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Minimal Incision for Repair of Non-ruptured Infrarenal Abdominal Aortic Aneurysms

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Abstract

Purpose: **In this study we evaluated the clinical and economic impact of minimal incision aortic surgery (MIAS) for the treatment of patients with non-ruptured infrarenal abdominal aortic aneurysms (AAAs).**

Methods: **Fifty four consecutive patients with non-ruptured infrarenal AAAs were prospectively studied in three different surgical approaches. They were divided into 3 groups of 18 patients each . Patients in Group I were operated by minimal incision aortic surgery (MIAS) technique, Group II by the traditional long midline transabdominal approach (TPA) and Group III by the left retroperitoneal approach (RPA). Demographic characteristics including age, sex, body weight, aneurysm size, and comorbid risk factors of the three studied groups were compared using Fischer exact test. Parameters including operating time, intraoperative fluid administration, and transfusion requirements were compared using 2-tailed Student t test . Length of stay in the intensive care unit (ICU), time to resuming regular dietary feeding, and hospital length of stay were recorded and compared using Wilcox rank sum test. The incidence of 30 days postoperative complications and mortality were compared among the groups.**

Results: **There was no significant difference among the MIAS, TPA, and RPA groups regarding age, sex distribution, aneurysm size, or body weight. There was male sex prevalence in all three groups. Surgical exposure of the common femoral arteries was more commonly required in Group III (RPA) than in other groups. Although length of incision tended to be longer in Group III (RPA) than in Group II (TPA) and Group I (MIAS), but there was no significant difference in the operative time and aortic cross-clamped time among the three groups. There was a significant difference in intraoperative fluid needs, the most in Group II (TPA) and the least in Group I (MIAS). There was significantly less blood loss in Group I (MIAS) as compared with other two groups, but intraoperative blood transfusion for all groups was not significantly different.**

ICU stay, return to general dietary feeding, and hospital length of stay for Group I (MIAS) and Group III (RPA) were significantly lower than those in Group II (TPA) which had higher incidence of postoperative ileus.

Conclusion: **MIAS is as safe as retroperitoneal and standard transabdominal repairs in the treatment of non-ruptured infrarenal AAAs and may be also more cost-efficient than the retroperitoneal and standard transabdominal repair.**

The development of endovascular repair for the treatment of arterial disease has generated enthusiasm for less invasive methods of aortic reconstruction. Endograft repair of abdominal aortic aneurysms (AAAs) is feasible, safe, less invasive, requires shorter hospital stay, and improves patient satisfaction.[1,2] The safety and efficacy of endovascular graft repair remain unproven.[3] Uncertainty about long-term durability has mandated life long computed tomography (CT) scan surveillance for the patients treated with endograft repair. While endovascular technology continues to evolve and improve, it is important to re-evaluate open

traditional surgical techniques in order to improve patient satisfaction and enhance cost efficiency while preserve quality outcome. In this study we evaluate the clinical outcome and economic impact of less invasive method for the treatment of patients with non-ruptured infrarenal AAAs.

Patients and Methods

Patients

Between January 2000 and December 2003, a series of 54 consecutive patients with non-ruptured infrarenal AAAs treated at Chiang Mai University Hospital and nearby private hospitals were included in a prospective, randomized cohort study of three different surgical approaches. They were divided into 3 groups of 18 patients each. Patients in Group I were operated by minimal incision aortic surgery (MIAS) technique, Group II had the traditional long midline transabdominal approach (TPA) with extracavitary retraction of small bowel for aortic exposure and Group III had left retroperitoneal approach (RPA).

Demographic characteristics, including age, sex, body weight, aneurysm size, and comorbid risk factors (serum creatinine above 2 mg/dl, diabetes, hyperlipidemia, hypertension, previous MI, COPD and smoking) of the three studied groups were compared using Fischer exact test (Table 1). Parameters,

Table 1 Patient demographics

	Group I (MIAS)	Group II (TPA)	Group III (RPA)
No. of patients	18	18	18
Age (yrs)	75.6 ± 7.6	75.3 ± 5.5	77.6 ± 6.4
Male/female	12/6	11/7	12/6
Body weight (kg)	53.4 ± 6.7	55.8 ± 8.6	54.3 ± 8.8
Aneurysm size (cm)	5.5 ± 0.5	5.9 ± 0.7	5.6 ± 0.8
Hypertension	7	10	8
Hyperlipidemia	7	6	6
Previous MI	4	6	5
COPD	12	13	12
Renal function	1	2	2
Smoking	13	14	13
Diabetes	3	4	3

There is no significant difference for demographic categories; P value > 0.05
MI = Myocardial infarction; COPD = chronic obstructive pulmonary disease
Data represent means ± SD

Table 2 Intraoperative data

	Group I (MIAS)	P value	Group II (TPA)	P value	Group III (RPA)
Abdominal incision (cm)	10 ± 1.2	< 0.05	25 ± 1.8	< 0.05	29 ± 2.9
Operative time (min)	183 ± 23	NS	205 ± 41	NS	209 ± 38
Aortic cross clamp time (min)	60.5 ± 18	NS	62 ± 18	NS	60.3 ± 21
Intraoperative fluid needs (ml)	2050 ± 510	< 0.05	3500 ± 300	< 0.05	2800 ± 350
Estimated blood loss (ml)	855 ± 316	< 0.05	1246 ± 615	NS	1150 ± 430
Intraoperative PRBC (units)	0.8 ± 1.5	NS	0.8 ± 1.6	NS	0.9 ± 1.5
Graft type					
Tube	9 (50%)		9 (50%)		8 (44.4%)
Bifurcated					
Aortoiliac	8		8		7
Aortobifemoral	1 (5.5%)		1 (5.5%)		3 (16.5%)

Data represent means ± SD,
NS = Not significant,
PRBC = Packed red blood cells.

Table 3 Details of postoperative recovery

	Group I (MIAS)	P value	Group II (TPA)	P value	Group III (RPA)
Mortality rate	-	< 0.05	1 (5.5%)	< 0.05	-
ICU stay (d)	1.0 ± 0.8	< 0.05	2.4 ± 1.5	NS	1.9 ± 0.8
Liquid diet (d)	1.1 ± 0.8	< 0.05	4.9 ± 1.3	< 0.05	2.6 ± 0.8
Solid diet (d)	2.0 ± 0.8	< 0.05	6.9 ± 1.4	< 0.05	2.3 ± 0.8
Ambulation (d)	2.1 ± 0.8	< 0.05	4.3 ± 2.3	NS	2.6 ± 0.7
Hospital stay (d)	8.3 ± 2.1	< 0.05	14.5 ± 2.1	< 0.05	10.2 ± 1.3

Data represent means ± SD,
NS = Not significant

including operating time, intraoperative fluid administration, and transfusion requirements were compared using 2-tailed Student t test. Length of stay in the intensive care unit (ICU), time to resuming regular dietary feeding, and hospital length of stay were recorded and compared using Wilcox rank sum test (Tables 2, 3). The incidence of 30-day postoperative complications and mortality were compared among the groups. Results were expressed as mean ± standard deviation (SD). A value of $P < 0.05$ was considered to be significant.

Operative Techniques

1. Minimal incision approach. The operation is performed with the patients under general anesthesia with endotrachial intubation. Access to the abdominal cavity is gained through a short 8-to-12 cm peri-umbilical midline incision (Figure 1). The duodenum and small bowel are retracted superiorly and laterally to the right of the aneurysm by sponge pads and a low-profile Bookwalter abdominal ring retractor with deep speculum retractors is placed circularly (Figure 2). An appropriate size of Dacron graft is selected, the patient is systemically anticoa-gulated, then the infrarenal aortic neck and the aortic branch vessels are cross-clamped with long atraumatic arterial clamps. The aneurysmal sac is opened, its contents removed, and back-bleeding lumbar vessels are ligated with sutures. Proximal and distal anastomoses are performed using 2-0 polypropylene sutures (Figure 3). When aneurysmal disease extends into the iliac arteries, surgeons must decide whether the iliac or femoral vessels should be selected for distal graft placement.

Fig. 1 Photograph showing the appearance of a minimal midline abdominal incision (short 8-to-12 cm) for MIAS

2. Conventional midline transabdominal approach. The conventional transabdominal approach entails a xiphoid-to-pubis midline incision after epidural block and induction of general anesthesia. The transverse colon is retracted to the cephalad and the small bowel displaced laterally, either in a bowel bag or operative towel wrap. Grafts are placed with hand-sewn vascular anastomoses.

3. Left retroperitoneal approach. After epidural block and induction of general anesthesia, the patient

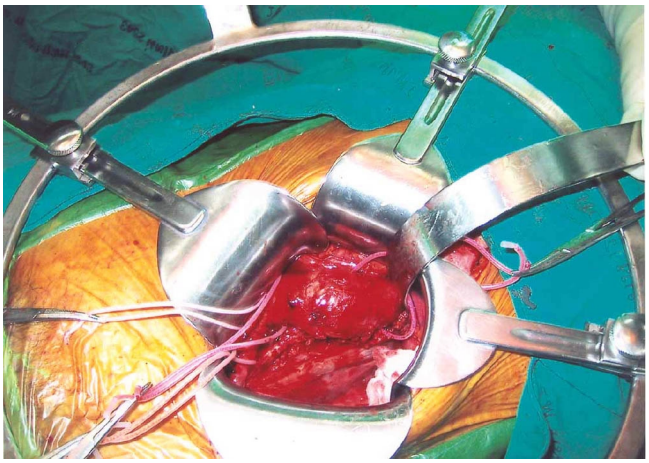

Fig. 2 Intraoperative photograph showing placement of the Bookwalter retractor set with circular deep blade retractors to expose infrarenal abdominal aortic aneurysm and its branches.

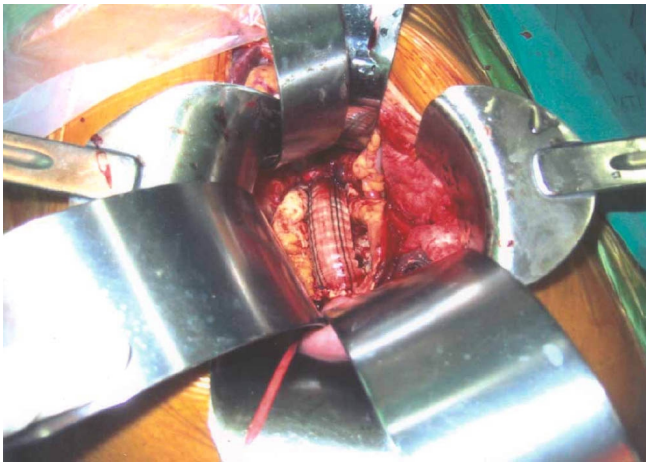

Fig. 3 Photograph showing aneurysmal repair with graft interposition. Both proximal and distal anastomoses can be performed with adequate operating field despite the minimal incision approach.

is placed in a right lateral decubitus position with the thorax held at 60 degree angle; the pelvis is rotated to the left and held at 30 degree to the table. An oblique incision along the course of the 11th and 12th ribs is made starting from the posterior axillary line and carried anteriorly to the lateral border of the rectus abdominis muscle. After division of the three muscular layers of the abdominal wall, the retroperitoneal space is entered. The peritoneum and abdominal viscera are retracted medially to expose the abdominal aorta and its branches. The right common iliac artery can also be easily approached by mobilizing the right lower portion of the peritoneum medially. Grafts are placed with hand-sewn vascular anastomoses. A self retaining retractor is used for maintaining the intended exposure through out the operation.

Patients undergoing MIAS are extubated in the operating or recovery room. Nasogastric tubes and urethral catheters are removed in the recovery room or during the first post-operative days. Epidural blocks are not used because we want the patients to have an early ambulation.

For retroperitoneal (RPA) and standard trans-abdominal approach (TPA), patients are extubated in the operating or recovery room. Nasogastric tubes are removed as soon as the patients have a return of bowel function. Epidural blocks are used routinely in RPA and TPA groups that results in the late removal of urethral catheters and late ambulation.

Results

The patient demographics were summarized in Table 1. There was no significant difference among the MIAS, TPA, and RPA groups regarding age, sex distribution, aneurysm size, or body weight. There was male sex prevalence in all three groups (Table 1). Use of tube graft for reconstruction was similar for all groups. Surgical exposure of the common femoral arteries was more commonly required in Group III (RPA) (3/18) than in Group I (MIAS) (1/18) and Group II (TPA) (1/18). Although length of incision tended to be longer in Group III (RPA) than in Group II (TPA) and Group I (MIAS), but there was no significant difference in the operative time and aortic cross-clamped time among the three groups (Table 2).

There was a significant difference in intraoperative fluid needs, the most in Group II (TPA) and the least in Group I (MIAS) (Table 2). There was significantly less blood loss in Group I (MIAS) as compared with other two groups, but intraoperative blood transfusion for all groups was not significantly different (Table 2).

ICU stay, return to general dietary feeding, and hospital length of stay for Group I (MIAS) and Group III (RPA) were significantly lower than those in Group II (TPA) (Table 3). Postoperative ileus (> 4 days) was found more in Group II (TPA) than in Group I (MIAS) and Group III (RPA), but wound complications were significantly more in Group III (RPA) than in Group II (TPA) and Group I (MIAS) (Table 4).

Table 4 Postoperative complications

	Group I (MIAS)	P value	Group II (TPA)	P value	Group III (RPA)
MI					
Nonfatal	1	NS	1	NS	1
Fatal	-	NS	1	NS	-
Atelectasis	1	NS	2	< 0.05	-
Ileus > 4 days	2	< 0.05	8	< 0.05	-
Wound pain	-	< 0.05	2	< 0.05	4
Abdominal wall hernia	-	NS	-	< 0.05	4
Hematoma	-	NS	-	NS	1
Percentage	(4/18) 23.5%	< 0.05	(14/18) 77.7%	< 0.05	(10/18) 55.5%

NS = Not significant

Discussion

Endovascular repairs for AAAs are frequently used in the United States, Europe and Australia, but they are not used commonly in Thailand because of the high cost. Conventional midline transperitoneal approach (TPA) by Creech has been a standard operation for open infrarenal AAAs repair since 1966.[4] This conventional median laparotomy with an incision of approximately 30 cm long from epigastrium to pubic symphysis, has also been a standard operation for AAAs in our institution for over 30 years. It causes significant trauma and is associated with pain and prolonged postoperative recovery. Because of the intraoperative extracavitary small bowel retraction, most patients develop postoperative adynamic ileus and have a late return to general dietary feeding. This sequela markedly prolongs the hospital stay and increases the cost of treatment.[5-9] In Group II (TPA), there was a significant increase of intraoperative fluid needs, estimated blood loss and postoperative ileus over those in Group III (RPA) and Group I (MIAS).

The retroperitoneal approach (RPA) has the advantage over the transperitoneal approach (TPA) with regard to an earlier resumption of oral intake and shorter hospital stay.[10-14] Despite excellent results of RPA, the technique has inherent drawbacks, such as technical difficulty in exposing the contralateral iliac artery, inability to investigate the abdominal content, and wound complications.[15,16] The major complications of RPA groups in our series were wound complications (wound pain 4, abdominal wall hernia 4, and hematoma 1).

In recent years, additional operative techniques designed to improve recovery from abdominal aortic surgery include the midline retroperitoneal exposure, laparoscopic assisted open aortic repair, and retroperitoneal laparoscopic repair.[9,17,18] These clinical trials suggested that postoperative ileus can be prevented and that hospital stay can be significantly shortened. However, prolonged operative times, as well as the need for advanced laparoscopic skills, make these techniques less desirable for routine treatment of patients with AAAs.[11,17,18]

The MIAS procedure is attractive for use in the treatment of patients with non-ruptured infrarenal AAAs in order to improve recovery after standard open aortic surgery. This procedure does not require advanced laparoscopic or catheter management skills. Equipment required to perform MIAS is low-profile and commonly available in most hospital operating rooms. The learning curve of retractor placement for aortic exposure and the use of long instrumentations can be overcome by the well-trained surgeon.[19-21] The midline incision can be extended easily if necessary without loss of clinical advantage. The small incision is important because it facilitates postoperative pain management and patient mobility. Intracavitary small bowel retraction goes along toward preventing post-operative ileus, which is the most common reason for prolonged hospitalization.[22] Our experience in Group I (MIAS) procedure suggests that postoperative ileus is significantly less than in Group III (TPA) (8; TPA, 2; MIAS). We do not use epidural catheter to control post-operative pain. Pain is simply managed, for small incision of MIAS exposure, by parenteral analgesics. Thus, patient mobilization has been more quickly achieved along with quicker removal of urethral

catheter. In our studies, morbidity rates were significantly different for patients treated with MIAS, RPA and TPA repairs (23.5% vs 55.5% vs 77.7%). The less invasive procedure is effective at reducing postoperative ileus and achieving a quicker return to general dietary feeding. Both significantly reduce ICU and hospital stay and thus also the hospital cost as well.

CONCLUSION

MIAS repair can be performed safely and effectively without specialized skill and should be considered as another option for the treatment of patients with non-ruptured AAAs. It is safe and cost-efficient, provides rapid recovery time with the same outcome quality and thus combines the best attributes of conventional transabdominal and retroperitoneal approaches. In addition to AAAs repair, MIAS can be used for aortobifemoral bypass procedure for the management of aortoiliac occlusion. Although study in larger number of cases is needed to confirm the value of minimally invasive approach, we wish to highlight the use of MIAs in our experience for non-ruptured AAAs repair.

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