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Guntani, Atsushi
Department of Surgery, Hiroshima Red Cross Hospital & Atomic-Bomb Survivors Hospital | Departments of Surgery and Science, Graduate School of Medical Sciences, Kyushu University

Fukunaga, Ryota
Departments of Surgery and Science, Graduate School of Medical Sciences, Kyushu University

Kuma, Sosei
Department of Vascular Surgery, Kokura Memorial Hospital

Okazaki, Jin
Department of Vascular Surgery, Kokura Memorial Hospital

他

https://doi.org/10.15017/1441360

出版情報：福岡醫學雜誌. 105 (1), pp.16-21, 2014-01-25. 福岡医学会
バージョン：
権利関係：

# Successful Treatment of an Abdominal Aortic Aneurysm with a Severely Angulated and Large Aortic Neck Using a Modified Zenith

Atsushi Guntani[1)2)], Ryota Fukunaga[2)], Sosei Kuma[3)], Jin Okazaki[3)], Yunosuke Nishihara[4)], Hitoshi Aibe[4)], Jun Okadome[2)], Koichi Morisaki[2)], Takuya Matsumoto[2)] and Yoshihiko Maehara[2)]

[1)]*Department of Surgery, Hiroshima Red Cross Hospital & Atomic-Bomb Survivors Hospital*
[2)]*Departments of Surgery and Science, Graduate School of Medical Sciences, Kyushu University*
[3)]*Department of Vascular Surgery, Kokura Memorial Hospital*
[4)]*Department of Radiology, Kokura Memorial Hospital*

**Abstract**
This report presents the case of an abdominal aortic aneurysm (AAA), in which the aortic neck was severely angulated. Furthermore, there was moderate stenosis and a severe angle with calcification of the suprarenal aorta. EVAR was performed with a commercial Zenith stent-graft, with a slight modification, because an open aneurysm repair was risky in general condition. No complications occurred during the follow-up period.

**Key words** : Abdominal aortic aneurysm・Angulated aortic neck・Zenith・Suprarenal stent

## Introduction

Endovascular aneurysm repair (EVAR), which provides a less invasive alternative to open abdominal aortic aneurysm (AAA) repair, has become an established method for aortic aneurysm repair[1)~4)].

Patients at high risk with major comorbid conditions or a hostile abdomen can receive treatment with a variety of commercial stent-grafts instead of open surgical repair.

However, treatment with stent-grafts sometime is limited by the anatomical features of the AAA, especially the aortic neck anatomy, including the diameter, length and angulation[5)~9)].

Good results have been reported for stent-grafts in patients with aortic neck anatomy that is suitable for endovascular aneurysm repair, and stent-grafts are used in increasing numbers of patients with hostile neck anatomy. A recent review revealed that about 60% of EVAR performed in the United States do not follow the device specific instructions for use (IFU) provided by the device manufacturers[10)~12)]. In general, surgeons are also now expanding the boundaries of IFU, and initial and mid-term results of EVAR are satisfactory.

The current patient had an AAA that did not conform to the IFU because the aortic neck was severely angulated. Furthermore, there was moderate stenosis and a severe angle with calcification of the suprarenal aorta. Therefore, the patient was at high risk for open aneurysm repair, and EVAR was performed with a commercial stent-graft, with a slight modification. No complications occurred during the follow-up period.

This report presents a case of successful treatment of an AAA with a severely angulated and large aortic neck using a modified Zenith stent-graft.

Correspondence to : Atsushi Guntani
Department of Surgery, Hiroshima Red Cross Hospital & Atomic-Bomb Survivors Hospital, 1-9-6 Senda-machi, Naka-ku, Hiroshima 730-8619, Japan
Tel : +81-82-241-3111, Fax : +81-82-246-0676
E-mail : aguntani@yahoo. co. jp

## Case report

An 86-year-old female was admitted for the treatment of angina with coronary stenosis. The patient had no abdominal symptoms ; however, aortography performed for treatment of coronary stenosis suggested the presence of an AAA.

Subsequent contrast enhanced abdominal computed tomography revealed the presence of an AAA, which measured 55 mm in diameter. The patient was petite physique, 140 centimeter in height and at relative risk of aneurysm rupture. And the patient and her family hoped sincerely to undergo an operation of the AAA. The aneurysm was in the infrarenal abdominal aorta with a severely angulated and large aortic neck (Fig. 1A, B). Furthermore, there was moderate stenosis and a severe angle with calcification in the suprarenal aorta (Fig. 1C, D). The morphological features, including the preoperative aneurysm diameter, an aortic neck diameter, neck length, neck angulation, iliac diameter, and a length of the iliac sealing zone are summarized in Table 1.

The patient was at high risk for open surgery, because she was an octogenarian with moderate chronic heart failure (Ejection Fraction : 50%) and a history of several coronary angioplasty using drug-eluting stents. And the AAA might interfere with treatment of heart failure through the femoral artery. Therefore, treatment with a commercial stent-graft, available in Japan at the time, including the Excluder (W. L. Gore &

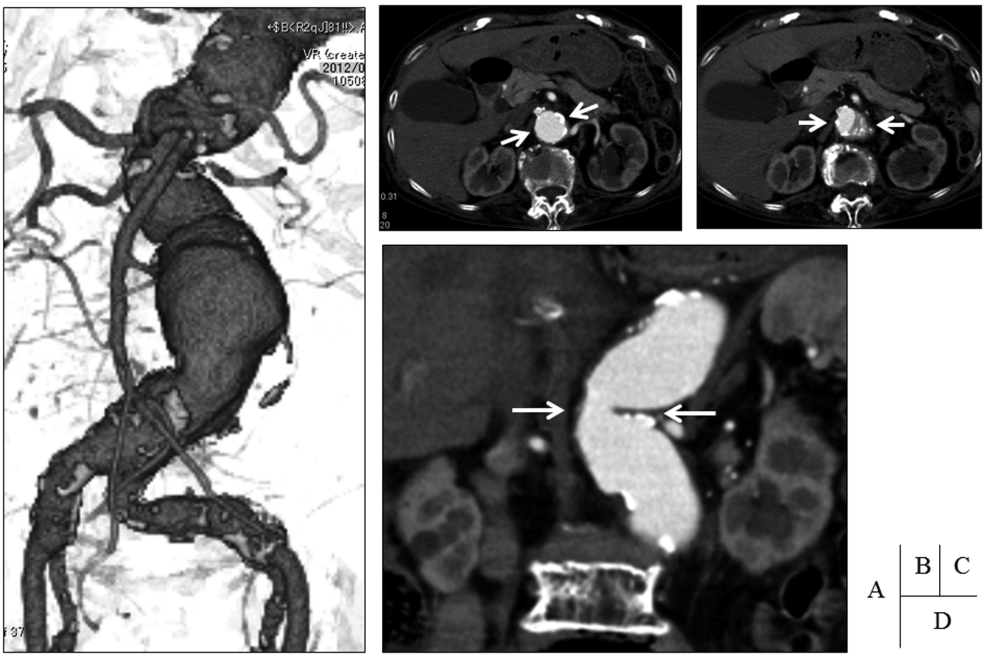


**Fig. 1** Contrast enhanced abdominal computed tomography revealed the aneurysm had a severely angulated and large aortic neck (A, B). There was moderate stenosis and a severe angle with calcification in the suprarenal aorta (C, D).

**Table 1** morphological feature

| Factors | |
|---|---|
| aneurysm diameter (mm) | 55 |
| aortic neck diameter (mm) | 30 |
| neck length (mm) | 15 |
| neck angulation (degree) | 90 |
| iliac diameter (mm) | rt. 10, lt. 13 |
| length of the iliac sealing zone (mm) | rt. 30, lt. 30 |
| suprarenal aortic angulation (degree) | 90 |
| suprarenal aortic diameter (mm) | 12 |

rt. : right, lt. : left

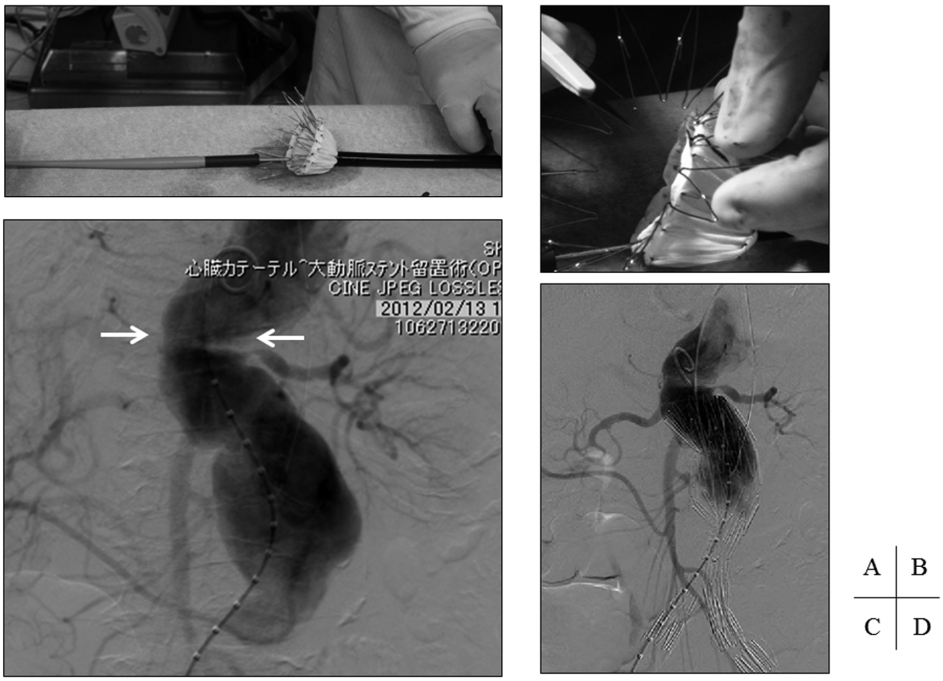


**Fig. 2** The suprarenal stent was deployed and removed carefully on the back table (A, B). The detailed morphological features of aortic neck and suprarenal aorta were checked (C). A complete aortography demonstrated that there was no type I or type III endoleak (D).

Associates, Flagstaff, AZ), Zenith (Cook, Bloomington, IN) and Powerlink System (Endologix, Irvine, CA) was proposed, and we decided to use the Zenith stent-graft for the large aortic neck. However, the pre-operative sizing based on the thin-slice CT, suggested that the suprarenal stent was blocked by moderate stenosis and a severe angle with calcification at the suprarenal aorta, which caused leakage from the proximal sealing zone in the infrarenal aortic neck (Fig. 1C, D).

Therefore, the procedure required a slight modification. The patient was placed under general anesthesia, and aortography was performed to check the configuration of the aneurysm. The outer sheath of main body delivery system was pulled slowly to expand the main body and the top cap of the main body sheath was released until the suprarenal stent was deployed. The suprarenal stent was carefully removed, which was sutured to the top of the stent-graft. The main body of the removed suprarenal stent was put into the delivery system and bundled by tourniquets (Fig. 2A, B). The catheter sheath for the main body delivery system was introduced to the pararenal aorta through the guide-wire (Amplatz ultrastiff guidewire ; 0.035 inch, 260 cm). Additional aortography was performed from the pigtail catheter located in the supra-renal aorta to check the accurate position of the renal arteries, which were marked on the monitor of the DSA instrument (Fig. 2C). The proximal gold marker, that was the proximal end of the main body, was placed just at distal position of the left renal artery ; the outer sheath was pulled slowly to expand the main body and the contralateral limb. The contralateral iliac leg stent and the ipsilateral iliac stent were released because the overlap to the main body was sufficient. Ballooning of the landing zones and overlap zones of the stent-graft was performed with the balloon catheter. The aortic body extension was released just at the distal position of the left renal artery to ensure the fixing force of the proximal sealing zone, as planned pre-operatively. Re-ballooning of the landing zone of the main body to the infrarenal aorta was performed with the balloon catheter. Complete aortography demonstrated that there was no type I or type III

**Fig. 3** Postoperative 3-D computed tomography revealed that there was no migration of the stent-graft or any major endoleak.

endoleak (Fig. 2D). The patient tolerated these procedures and was transferred to the recovery room in a hemodynamically stable condition.

The patient recovered and was discharged 7 days after the operation. Imaging with 3-Dimentional computed tomography 1 month after the operation revealed that the aneurysm was shrinking and no migration of stent-graft or major endoleak had occurred (Fig. 3). No complications occurred during the 18-month follow-up period.

## Discussion

The current patient was at high risk for open surgery for an AAA. Therefore, she was treated with a commercial stent-graft. The pre-operative thin-slice CT revealed that the aneurysm was at the infrarenal abdominal aorta with a severely angulated and large aortic neck (Fig. 1A, B). The morphological features indicated that the Zenith stent-graft was appropriate for the large aortic neck. The other commercial stent-graft, Powerlink System or Excluder, do not have sufficient size variations for covering an aortic neck over 26 mm in diameter at the time in Japan. The Zenith can support a large aortic neck up to 32 mm in diameter with a 36 mm stent-graft. Some devices and size variations, such as Endurant Stentgraft System, are available at the present time. Further study is required for their effectiveness.

However, the Zenith has a bare stent with an anatomical limit of suprarenal aortic angulation of 45 degrees or less. The effectiveness of fenestrated and branched stent-grafts in the management of high risk conditions with a thoraco-abdominal aortic aneurysm or juxtarenal abdominal aortic aneurysm is limited to the sealing zone at the suprarenal aorta[13)14)]. Unfortunately, these devices were off-label for insurance in Japan. The current patient had moderate stenosis and a severe angle with calcification in the suprarenal aorta. The suprarenal stent was possibly blocked by this aortic neck anatomy, thus causing inadequate expansion of the stent-graft and a leakage from the proximal sealing zone at the infrarenal aortic neck. In consideration of the structure of delivery system, the modification of the Zenith stent-graft was relatively easy, compared to other devices.

Therefore, we used the Zenith, of which the suprarenal stent was removed. However, there was concern that the Zenith would be unstable in the proximal sealing zone in the infrarenal aortic neck, thus causing leakage and migration of the stent-graft.

The main body delivery system was fixed firmly to prevent migration of the stent-graft until the contralateral iliac leg stent was completed. Furthermore, aortic body extension had to be released at the juxtarenal aorta in order to ensure the fixing force of the proximal sealing zone.

Careful observation was the only option before effective treatments were developed for repairing an abdominal aortic aneurysm in patients at high risk for open surgery. A modified Zenith can be considered for the treatment of patients at high risk who have a complex aortic aneurysm

requiring early treatment. The current case demonstrated that the modified Zenith method was both technically feasible and useful. However, concerns remain about the long-term durability and safety of this method.

## Conclusion

This report presented a rare case of successful treatment of an AAA with a severely angulated and large aortic neck using a modified Zenith stent-graft. This method could therefore be a useful treatment options for patients at high risk for open surgery with a complex aortic aneurysm requiring early treatment.

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(Received for publication December 18, 2013)

（和文抄録）

# ステントグラフトに工夫を要した高度屈曲かつ大口径ネックを伴う腹部大動脈瘤の一例

[1)]広島赤十字・原爆病院　外科
[2)]九州大学　消化器・総合外科
[3)]小倉記念病院　血管外科
[4)]小倉記念病院　放射線科

郡谷篤史[1)2)]，福永亮大[2)]，隈　宗晴[3)]，岡崎　仁[3)]，西原雄之助[4)]，
相部　仁[4)]，岡留　淳[2)]，森崎浩一[2)]，松本拓也[2)]，前原喜彦[2)]

症例は 86 歳，女性．腎動脈下に 55mm，紡錘状の腹部大動脈瘤を認めた．高齢，冠動脈ステント後かつ慢性心不全のため開腹人工血管置換術は，周術期合併症や手術死亡の危険性が高いと判断した．動脈瘤の中枢頸部は径 30mm，長さ 15mm，屈曲高度を伴い，かつ腎動脈直上は高度屈曲，石灰化狭窄を認め，解剖学的にはステントグラフトの適応外であった．

大口径のステントグラフト（ゼニス 36mm）を用いれば，中枢頸部の圧着は可能であるが，腎動脈直上の高度屈曲，石灰化狭窄のため腎動脈上ステントが展開しない恐れがあった．そこで我々は，バックテーブルでステントグラフトを展開し，腎動脈上ステントを除去した後に，ステントグラフトをシース内に再格納し，腎動脈上ステントを除去したステントグラフトを腎動脈直下に展開することによって，動脈瘤治療の技術的成功を得た．

現在までステントグラフトの脱落やエンドリークは認めず，術後経過は良好であった．

ステントグラフトを工夫することにより，開腹人工血管置換術のハイリスク症例かつ屈曲高度を伴う解剖学的ステントグラフト適応外症例において，一つの治療オプションとなる可能性がある．