schoder et al. reported that retrograde IIIb aortic dissection as a TEVAR-related complication was experienced in 2 cases (11.8 %) out of 17 cases with complicated acute type B aortic dissection (Schoder M, et al., 2006). An appropriate length of stent graft, a desirable site of a proximal landing zone and a best type of stent grafts for dissection are still unknown.

In this chapter, an application and reported results of emergency TEVAR for ruptured type B aortic dissection and visceral ischemia including leg ischemia due to obstruction of aortic branches are explained considering our 10-year experiences.

## 2. Ruptured acute type B aortic dissection

Despite an improved surgical technique and perioperative care, the early mortality rate of conventional open repair for ruptured acute type B aortic dissection are 30 – 40 % (Sachs T, et al., 2010, Zeeshan A, et al., 2010). Because clinical status of patients with rupture is already in a critical condition before surgery, a less-invasive initial treatment should be desirable, such as TEVAR. Emergency TEVAR is performed to close a primary entry in order to reduce a blood flow in a ruptured false lumen. Considering possible distal re-entries of ruptured acute type B aortic dissection, an expected success rate by emergency TEVAR should be different between DeBakey type IIIa (localized dissection) and DeBakey type IIIb (extended dissection). It is possible to cover all dissected aorta in type IIIa, which means that all entries including possible re-entries can be closed by stent-grafts. On the other hand, it is impossible to stop retrograde blood flow into a ruptured false lumen in the descending thoracic aorta through re-entries in the abdominal aorta or the iliac artery in cases of type IIIb. Although a 1st report of application of emergency TEVAR for ruptured acute aortic dissection was in 1996 (Dake MD, et al., 1999), there is few reports in which exact results of emergency TEVAR for ruptured acute type B aortic dissection were described depending on each type of localized DeBakey type IIIa or extended type IIIb dissection (Steuer J, et al., 2011). Previous reports described that early mortality rates following emergency TEVAR for ruptured acute B including both type IIIa and IIIb aortic dissection were 16 – 33% (Feezor RJ, et al., 2009, White RA, et al., 2011). Considering above mentioned background of different characters in each type of localized or extended dissection, it is hard to understand the real mean of reported early mortality rates of emergency TEVAR for ruptured acute type B aortic dissection without categorizing type IIIa or IIIb.

In a clinical setting, we sometimes experience that patients with rupture have to be transferred to the operating room without sufficient preoperative image studies. However, when considering TEVAR as an initial management for acute aortic dissection, preoperative image examination should be necessary, such as computed tomography (CT) with contrast

medium. Moreover, although TEVAR for complicated acute aortic dissection is emergency, at least, multiplanar reconstruction CT images should be ready to decide an appropriate proximal landing zone preoperatively (Fig. 1). When patients are hemodynamically stable, construction of volume rendering CT images are recommended for successful TEVAR even though it is time-consuming (Fig. 2). Intra-vascular ultrasound (IVUS) is very useful to confirm a position of guide wire in a true or false lumen (Fig. 3), a location of targeted dissected aorta and a condition of a false lumen before and after TEVAR (Fig. 4) during operation. For type IIIa aortic dissection, trans-esophageal echo (TEE) can be an alternative to IVUS because dissected aorta is limited in the thoracic cavity.

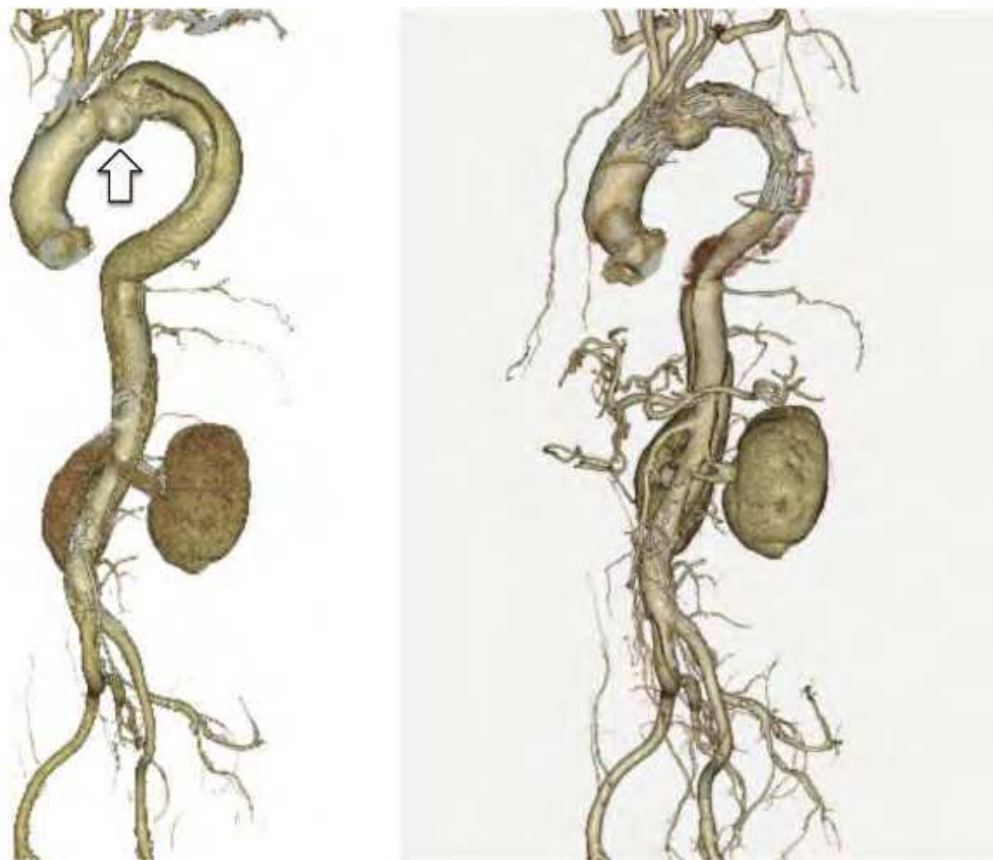


A 72-year-old woman was given a diagnosis of ruptured acute type B aortic dissection by CT. Despite a thrombosed false lumen, the patient was transferred to the operating room considering mediastinal hematoma. The patient suffered from hemorrhagic shock before an induction of general anesthesia due to re-rupture. MPR images were useful to determine an appropriate position and a length of stent grafts. The hand-made fenestrated stent graft was placed from zone 0 with a simple coverage of the left subclavian artery and preserving the brachiocephalic and left carotid arteries.

Fig. 1. Multiplanar reconstruction (MPR) computed tomography (CT) images of ruptured acute type B aortic dissection.

Complete coverage of whole dissected descending thoracic aorta is usually possible for type IIIa with or without coverage of the left subclavian artery (LSA). In our experience, a primary entry of ruptured acute type IIIa is commonly located at a great curvature of distal aortic arch close to LSA as well as a primary entry of type IIIb. When using commercially available stent grafts as of 2011, there are cases in which LSA has to be sacrificed and covered by a stent graft in order to close a primary entry and to achieve a stable positioning of placed stent graft. Our current policy of TEVAR for aortic dissection is that a proximal

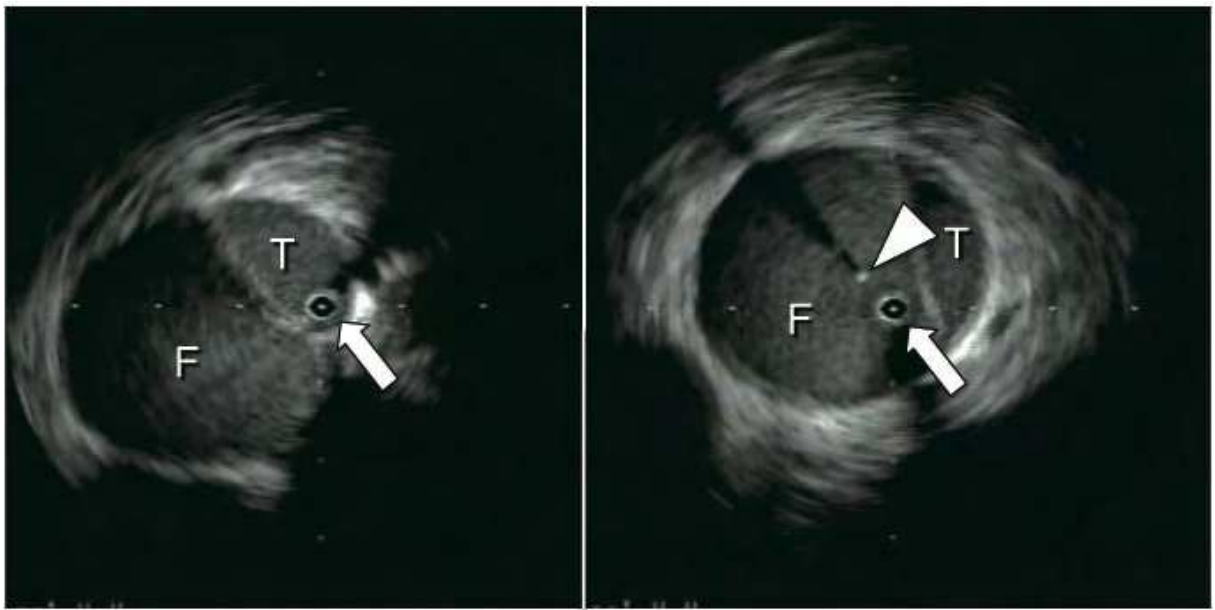




A 75-year-old man was transferred complaining left leg pain suddenly occurred 10 days after an initial onset of acute type B aortic dissection. VR-CT revealed small distal aortic arch aneurysm (White arrow in left) as well as acute aortic dissection. VR images were useful as a preoperative image study when a patient's condition allows reconstruction of original CT data. The hand-made fenestrated stent graft was placed from zone 0 with a simple coverage of the left subclavian artery preserving the brachiocephalic and left carotid arteries. Although type Ia endoleak into distal aortic arch aneurysm through a fenestration for the left carotid artery was observed, left leg ischemia was immediately improved just after TEVAR.

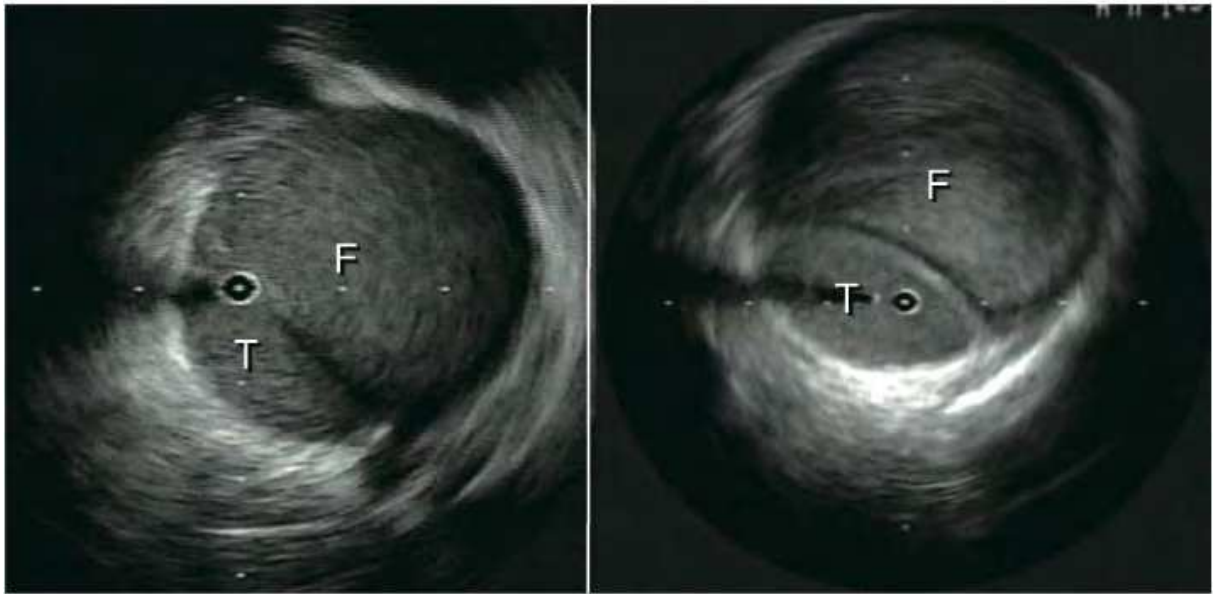
Fig. 2. Volume rendering (VR) computed tomographic (CT) images of left leg ischemia due to acute type B aortic dissection.

landing zone should be non-dissected aorta, generally, which is the aortic arch in cases of acute type B aortic dissection. Based on our study, there is a risk of complication around 5 % if LSA is simply covered by a stent graft (Kurimoto Y, et al., 2008a, 2009). In addition of cerebral complication, a simple coverage of LSA possibly increases a risk of spinal cord ischemia as postoperative complication. Although 10 % incident rate of spinal cord ischemia (Schoder M, et al., 2006) might be negligible considering a critical situation of ruptured acute type B aortic dissection, LSA should be reconstructed as much as possible if patient's general condition allows. Hybrid TEVAR combined with great-vessel, such as the brachiocephalic, the left common carotid and LSA, bypass-grafting, so called "debranching technique" (Schoder M, et al., 2006), has been commonly performed for cases in which a stent graft has to be placed from zone 0-2 (Fig. 5). In our hospital, we have chosen a hand-made fenestrated stent graft (Fig. 6) which enables preservation of great-vessels branched from the aortic arch without additional bypass-grafting in most cases of complicated acute type B aortic dissection.



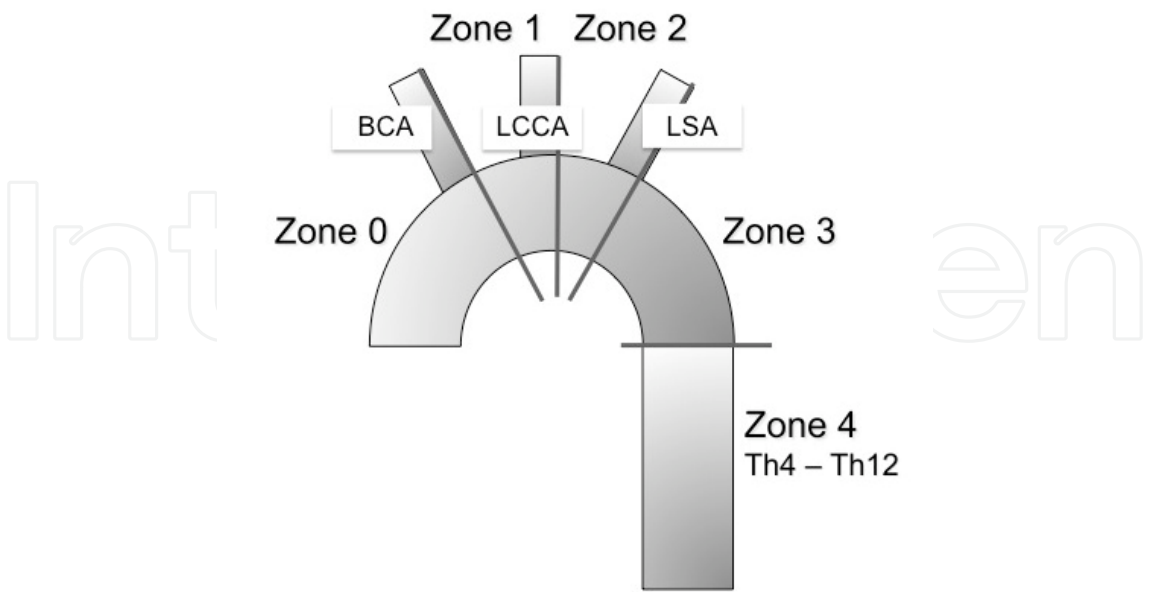
IVUS is useful to confirm a lumen of dissected aorta in which a guide wire is running. Stent-graft system should be advanced on a guide wire (White arrow) running in a true lumen from the iliac artery to the aortic arch (Left). In an elective case, a bailout guide wire in a false lumen (White arrow and arrow head) might be helpful just in a case of visceral organ ischemia secondary to malperfusion of false-lumen-branched organ following an entry closure by a stent graft (Right). T; true lumen, F; false lumen.

Fig. 3. Intra-vascular ultra-sound (IVUS) images during TEVAR for aortic dissection.

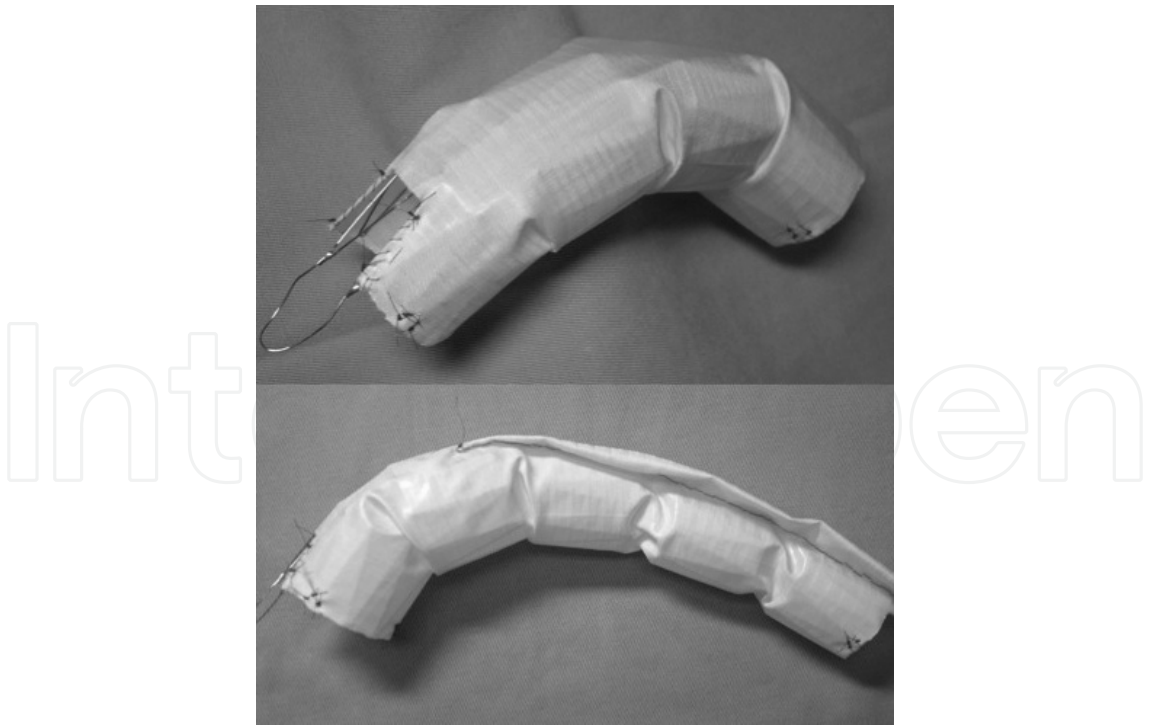


Smoke-like echo image, we call it “moya-moya echo”, generally guarantees a thrombo-occlusion of a false lumen in the descending thoracic aorta (Right). In an elective case of chronic aortic dissection with a dilated false lumen, additional distal stent graft might be considered when “moya-moya echo” is not observed in IVUS after placement a 1<sup>st</sup> proximal stent graft (Left). T; true lumen, F; false lumen.

Fig. 4. Intra-vascular ultrasound (IVUS) images during TEVAR for aortic dissection.



BCA; brachiocephalic artery, LCCA; left common carotid artery, LSA; left subclavian artery.  
Fig. 5. Zone classification of proximal position of a stent graft in thoracic endovascular aortic repair (Mitchell RS, et al., 2002).

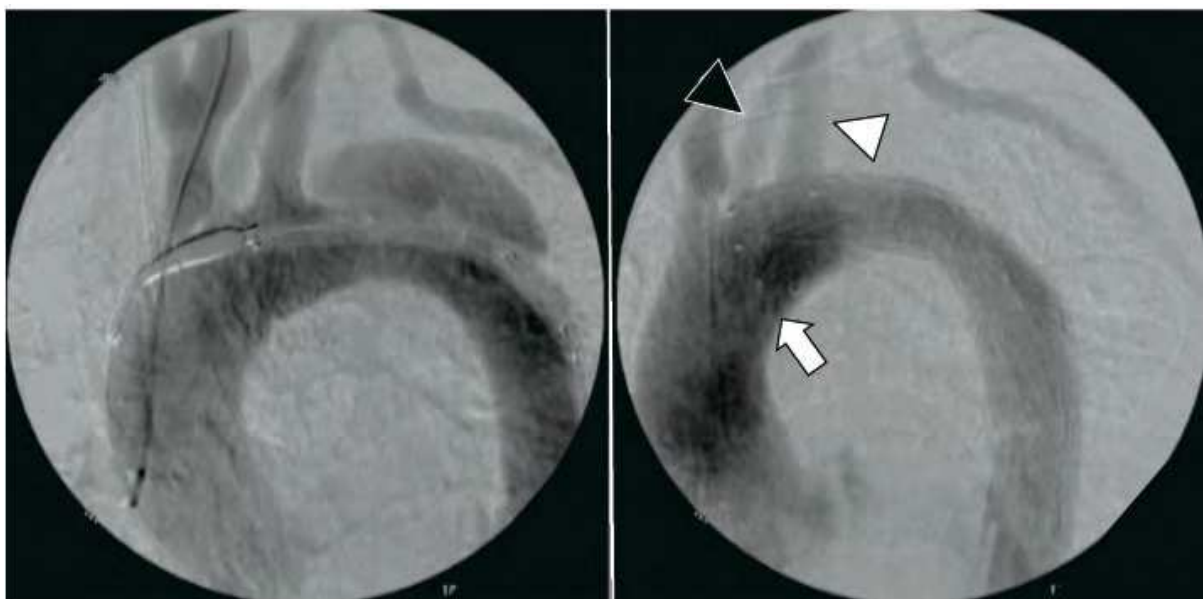


A proximal roof of a stent graft is fenestrated to preserve great vessels from the aortic arch (Upper). A stent graft is tapered in a case in which a diameter of a distal aortic neck is smaller more than 10 mm compared with one of a proximal aortic neck (Lower).  
Fig. 6. Hand-made stent grafts in our facility.

### 2.1 Ruptured acute DeBakey type IIIa aortic dissection (Localized type)

Incidence of acute type IIIa aortic dissection is supposed to be rare compared with type IIIb. However, ruptured acute type B aortic dissection is likely to be more often experienced in type IIIa in a clinical setting (Steuer J, et al., 2011). This is very same in acute type A aortic dissection. Clinically, incident of acute DeBakey type II (localized type) is rare compared with type I (extended type). A high incidence of rupture in the localized type is probably due to lack of distal re-entry. However, once patients with ruptured acute type IIIa aortic dissection can be placed on the operating table as candidates of TEVAR, satisfactory early and long-term results can be expected if appropriate proximal and distal landing zones can be achieved (Fig. 7).

There is a possibility that emergency TEVAR can be almost a definitive treatment for ruptured acute type IIIa aortic dissection. As long as our 10-year experience of ruptured type IIIa, all 5 patients have been doing well with complete resolution of a false lumen without any dilatation of the descending thoracic aorta including proximal and distal landing zones (Fig. 8). Because of small number of patients and limited period of follow-up, we would like to wait for other reports regarding results of emergency TEVAR for ruptured type IIIa aortic dissection.



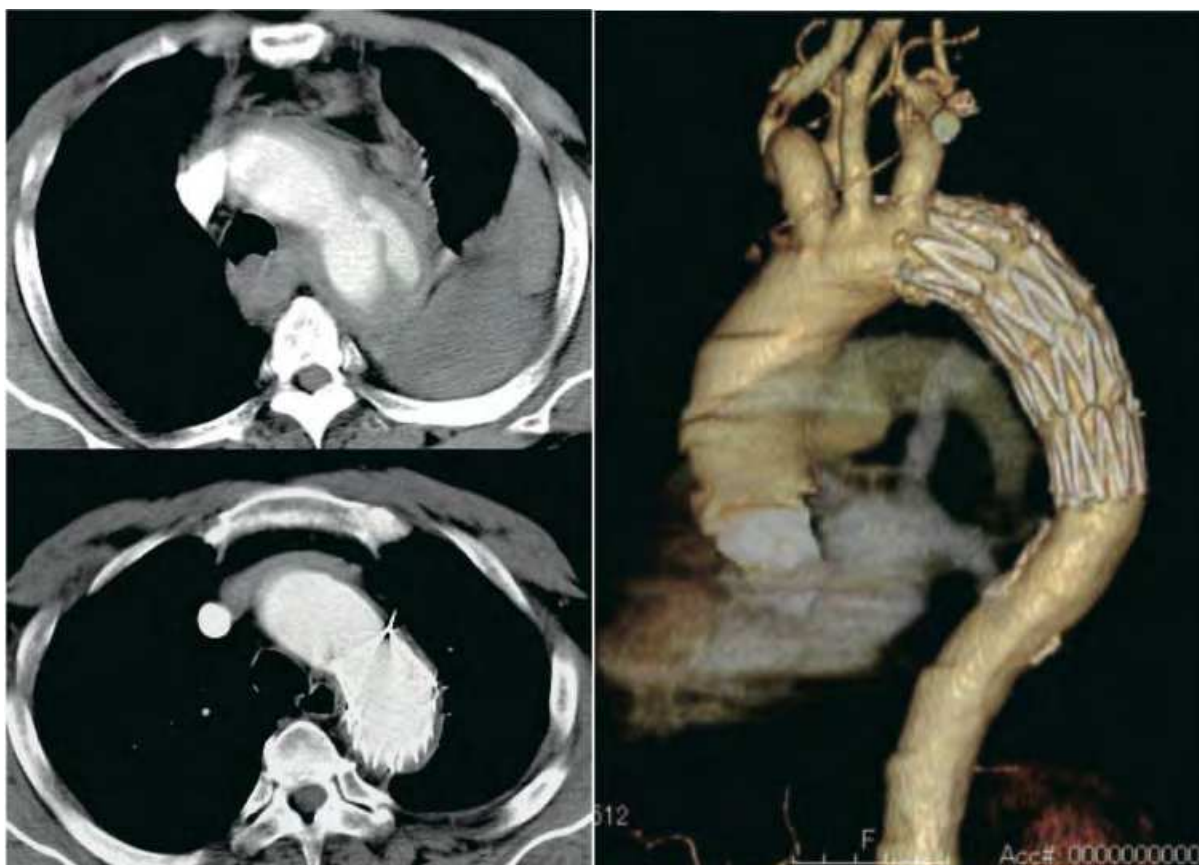
We think that a proximal landing zone for acute type B aortic dissection should be non-dissected aorta, which means that a stent graft is generally placed from the aortic arch. The left common carotid artery (LCCA) is always preserved and the left subclavian artery (LSA) is also preserved when a proximal entry is located more than 15 mm distally from LSA (Left), using a fenestrated stent graft without any debranching technique (Right). White arrow shows a proximal end of the stent graft with a fenestration to preserve LCCA (Black arrowhead) and LSA (White arrowhead)(Right).

Fig. 7. Digital subtracted angiographic (DSA) images of emergency TEVAR for ruptured acute type IIIa aortic dissection.

### 2.2 Ruptured acute DeBakey type IIIb aortic dissection (Extended type)

Ruptured acute type IIIb aortic dissection is rare, but a lethal complication. Although exact data is not unknown, most patients with ruptured acute type IIIb aortic dissection probably die before admission to hospitals. Based on reported thrombo-occlusion rate of more than 90%





A 57-year-old man was transferred in a hemorrhagic shock due to mediastinal hematoma and left hemothorax (Left upper) and underwent emergency TEVAR. CT images at 2 months after TEVAR showed complete resolution of a ruptured false lumen (Left lower). 3D-CT image at 7 years after emergency TEVAR showed no problematic change in the descending thoracic aorta (Right).

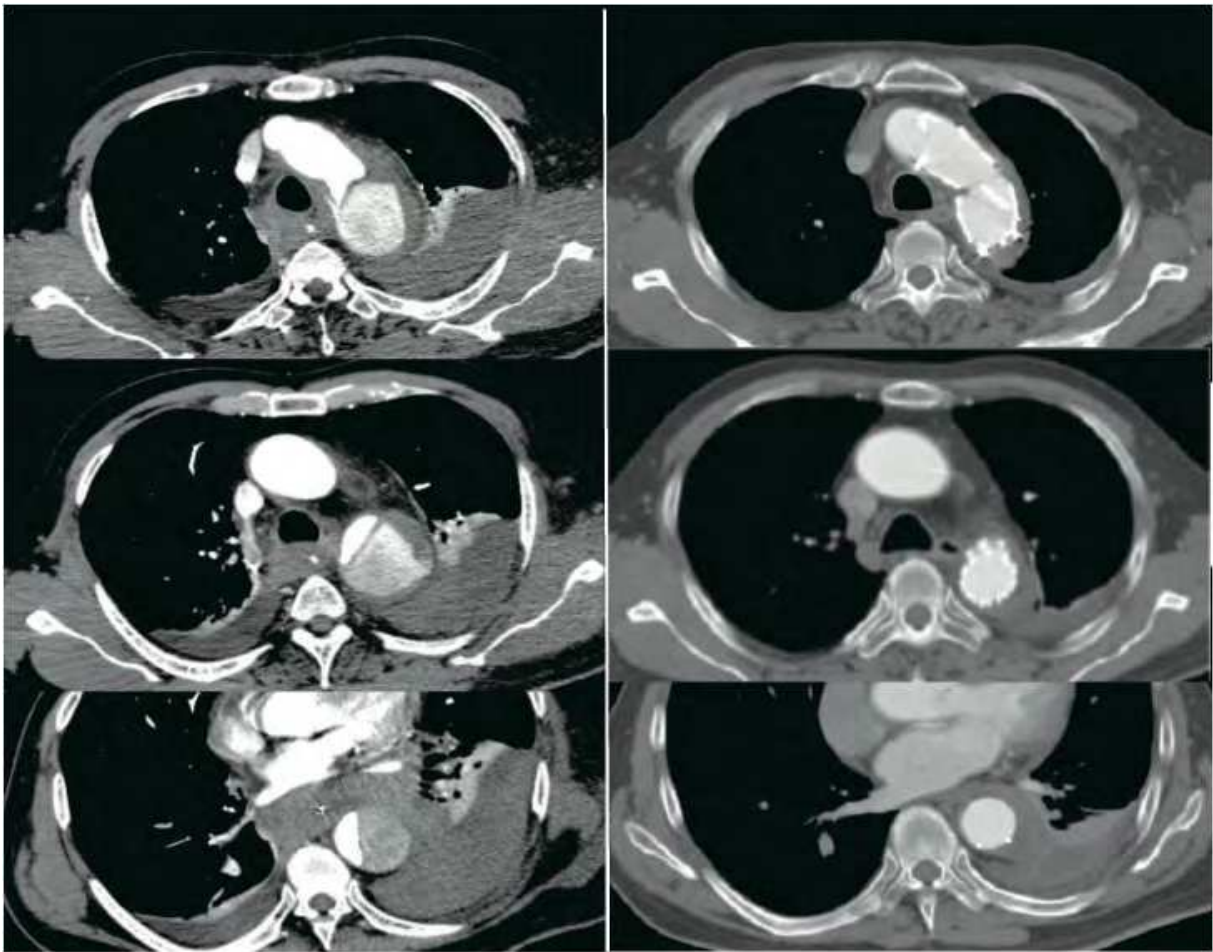
Fig. 8. Computed tomographic (CT) images of ruptured acute type IIIa aortic dissection.

in a false lumen following elective TEVAR for acute aortic dissection, it makes emergency TEVAR to be a promising less-invasive treatment of choice for ruptured acute type B aortic dissection. A big concern is how much impact a retrograde blood flow via distal re-entries has for a ruptured false lumen following primary entry closure using a stent graft, which is totally different from a localized type IIIa with rupture.

Based on our experience of early mortality rate 50% (2/4), there is no advantage in TEVAR for ruptured acute type IIIb compared with conventional open repair. However, emergency TEVAR is still thought to be a treatment of choice even for ruptured acute type IIIb (Fig. 9a,b) because of short operation time and feasibility of repeated TEVAR or open conversion as an urgent not emergent. Further experience will be necessary to conclude whether TEVAR is effective for ruptured acute type IIIb aortic dissection.

We experienced a difficult treatment in one case of ruptured type IIIb aortic dissection (chronic dissection, not acute). A 58-year-old man with 12-year history of hemodialysis and malignant rheumatic arthritis was transferred to our hospital by helicopter because of ruptured chronic type IIIb aortic dissection (Fig. 10a). Primary entry closure by placing a hand-made fenestrated stent graft from zone 1 to the level of Th 9 was effective to manage

rupture into the mediastinum, but follow-up CT images revealed enlargement of the false lumen of ruptured descending thoracic aorta. To thrombo-occlude a false lumen of the entire aorta, 2<sup>nd</sup> and 3<sup>rd</sup> stent grafts were necessary to be placed from the aortic arch to the common iliac artery. The celiac and supra-mesenteric arteries were preserved using a hand-made fenestrated stent graft. Finally, the false lumen was completely thrombo-occluded and a diameter of the descending thoracic aorta was reduced (Fig. 10b). Considering a clinical course of this case and high early mortality rates of our experience, there is a risk that proximal entry closure does not work for ruptured type IIIb aortic dissection. To improve these high mortality rates, Sfyroeras GS, et al. mentioned in their report regarding malperfusion in acute type B aortic dissection that stent grafts should be placed in whole descending thoracic aorta from LSA to the celiac artery in cases associated with rupture accepting a possible increase of incident rate of spinal cord ischemia (Sfyroeras GS, et al., 2011).



A 62-year-old man was transferred complaining severe back pain in a hemorrhagic shock. CT revealed acute type IIIb aortic dissection ruptured into mediastinum and bilateral pleural cavities (Left). Emergency TEVAR was chosen as an initial treatment because of deteriorated patient's general condition. CT at 2 months after emergency TEVAR showed complete resolution of a false lumen of the descending thoracic aorta (Right).

Fig. 9a. Computed tomographic (CT) images of emergency TEVAR for ruptured acute type IIIb aortic dissection.



Preoperative VR-CT showed that all visceral main arteries were branched from a true lumen (Left). VR-CT at 2 months after emergency TEVAR showed full expansion of a true lumen of the entire aorta (Right).

Fig. 9b. Volume rendering (VR) computed tomographic (CT) images of ruptured acute type IIIb aortic dissection.

### 3. Visceral ischemia including leg ischemia secondary to acute type B aortic dissection

Malperfusion, especially mesenteric ischemia, secondary to acute aortic dissection is one of typical lethal complications as well as rupture above mentioned. Proximal aortic repair including excision of a primary entry seems to be too time-consuming to salvage visceral ischemia. Since before the era of a stent graft, a usefulness of percutaneous endovascular treatment has been reported as a creation of intimal fenestration for compressed and collapsed aortic true lumen or a bare stenting for dissected or occluded aortic branches. Theoretically, a creation of intimal fenestration can restore a blood flow in a collapsed true lumen of the aorta, but can not be a treatment of dissected aorta itself. Reported clinical results of catheter fenestration is difficult to be understood because these reports include type A aortic dissection treated by open surgery following percutaneous catheter intervention. However, early mortality rate of 31 % and no dilatation of dissected aorta during mid-term follow-up (Midulla M, et al., 2011) might have been acceptable at least until before an emergence of TEVAR.

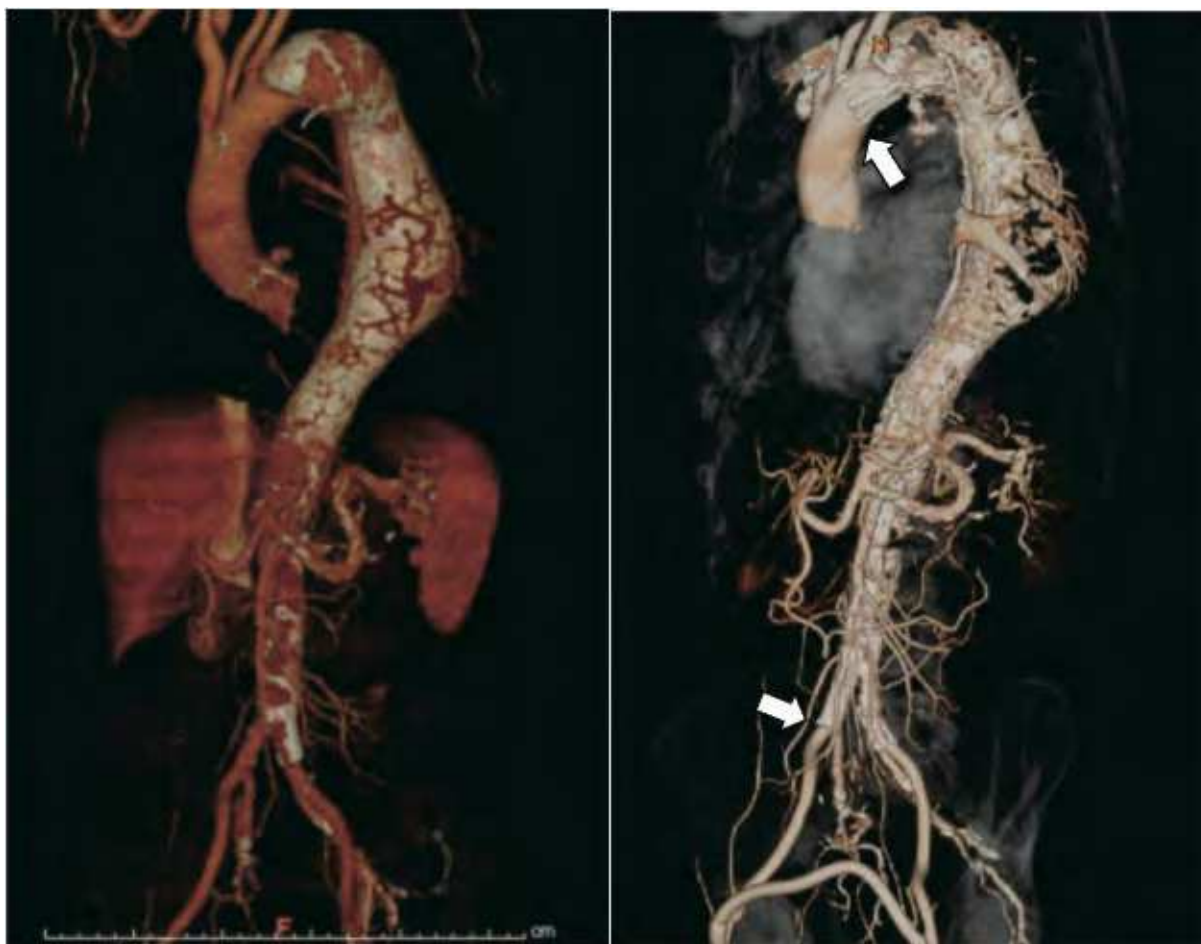




A 58-year-old man with a 12-year history of hemodialysis and malignant rheumatoid arthritis was transferred due to chronic type IIIb aortic dissection ruptured into the mediastinum (Left). Emergency TEVAR to close the primary entry was not able to thrombo-occlude a false lumen of the descending thoracic aorta. Additional EVAR and stent-grafting for thoracoabdominal aorta were necessary to thrombo-occlude a false lumen and to reduce a size of ruptured dissected aorta (Right).

Fig. 10a. Computed tomographic (CT) images before and after TEVARs and abdominal endovascular aortic repair (EVAR) for ruptured chronic type IIIb aortic dissection.



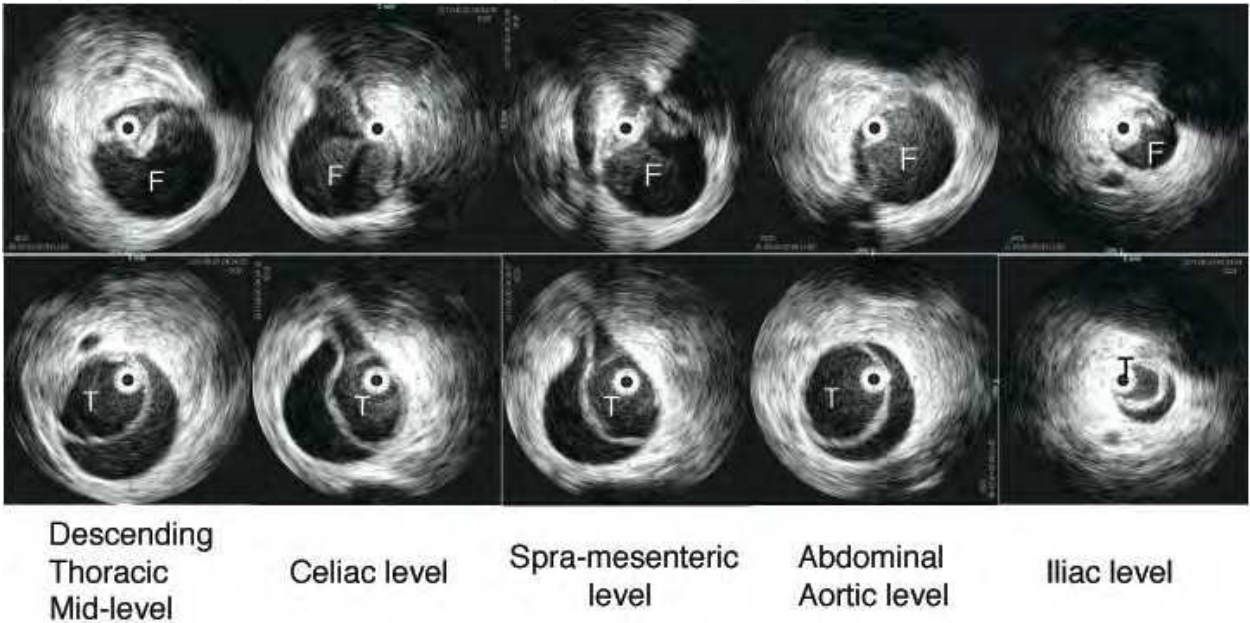


Preoperative VR-CT showed severely calcified false lumen of the entire aorta (Left). Because of insufficient thrombo-occlusion of a false lumen, Excluder (GoreTex, Japan) was placed in an aorto-uni-iliac fashion to close re-entries below a level of the supra-mesenteric artery (SMA) and a hand-made fenestrated stent graft to close re-entries around the thoracoabdominal aortic area was placed preserving the celiac and SMA without any debranching technique. As a result, 4 stent grafts were placed from zone 1 (White arrow) to the right common iliac artery (White arrow) and thrombo-occlusion of an entire false lumen was achieved (Right).

Fig. 10b. Volume rendering (VR) computed tomographic (CT) images of aortic stent-grafting for ruptured chronic type IIIb aortic dissection.

In cases of visceral ischemia due to malperfusion, emergency TEVAR can be applied based on a mechanism of malperfusion. In a case that dissected aortic branch itself is causing organ ischemia, conventional percutaneous catheter intervention using a bare stent should be chosen. In a case that thrombo-occluded aortic branch is causing malperfusion, direct bypass-grafting to ischemic organ usually has to be chosen. A catheter thrombectomy might be effective for limited cases of malperfusion. A primary entry closure by a stent graft is very effective for malperfusion caused by a collapsed true lumen compressed by an enlarged false lumen in the thoraco-abdominal aorta. This mechanism is called “dynamic obstruction” which is different from “static obstruction” above mentioned. Generally, it is not necessary to thrombo-occlude a false lumen in the descending thoracic aorta at least as an initial treatment for malperfusion. A minimum goal of emergency TEVAR for malperfusion is to reduce a blood flow in a false lumen and to re-expand a true lumen (Fig.

11). Therefore, emergency TEVAR is technically not demanding (Fig. 12) and should be more commonly considered as an initial management following accurate diagnosis of malperfusion mechanism. White RA et al. reported that early mortality rate following emergency TEVAR for malperfusion was 8.6 % (5/58). In our 7 cases of malperfusion, emergency TEVAR was effective for all cases except for one case associated with ruptured type IIIb aortic dissection which died due to re-rupture one day after TEVAR.



Preoperatively, a true lumen of the entire dissected aorta was critically compressed by an enlarged false lumen (Upper). Following emergency TEVAR to close a primary large entry at the distal aortic arch, a true lumen in each level was re-expanded (Lower). F; false lumen, T; true lumen.

Fig. 11. Intra-vascular ultrasound (IVUS) images during emergency TEVAR for malperfusion secondary to acute type B aortic dissection.

Procedure of emergency TEVAR for malperfusion secondary to acute type B aortic dissection is almost same as one for rupture already mentioned. In a case of ischemic leg, a stent-graft system should be approached via the side of ischemic leg because non-pulsatile femoral artery is usually perfused via a collapsed true lumen. In addition to confirmation of guide wire in a true lumen, IVUS is useful to determine a necessity of additional distal stent graft which can be placed until the level of the celiac artery with a little increasing risk of spinal cord ischemia. In our hospital, distal extension using a 2<sup>nd</sup> stent graft has not been employed when LSA is sacrificed to close a primary entry next to LSA because of a possible spinal cord ischemia. The facility where stent grafts have been placed on 87% of the descending thoracic aorta and LSA-reconstruction rate was 14%, reported that an incident rate of spinal cord ischemia following TEVAR for complicated type B aortic dissection was 15% (5/33) (Feezor RJ, et al., 2009). On the contrary, we have not experienced a spinal cord ischemia following 21 emergency TEVARs for complicated acute type B aortic dissection. Shu C, et al. also reported 0% of paraplegia following 45 emergency TEVAR for complicated type B aortic dissection (Shu C, et al., 2011). Our policy for acute aortic dissection is as same as ruptured aortic dissection. Proximal landing zone should be achieved at non-dissected



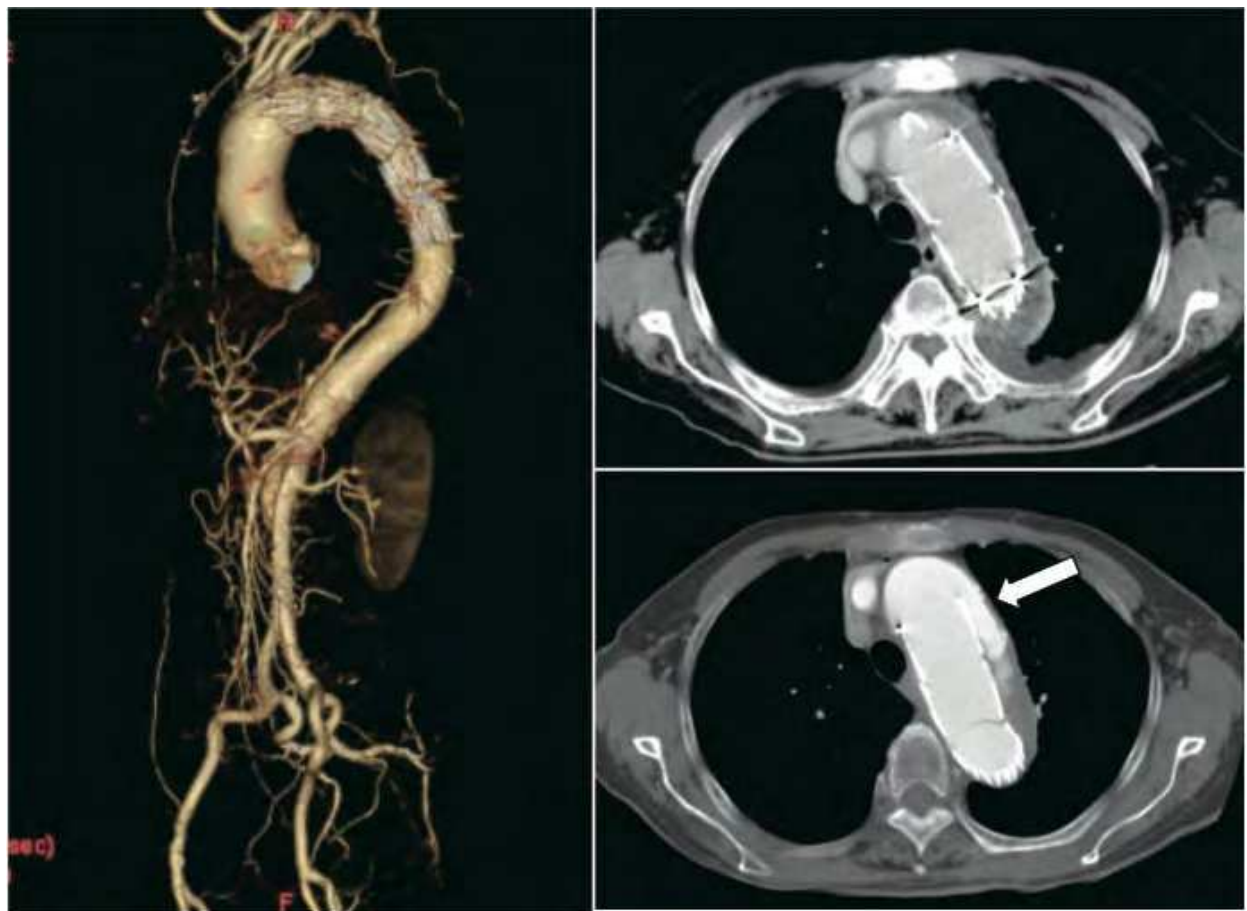
A 58-year-old man was transferred due to renal and right leg ischemia secondary to acute aortic dissection (Left). Emergency TEVAR was effective without any additional intervention. Volume rendering CT at 6 years after TEVAR showed a satisfactory remodelling of the entire aorta (Right). F; false lumen.

Fig. 12. Computed tomographic (CT) images of malperfusion secondary to acute aortic dissection.

aorta, usually the aortic arch, and great-vessels including LSA are preserved using a hand-made fenestrated stent graft as much as possible. Placement of stent graft from dissected aorta as a proximal landing zone has a risk of creation of a new entry (Fig. 13). Additional distal stent graft should be placed only for a case of ruptured acute type IIIb aortic dissection when necessary. A stent graft with proximal bare stent is not applied for acute aortic dissection when a hand-made fenestrated stent graft is available. A clinical impact regarding stent grafts with or without proximal bare stent for acute aortic dissection will be partially understood by the currently going clinical trials using Variant Captivia (Medtronic Vascular, CA, USA) and Gore cTAG (WL Gore & Associates Inc, AZ, USA). Although we currently have no experience of Relay NBS (no bare stent)(Bolton Medical SL, Spain), it might be suitable as a commercial device for acute aortic dissection instead of a hand-made stent graft (Zipfel B, et al., 2011).



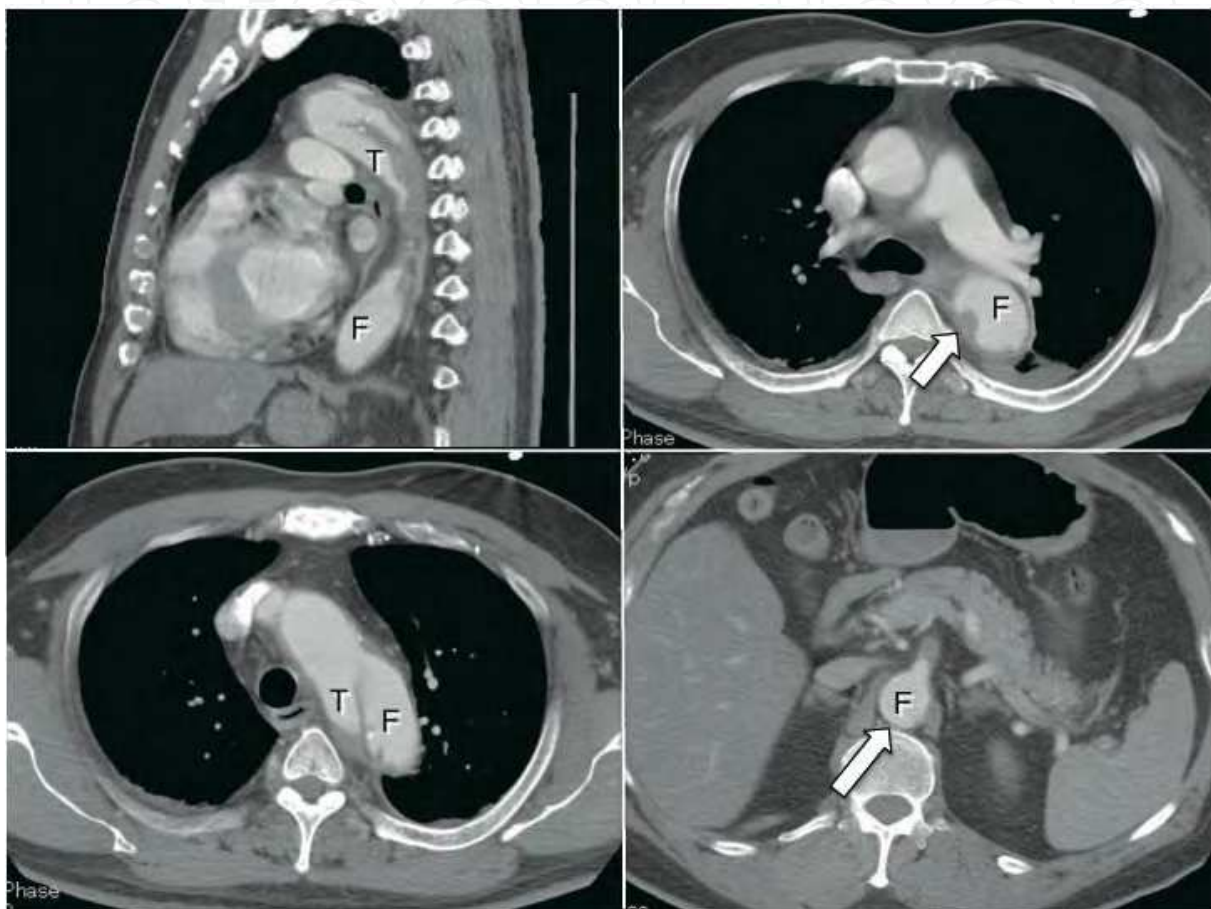
Since TEVAR became available as a treatment for malperfusion secondary to acute type B aortic dissection, an early diagnosis of malperfusion has become more important. Most difficult and clinically important malperfusion is mesenteric ischemia. Since we reported a usefulness of a diameter of supra-mesenteric vein and increased level of arterial lactate (Kurimoto Y, et al., 2004, 2008b), we have never experienced massive mesenteric resection caused by delayed diagnosis of mesenteric ischemia. There is another reason why an early diagnosis is the key of success for re-canalization of ischemiac organ by TEVAR. Emergency TEVAR can re-expand collapsed true lumen of dissected aorta even more than several hours after onset, but obstructed aortic branches sometimes become thrombo-occluded, so called “static obstruction”, and can not be re-canalized by a simple TEVAR (Fig. 14a,b,c). Further studies are necessary to determine what situation of malperfusion should be managed by direct open surgery including bypass-grafting to ischemic organ skipping primary TEVAR.



An 82-year-old woman was transferred due to bilateral leg ischemia secondary to acute type A aortic dissection with the thrombo-occluded false lumen of the ascending aorta and the primary entry at the proximal descending thoracic aorta. Although postoperative CT was satisfactory (Left and Right upper), follow-up CT at 18 months after emergency TEVAR revealed a new entry (White arrow) at the proximal end of placed stent graft in the aortic arch (Right lower).

Fig. 13. Computed tomographic (CT) images of malperfusion secondary to acute type IIIbR aortic dissection with a thrombosed false lumen of the ascending aorta.





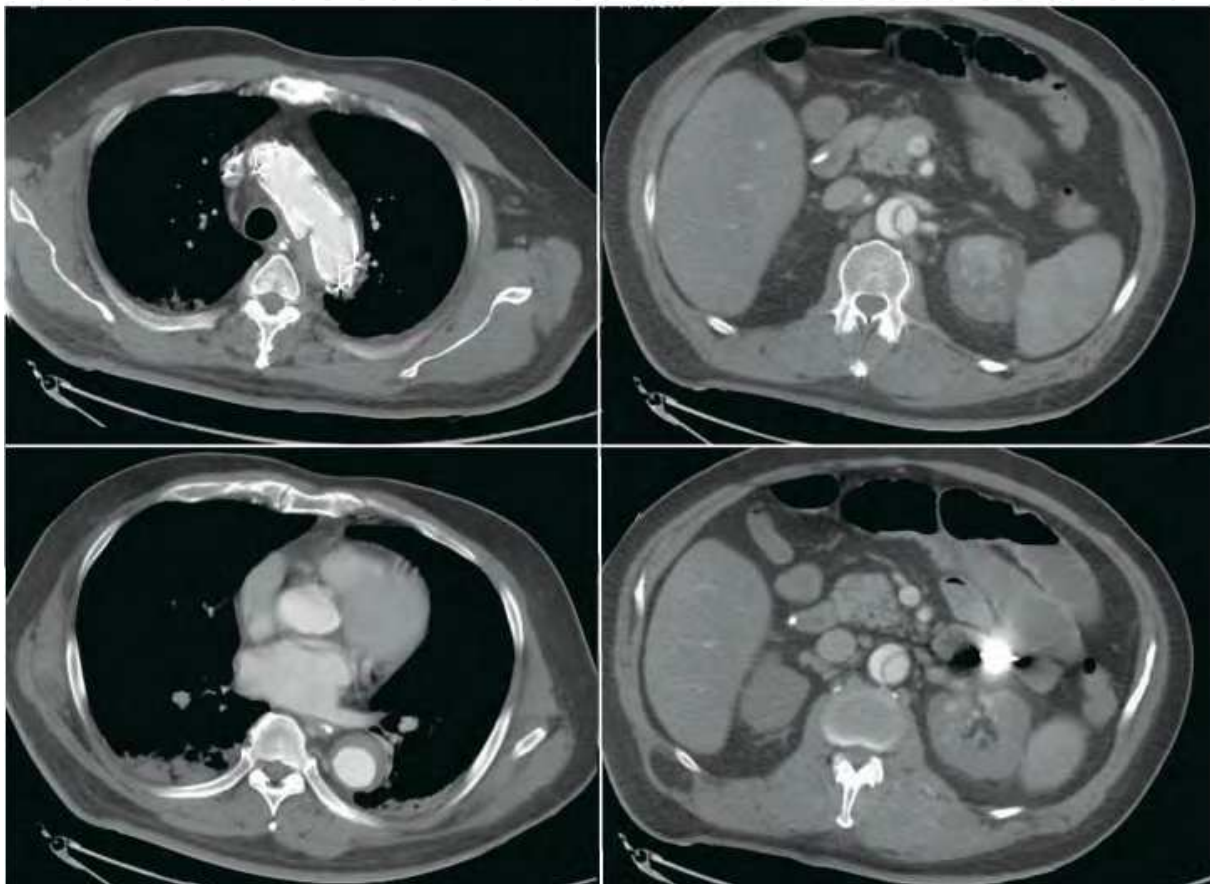
A 51-year-old man was transferred due to complicated acute type B aortic dissection 8 hours after onset. Preoperative CT including multiplanar reconstruction revealed a primary large entry at the distal aortic arch (Left) and completely collapsed true lumen (White arrow) of the descending thoracic aorta (Right). F; false lumen, T; true lumen.

Fig. 14a. Computed tomographic (CT) images of renal and left leg ischemia due to malperfusion secondary to acute type B aortic dissection.



The hand-made fenestrated stent graft was placed from zone 0 with a simple coverage of the left subclavian artery 10 hours after onset of complication secondary to acute aortic dissection (Left). Although the true lumen was well re-expanded by a primary entry closure, bilateral renal arteries were already thrombo-occluded and re-canalization was not achieved (Right).

Fig. 14b. Postoperative volume rendering computed tomographic images of malperfusion secondary to acute type B aortic dissection.



CT showed the successfully placed stent graft (Left upper) and satisfactory re-expanded true lumen with thrombo-occluded false lumen in the descending thoracic aorta (Left lower). Although the renal artery was enhanced, no flow in bilateral kidney was confirmed possibly due to long elapsed time from the onset (Right lower)

Fig. 14c. Postoperative computed tomographic (CT) images of malperfusion secondary to acute type B aortic dissection.

#### 4. Conclusion

Emergency indication of TEVAR for acute aortic dissection is obviously expanding. Ruptured acute DeBakey type IIIa aortic dissection can be managed by emergency TEVAR with satisfactory early and long-term results. Although there are still points to evaluate about an efficacy of TEVAR for ruptured acute DeBakey type IIIb aortic dissection, currently reported results are relatively acceptable as an initial treatment for deteriorated patients. Malperfusion secondary to acute type B aortic dissection can be managed well by TEVAR when exact early diagnosis and mechanism of malperfusion are made. To reduce TEVAR-related complication rates, appropriate commercial device for acute aortic dissection should be developed based on clinical experiences.

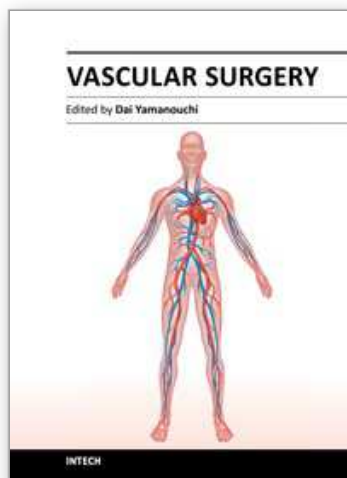
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This book aims to provide a brief overview of conventional open vascular surgery, endovascular surgery and pre- and post-operative management of vascular patients. The collections of contributions from outstanding vascular surgeons and scientists from around the world present detailed and precious information about the important topics of the current vascular surgery practice and research. I hope this book will be used worldwide by young vascular surgeons and medical students enhancing their knowledge and stimulating the advancement of this field.

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