

# Endovascular stent graft repair of aorto-iliac pseudoaneurysms - Hospital Kuala Lumpur experience

Nan Chuang Khang, M Surg, Zainal Ariffin bin Azizi, FRCS

Department of Surgery, Hospital Kuala Lumpur, Kuala Lumpur, Malaysia

## ABSTRACT

**Background:** This is a single institutional review of aorto-iliac pseudoaneurysm of various aetiologies managed with endovascular stent graft repair.

**Methods:** From 2009 to 2014, 16 patients had endovascular stent graft inserted for pseudoaneurysm of the thoracic aorta, abdominal aorta and iliac arteries in Hospital Kuala Lumpur. Co-morbidity, causative agents, in-hospital mortality, complications and outcomes were examined.

**Results:** The average age was 59.1 years (range 36-77). Comorbidities include hypertension, diabetes mellitus, tuberculosis, prior infection and previous open aneurysmal repair. All patients had raised WBC ( $>10.0 \times 10^9 /L$ ), ESR or C-reactive protein on admission while 50% of patients had fever. Blood cultures were positive in 4 patients. All patients were given antibiotics. Only one in-hospital mortality was noted at day-47 post-procedure. Two patients died of aorto-enteric fistula at district hospital eight and 16 months later. One patient died of chronic graft infection two years later. One died of unrelated cause. One patient developed type IB endoleak from internal iliac artery two years later and surgical ligation was performed. The average follow up was 15.8 months.

**Conclusion:** Endovascular stent graft repair for pseudoaneurysm is a viable option compared to open surgery. It is less invasive, has lower operative morbidity and fair outcomes. However, some cases may be due to inflammatory aortitis instead of infective pseudoaneurysm, given the frequent culture-negative results. In order to obtain high yield of bacteria culture for infected pseudoaneurysm, open repair with tissue culture is still the main mode of treatment especially for patients with low co-morbidity.

## KEY WORDS:

*Stent graft, mycotic aneurysm, pseudoaneurysm, aorto-iliac disease*

## INTRODUCTION

Pseudoaneurysm of the aorto-iliac vessels constitutes 1-3% of the overall aortic aneurysm.<sup>1</sup> There are various pathologies that can lead to formation of pseudoaneurysm, such as infection or inflammatory aortitis with penetrating ulcer. For those caused by infection, patients typically present with fever and abdominal or back pain. Laboratory investigations

will usually yield raised white cell counts (WCC), raised erythrocyte sedimentation rate (ESR) and raised C-reactive proteins (CRP). The disease carries a high morbidity and mortality rate if not treated early and aggressively.<sup>2</sup>

The gold standard of treatment for pseudoaneurysm of the aorto-iliac vessels has traditionally been open surgical repair. This is done with extensive surgical debridement of the inflamed or infected area followed by revascularisation procedures with silver-impregnated prosthetic graft, either with in situ graft implantation or extra-anatomical bypass grafting.<sup>3</sup> In cases with suspected infection, broad-spectrum intravenous antibiotics are instituted peri-operatively and once culture and sensitivity of the infected microorganisms is identified, targeted antibiotics will be continued for several months post-operatively. Nevertheless, it is reported widely that open surgical repair carries high mortality rate, and those who survived, long hospital stay for recovery are expected.<sup>4</sup>

The treatment of pseudoaneurysm of the aorto-iliac vessels by endovascular stent graft has shown some promising results. This is evident even in the presence of infection. Multiple case series and reports have shown that it is an alternative and safe method to use, either as bridging treatment prior to open surgical repair later, or as a definitive modality of treatment.<sup>5-7</sup>

This report will highlight our institutional experience with stent graft placement for the treatment of pseudoaneurysm of aorto-iliac disease in terms of its short and medium term durability.

## MATERIALS AND METHODS

A search was conducted through our operative registry for all the patients who underwent endovascular stent graft placement for pseudoaneurysm of the aorto-iliac vessels in our institution. This operative registry covered a 5-year period from 2009 to 2014.

The patients included in our reported series have two or more of the clinical, laboratory or imaging criteria for aorto-iliac pseudoaneurysm. Clinical symptoms include fever, abdominal, groin or back pain. Laboratory investigations on initial presentation as well as on follow up were recorded. These include WCC, ESR and CRP. Blood cultures were obtained on admission. Imaging from computed topographic (CT) scan were taken pre-operatively and those with

*This article was accepted: 17 February 2016*

*Corresponding Author: Nan Chuang Khang, Department of Surgery, Hospital Kuala Lumpur, Jalan Pahang, 50586 Kuala Lumpur, Malaysia*

*Email: khangnc@hotmail.com*

thickened and/or irregular aortic wall, penetrating ulcer, saccular in nature along with positive clinical symptoms of infection were included. Comorbidities of the patients were recorded.

Device selection and its placement were no different compared to our usual practice for treatment of aorto-iliac aneurysmal vessels. The chosen grafts were upsized 20% to the measured lumen. This was performed with the mobile C-arm by Ziehm Imaging. The devices selected for pseudoaneurysm of the thoracic and abdominal aorta were either Talent or Endurant I aorto-uni-iliac device by Medtronic Inc. As for the pseudoaneurysm of the iliac vessels, V12 stent grafts by Atrium Medical were used.

As both inflammatory aortitis and infected pseudoaneurysm present similarly, all patients with pseudoaneurysm of the aorto-iliac vessels were given intravenous broad-spectrum antibiotics on admission. Blood cultures were obtained and their antibiotics sensitivities were matched accordingly. Those patients with negative blood cultures were given intravenous antibiotics according to salmonella species, which is the commonest causative microorganism for infected pseudoaneurysm in this region. The antibiotics were continued throughout the hospital stay and upon discharge, oral ciprofloxacin was given for a minimum duration of three months.

On follow up, laboratory investigations such as ESR and CRP were taken to monitor the progress of infection. CT scan or ultrasounds were used to provide a form of imaging modality to see if the inflammation of surrounding tissue has subsided. Causes of peri-operative and post-operative mortality were noted.

## RESULTS

### *Patient demographics and co-morbidities*

A total of 16 patients had endovascular stent graft inserted for various vessels from 2009 until 2014. All were males. The median age of these patients were 62 years (range of 37 to 77 years). Co-morbid factors include diabetes mellitus, hypertension, pulmonary tuberculosis, ischemic heart disease and previous infections such as liver abscess, melioidosis, perinephric abscess and septic arthritis. One patient had an open abdominal aortic aneurysm repaired previously. One patient had penetrating stab injury to his back resulted in retro-peritoneal hematoma which subsequently developed pseudoaneurysm to the supra-renal aorta at the celiac artery level. The breakdowns of the co-morbidities are illustrated in Table I.

### *Presenting symptoms, laboratory and imaging results*

Twelve patients were referred from other hospitals from other parts of the country. Half of the patients in this study had fever on admission. Pain on various parts of the body was noted in 75% of the patients in this study. 81.3% of the patients had leukocytosis (WCC more than  $10.0 \times 10^9/L$ ) on presentation. Almost all patients had raised ESR (more than 15mm/hour) and CRP (more than 5.0mg/L) level. Only 4 out of 16 blood cultures taken were positive, in which the commonest microorganism was *Klebsiella* species. The others

were *Salmonella* and *Enterococcus* species. Table II summarised the clinical manifestations of the patients in this study. From the CT imaging, four patients presented as leaking pseudoaneurysm, while four patients had pseudoaneurysm with saccular morphology (Figure 1).

### *Sites and types of stent grafts*

Half of the affected vessels were from abdominal aorta, seven were from iliac arteries (five were common iliac arteries, two were internal iliac arteries) and one from thoracic descending aorta. There were eight patients who had aorto-uni-iliac (AUI) stent graft inserted of either Talent or Endurant I from Medtronic Inc. An occlusive device was inserted to obliterate the contralateral common iliac artery. These were followed by an open femoro-femoral crossover repair with polytetrafluoroethylene (PTFE) graft. Three patients were without femoro-femoral crossover surgery. The patient who had the descending thoracic aortic aneurysm was treated with Valiant thoracic aortic graft placement at zone 3. The remaining four patients had Atrium V12 covered stent graft inserted at common or internal iliac arteries.

### *Complications and mortalities*

In this study, four patients developed fistulas, of which three of them were aorto-duodenal fistulas and the remaining one developed aorto-cutaneous fistulas (Figure 2). All succumbed to the complication (Table III). Three patients needed open debridement on a later date following endovascular repair. One of them was the thoracic descending aneurysm that needed open thoracotomy one month after deployment of thoracic stent graft. Only one patient developed endoleak after the placement of stent graft. He had type IB endoleak from internal iliac artery on follow up two years after the placement. CT scan showed persistent aneurysmal size increment with non-resolving type IB endoleak. Open ligation of the internal iliac artery with aneurysmal sac decompression was performed. He was discharged and followed up well till date. The third patient with common iliac artery infected pseudoaneurysm developed recurrence of abdominal pain and fever with chills. Initial follow up CT scan three months after the endovascular intervention showed reduction of pseudoaneurysmal sac. However due to recurrent symptoms, CT scan six months later showed increasing size of the sac. Subsequent open drainage of the sac was performed via retroperitoneal approach. Tissue culture yields *Burkholderia pseudomallei*. One patient who had common iliac arterial stent graft inserted developed stent graft migration proximally into the distal aorta (Figure 3). However, ultrasound duplex showed no impediment of flow to the contralateral common iliac artery. There were five mortalities noted, three died of aorto-duodenal fistulas and one died of aorto-cutaneous fistula. One died of unrelated cause. Only one patient died while in-patient at day 47 of admission. All survived more than 30 days.

### *Follow up*

The average length of stay in intensive care unit was two days (range of zero to eight days). Besides that, the median hospital stay was 23 days (range of 6 to 75 days). Intravenous antibiotics were prescribed throughout the hospital stay. All except four patients were given ceftazidime. Of which, two were given ceftriaxone, while the remaining two were given

Table I: Associated diseases and other important factors

Comorbidities	Number	%
Hypertension	10	63
Diabetes mellitus	6	38
Previous history of tuberculosis infection	3	19
Ischemic heart disease	2	13
History of cancer	2	13
History of localized or systemic infection (septic arthritis, liver abscess, perinephric abscess)	3	19
Previous graft implantation	1	6
History of trauma	1	6

Table II: Clinical manifestation

Clinical manifestations	Number	%
Fever	8	50
Pain (Abdomen, chest, back, groin)	12	75
WCC > 10.0x10 <sup>9</sup> /L	13	81
ESR > 15mm/hour	16	100
CRP > 5.0mg/L	14	88
Positive blood cultures	4	25
<i>Klebsiella spp</i>	2	13
<i>Salmonella spp</i>	1	6
<i>Enterococcus spp</i>	1	6

Table III: Mortalities

Age	Sex	Site	Device	Complications	Re-intervention	Time of death
70	Male	Aorta	AUI with occluder, followed by cross-over bypass	Encephalitis Retroperitoneal abscess Aorto-duodenal fistula	Type I endoleak, converted from bifurcated SG to AU SG with cross-over bypass	16 months
48	Male	Aorta	AUI with occluder, followed by cross-over bypass	Aorto-enteric fistula	None	2 months
77	Male	Aorta	AUI with occluder, followed by cross-over bypass	Aorto-cutaneous fistula	None	28 months
63	Male	Aorta	AUI with occluder, followed by cross-over bypass	Persistent graft infection Para-vertebrae abscess Aorto-enteric fistula	Explantation of graft	10 months
50	Male	Common iliac artery	AUI with occluder, followed by cross-over bypass	None	None	3 months

imipenem and amoxicillin with clavulanic acid respectively. Upon discharge from the hospital, they were prescribed ciprofloxacin and doxycycline or amoxicillin with clavulanic acid for a minimum of three months duration. On their follow up visit to our clinic, laboratory inflammatory markers of ESR and CRP were taken. All those patients who needed no re-intervention showed reduction of all inflammatory markers. All patients survived the first 30 days after the procedures. Eight patients survived for more than one year after interventions while three patients are still healthy after three years. Of all the patients who survived the initial stent graft placements, four patients have defaulted their follow up, but they were seen in our clinic at least for one month after discharged from hospital. The average follow up period was 15.8 months. Those patients who are still on our follow up showed reduction in aneurysmal size significantly (more than 5mm) by CT scan (Figure 4).

## DISCUSSION

Aorto-iliac pseudoaneurysm can be due to various causes, such as penetrating ulcer from the inflammatory aortitis, infection or para-anastomotic pseudoaneurysm arising from previous aortic repair. Pseudoaneurysm of the aorto-iliac



Fig. 1: Saccular pseudoaneurysm arising posteriorly from the right common iliac artery.

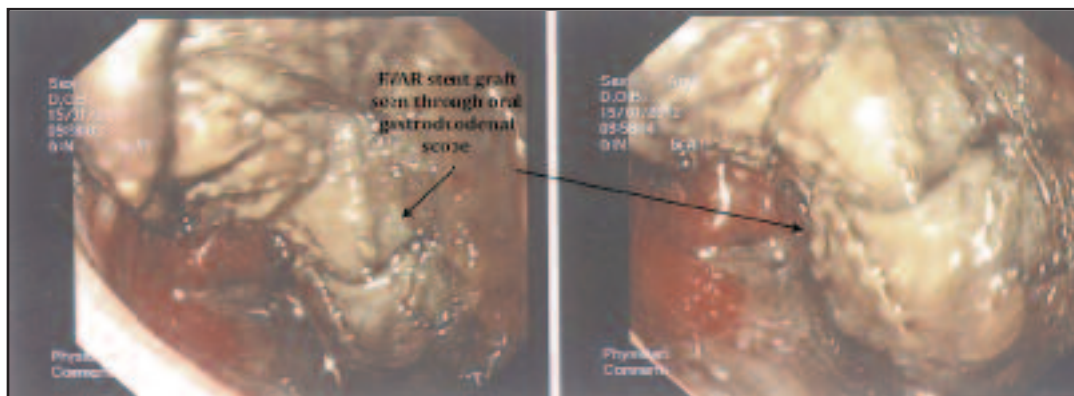


Fig. 2: Aorto-duodenal fistula with visualization of EVAR stent graft.

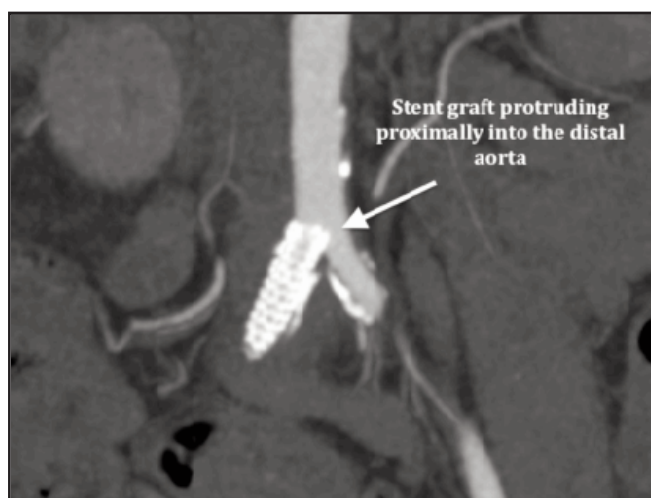


Fig. 3: Proximal migration of stent graft into the distal aorta.

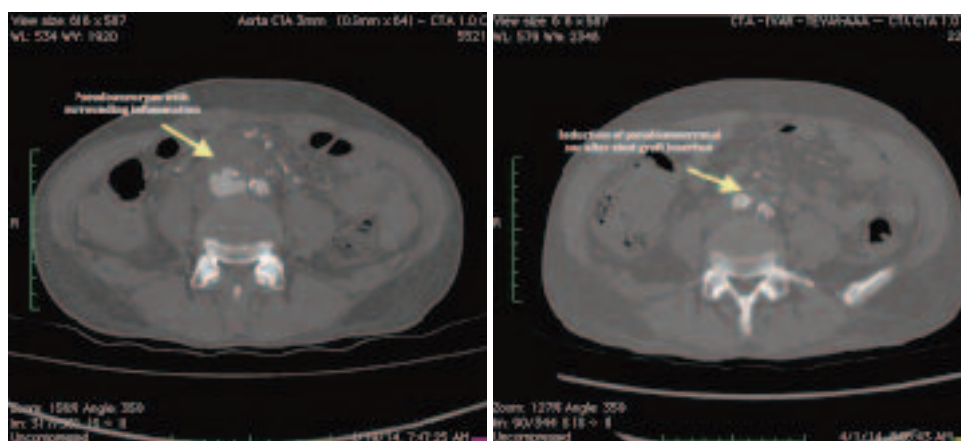


Fig. 4: Comparison of pseudoaneurysm size and its surrounding inflammation before and 2 months after the stent graft placement.

vessels is a complex disease which poses a challenging clinical management. Although pseudoaneurysm of the aorto-iliac vessels represents a small percentage of the overall aneurysm, it is not uncommon in this part of the world, especially the infected pseudoaneurysm.<sup>8</sup> In such cases, extensive surgical resection and debridement coupled with aggressive antibiotics treatment remain as the main focus of

the management. Open *in situ* graft implantation or extra-anatomical bypasses with ligation of the ruptured vessels are the gold standard of treatment.<sup>2,9</sup> However, due to the extensiveness of the resection, mortality from open debridement is high.<sup>10</sup> Endovascular placement of stent graft has been reported to have lower post-operative mortality in both primary intervention and as bridging therapy prior to

second intervention.<sup>6,8,11</sup> In the case of bridging therapy, endovascular stent graft placement serves as a tool in cases of ruptured pseudoaneurysm while patient being resuscitated.<sup>12</sup>

Clinical features of pseudoaneurysm of the aorto-iliac vessels can be indistinguishable. This is especially so in the case of infection or inflammatory entity. Both situations can present with symptoms of fever, abdominal pain and leukocytosis.<sup>13</sup> This can be shown in most of our patients presented in this study. Obtaining positive cultures from the blood however remains a difficult yield.<sup>14</sup> Only 25% of our patient in this study had shown positive blood cultures with *klebsiella spp* as the commonest microorganism. The low yield in blood culture may be explained by antibiotics being started prior to transferring to our institution for definitive treatment. It can also be due to the fact that the pseudoaneurysm was not infective in the first place, even though clinically it exhibited classical features of infection.

Most of the reported series noted that *salmonella spp* is the commonest reported infective microorganism in South East Asia.<sup>15,16</sup> It is also worth noting that melioidosis (caused by *Burkholderia pseudomallei*) is endemic to this part of the world.<sup>17</sup> Although rare, infected pseudoaneurysm of the aorto-iliac vessels has been reported in our previous literature.<sup>18</sup>

Several reviews have indicated that endovascular treatment for infected pseudoaneurysm of the aorto-iliac vessels do show favourable results in terms of mortality and morbidity.<sup>14,15</sup> However, a closer look into those reports also showed that the yield for positive bacteria culture from the blood is low. Inflammatory aortitis can present in a similar clinical fashion as infected pseudoaneurysm with abdominal pain, raised ESR and CRP, and thickened tissue surrounding the aorta in the CT scan. The low yield of positive blood culture for infective microorganism, besides the reason given above, can be due to the fact that inflammatory aortitis were lumped together as preliminary data. Hence the favorable result from stent graft placement could be due to the group belonging to inflammatory aortitis. Unless blood culture yield positive results, clinical and imaging features alone may not be sufficient to determine the diagnosis of infected pseudoaneurysm. Our results had shown that out of the four positive blood culture from infective pseudoaneurysm, only one mortality is observed, thus endovascular intervention may confer positive outcome, although the number may not be significant. We suggest selection of patient to undergo endovascular intervention should be confined to positive blood culture. If however the patient presented with positive clinical, biochemical and imaging features of infective pseudoaneurysm, but negative blood culture result, we advocate open repair if patient is a suitable operative candidate. If the patient has multiple co-morbidities, endovascular intervention should be used as a bridging therapy prior to open surgery later.<sup>21</sup>

Antibiotics should be targeted to the cultured microorganism obtained from the patient in suspected cases of infected pseudoaneurysm. However, due to the low yield of blood cultures, empirical antibiotics were started to cover gram-negative bacteria such as *salmonella spp* and *burkholderia spp*.

Our common choice of intravenous antibiotic remains as ceftazidime for a minimum of 2 weeks followed by ciprofloxacin and doxycycline given orally for a minimum period of 3 months.<sup>18</sup> The exact coverage of oral antibiotics is unknown, although some recommend up to 6 months duration.<sup>14,15</sup> Hence the use of inflammatory markers monitoring is our main follow up strategy. ESR and CRP are taken at each follow up. Repeated imaging such as CT scan provides an invaluable tool to see the resolution of the surrounding inflammation and reduction of the pseudoaneurysm sac.<sup>19</sup> After the pseudoaneurysmal sac has resolved or reduced in size, bedside ultrasound with duplex is a simpler tool to use in our follow up clinic.

Despite establishment of direct blood flow from the stent graft deployment, the persistent infection and inflammation surrounding the pseudoaneurysm may still cause erosion into adjacent bowel or cutaneous surface forming secondary aortic fistula.<sup>6,8,20</sup> The occurrence of fistula and its related mortality is well noted in this study. This is despite aggressive antibiotics regime before and long after the stent graft deployment. For this subgroup of patients with secondary aortic fistula after stent graft deployment, we advocate open surgical intervention by obliterating the fistula tract, excision of infected tissue, and repair of both gastrointestinal tract and the aortic lumen. Endovascular repair for the treatment of secondary aortic fistula has not been proven effective, given the fact that the continuous presence of foreign graft and the patient's hemodynamic instability.

## CONCLUSION

The treatment of aorto-iliac pseudoaneurysm with endovascular stent graft repair is a viable option treatment compared to open surgical repair. Although short and medium term results remains satisfactory, it is debatable as biasness may be present due to similar clinical presentation of inflammatory aortitis with penetrating ulcer and infected pseudoaneurysm. Recognising the causative microorganism is important in establishing the diagnosis and to institute targeted antibiotics regime. Long-term antibiotic therapy should be given following stent graft repair for the infected pseudoaneurysms. As convincing positive evidence of endovascular stent graft repair for infected pseudoaneurysm of aorto-iliac vessels is still lacking, we advocate endovascular treatment as a bridging therapy for patients with many co-morbidities. Open surgery is still the main mode of therapy in patients with minimal co-morbidity and those with secondary aortic fistula.

## REFERENCES

1. Chan FY, Crawford ES, Coselli JS, Safi HJ, Williams TW Jr. In situ prosthetic graft replacement for mycotic aneurysm of the aorta. *Ann Thorac Surg* 1989; 47(2): 193-203.
2. Müller BT, Wegener OR, Grabitz K, Pillny M, Thomas L, Sandmann W. Mycotic aneurysms of the thoracic and abdominal aorta and iliac arteries: experience with anatomic and extra-anatomic repair in 33 cases. *J Vasc Surg* 2001; 33(1): 106-13.
3. Hsu RB, Tsay YG, Wang SS, Chu SH. Surgical treatment for primary infected aneurysm of the descending thoracic aorta, abdominal aorta, and iliac arteries. *J Vasc Surg* 2002; 36(4): 746-50.
4. Fillmore AJ, Valentine RJ. Surgical mortality in patients with infected aortic aneurysms. *J Am Coll Surg* 2003; 196(3): 435-41.

5. Ting AC, Cheng SW, Ho P, Poon JT. Endovascular stent graft repair for infected thoracic aortic pseudoaneurysms - a durable option? *J Vasc Surg* 2006; 44(4): 701-5.
6. Clough RE, Black SA, Lyons OT, Zayed HA, Bell RE, Carrell T, *et al.* Is endovascular repair of mycotic aortic aneurysms a durable treatment option? *Eur J Vasc Endovasc Surg*. 2009; 37(4): 407-12.
7. Sedivy P, Spacek M, El Samman K, Belohlavek O, Mach T, Jindrak V, *et al.* Endovascular treatment of infected aortic aneurysms. *Eur J Vasc Endovasc Surg*. 2012; 44(4): 385-94.
8. Kritpracha B, Premprabha D, Sungsirij J, Tantarattanapong W, Rookkapan S, Juntarapatin P. Endovascular therapy for infected aortic aneurysms. *J Vasc Surg* 2011; 54: 1259-65.
9. Luo CY, Ko WC, Kan CD, Lin PY, Yang YJ. In situ reconstruction of septic aortic pseudoaneurysm due to Salmonella or Streptococcus microbial aortitis: long-term follow-up. *J Vasc Surg* 2003; 38: 975-82.
10. Oderich GS, Panneton JM, Bower TC, Cherry KJ Jr, Rowland CM, Noel AA, *et al.* Infected aortic aneurysms: aggressive presentation, complicated early outcome, but durable results. *J Vasc Surg* 2001; 34(5): 900-8.
11. Kan CD, Yen HT, Kan CB, Yang YJ. The feasibility of endovascular aortic repair strategy in treating infected aortic aneurysms. *J Vasc Surg* 2012; 55(1): 55-60.
12. Fukunaga N, Hashimoto T, Ozu Y, Yuzaki M, Shomura Y, Fujiwara H, *et al.* Successful treatment for infected aortic aneurysm using endovascular aneurysm repairs as a bridge to delayed open surgery. *Ann Vasc Surg*. 2012; 26(2): 280.e5-8.
13. Moneta GL, Taylor LM, Yeager RA, Edwards JM, Nicoloff AD, McConnell DB, *et al.* Surgical treatment of infected aortic aneurysm. *Am J Surg* 1998; 175(5): 396-9.
14. Kan CD, Lee HL, Yang YJ. Outcome after endovascular stent graft treatment for mycotic aortic aneurysm: a systematic review. *J Vasc Surg* 2007; 46: 906-12.
15. Lee KH, Won JY, Lee do Y, Choi D, Shim WH, Chang BC, *et al.* Stent-graft treatment of infected aortic and arterial aneurysms. *J Endovasc Ther* 2006; 13: 338-45.
16. Zhou T, Guo D, Chen B, Jiang J, Fu W, Wang Y. Endovascular stent-graft repair of mycotic aneurysms of the aorta: a case series with a 22-month follow-up. *World J Surg* 2009; 33(8): 1772-8.
17. Low JG, Quek AM, Sin YK, Ang BS. Mycotic aneurysm due to Burkholderia pseudomallei infection: case reports and literature review. *Clin Infect Dis* 2005; 40(1): 193-8.
18. Azizi ZA, Yahya M, Lee SK. Melioidosis and the vascular surgeon: Hospital Kuala Lumpur experience. *Asian J Surg*. 2005; 28(4): 309-11.
19. Spacek M, Stadler P, Bělohávek O, Sebesta P. Contribution to FDG-PET/CT diagnostics and post-operative monitoring of patients with mycotic aneurysm of the thoracic aorta. *Acta Chir Belg* 2010; 110(1): 106-8.
20. Song Y, Liu Q, Shen H, Jia X, Zhang H, Qiao L. Diagnosis and management of primary aortoenteric fistulas - experience learned from eighteen patients. *Surgery* 2008; 143(1): 43-50.
21. Lindblad B, Holst J, Kolbel T, Ivancev K; Malmö Vascular Centre Group. What to do when evidence is lacking - implications on treatment of aortic ulcers, pseudoaneurysms and aorto-enteric fistulae. *Scand J Surg* 2008; 97(2): 165-73.