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ORIGINAL ARTICLE

ENDOSCOPIC VERSUS OPEN LUMBAR SYMPATHECTOMY

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Aim: *There have been increasing reports of early experiences with endoscopic lumbar sympathectomy. Most of these reports mentioned a small number of cases and non compared this minimal invasive procedure to the standard open approach.*
Methods: *Thirty-one patients with inoperable critical limb ischemia attended our hospital over 32 months, were randomized to either open or endoscopic approach for lumbar sympathectomy. We used the standard technique for the open approach and used the aid of two different purpose balloons for the endoscopic approach. Data regarding operative time, complications, operative success, operative wound pain control and hospital stay were compared in both groups.*
Results: *Operative time was initially longer in the endoscopic approach, but toward the end of the study, it was nearly the same in both groups. The aid of the dissecting and retracting balloons helps to have a safe endoscopic approach with no intraoperative complications.*
Patients who had endoscopic approach significantly required fewer painkillers for the operative wound and had shorter hospital stay than those who had the open approach.
Conclusion: *Endoscopic lumbar sympathectomy is a safe and feasible procedure. It has a better outcome when compared to the open approach.*

Keywords: *Minimally invasive, Retroperitoneal, Critical ischemia.*

INTRODUCTION

In the last century, Diez from Argentina and subsequently Royale from Australia and Adson from the United stats described the first successful Lumbar sympathectomy.[1] This operation was popular between 1930s and 1950s, as it was the only available procedure to save an ischemic limb. After that time, revascularization surgery replaces sympathectomy and limits its indications.[2]

It is agreed that sympathectomy will lead to increases in cutaneous blood flow and altered pain transmission,[3] this can be used to treat specific conditions such as Causalgia, symptomatic vasospastic disorders, hyperhidrosis in addition to inoperable distal arterial occlusive diseases.[2,4,5,6]

In inoperable arterial occlusive disease, sympathectomy has been proved by meta analysis to be beneficial in ulcer healing, limit the progress of superficial gangrene and relieve rest pain,[7] with nearly fixed expected results in those selected indications.[2,7]

For many years, open sympathectomy has remained the gold standard approach for lumbar sympathectomy. The oblique abdominal incision give a good access through the retroperitoneal space to reach the side of the lumbar vertebrae, that enables the surgeon to excise sympathetic ganglions 2,3 and preferably 4.[8] On the other hand, this relatively long abdominal incision is used in co-morbid patients. These patients are chronically ill due to the prolonged pain, many of them has ischemic heart diseases and/or chronic lung disease.[9] The use of this approach to perform lumbar sympathectomy may lead to cardio-respiratory complications, long hospital stay, slow recovery and subsequently increase the morbidity and mortality of the patient's condition.[10]

For this reason, less invasive approaches to perform lumbar sympathectomy were suggested. Chemical sympathectomy, with C-arm or CT guidance has the benefits of minimal invasion, done under local anesthesia and very short hospital stay. However, incomplete sympathetic block and transient denervation were observed with this approach that limits its use.[11,12] Radiofrequency ablation is sophisticated and need very precise positioning of the electrodes.[13]

With the advance in using laparoscopy, Transperitoneal, Retroperitoneal and ROBOT assisted approaches were reported.[14,15-17] The minimal invasion accomplished by the use of special endoscopic instruments was suggested to favor this procedure over the open one.[18,19,20] Early experiences using this approach had few difficulties, of which obesity claimed to be most the influencing.[21]

To our knowledge, previous reports using the endoscopic approach did not include a comparative study to support its benefits over the open approach. This study performed to evaluate the endoscopic approach for lumbar sympathectomy for patients with inoperable arterial occlusive diseases and to compare it with the gold standard open approach.

PATIENTS AND METHODS

This is a prospective comparative study, performed at Suez Canal University Hospital, Ismailia, Egypt, between April 2005 and December 2007.

Patients suffering from APAOD or Burger's disease, who were indicated for sympathectomy according to Ali F & Robert Rutherford[2] were included in the study. They were selected according to the following inclusion criteria: Ischemic rest pain that requires continuous analgesia for > 2 weeks, Ischemic foot ulcers that failed to heal for > 6 week or distal gangrene which is limited to the forefoot (chronic ischemia grad 4 and 5).[22]

Patients were subjected to routine vascular and preoperative assessment, that include in additional to the general and local examinations, segmental arterial duplex measures, blood tests, chest and foot X-ray, ECG and Echocardiogram. Patients proved to be fit for operation had conventional angiography. According to these assessment measures, Patients with the following criteria excluded from the study: patients with arterial lesions amenable to surgical intervention, patients with deep infection or proximal gangrene, that reach the heal, patients with Ankle/Brachial pressure < 0.3, presence of diabetic neuropathy, detected by the 10 gm thread.

As the patients' body built suggested by Wander et al.[21] to be a determining point that may affect the accessibility of the operation, patients were classified according to their body mass index (BMI) into underweight <18.5, average 18.5 - <25, overweight 25-<30, obese 30 – <40 and morbidly obese > 40.[23] We recruited 6 patients with average BMI, 18 overweight and 7 obese patients. Within each BMI category, patients were subdivided using a periodic random way into group (A) and Group (B). Therefore, we had two comparable groups according to their BMI. Group (A) included: 3 average, 9 overweight and 4 obese patients and group (B): included: 3 average, 9 overweight and 3 obese patients.

Patients in group (A) had open lumbar sympathectomy, while those in group (B) had endoscopic sympathectomy.

All patients signed an informed consent and those patients listed for the endoscopic procedure informed that operation might convert to open.

The open surgical technique: we used the standard open method described by Ali F and Robert B,[2] in which the retroperitoneal space approached through a 12-15 cm oblique flank incision. The peritoneum was reflected medially, to reach the sympathetic chain, where at least the second and third ganglions were resected.

The endoscopic technique: we used the extraperitoneal approach described initially by Elliot et al,[14] with the use of dissecting and retracting balloons. In this approach, the patient was secured in a semi-lateral position, with the operating table broken under the contralateral flank. The surgeon and the camera operator stood facing the patient's back, with the video monitor directly opposite. A short (2 cm) transverse incision was made midway between the anterior superior iliac spine and the costal margin in the anterior axillary line. After gridiron dissection of the oblique muscles of the abdominal wall, the peritoneum was dissected and reflected medially. We used the dissecting balloon (Autosuture, 10 mm SBT) (Fig. 1) (top). It was inserted in the retroperitoneal plane and inflated using the hand pump (with the camera inserted through it) to give a working space of approximately one litter. The balloon was deflated and another horseshoe-shape balloon (Autosuture 10 m SBT) (Fig. 1) (bottom), was inserted and inflated to help in peritoneal retraction. A camera was inserted through the balloon port and gas insufflation to 12-13 mmHg pressure was used to keep the dissected tissue retracted. Furthermore, two 5 mm ports were inserted in the mid-axillary line, just below the costal margin and just above the iliac crest, (Fig. 2).

Following insertion of all the ports additional blunt dissection was performed and preceded postero-medially towards the psoas muscle and the lumbar spine. Once the sympathetic trunk has been identified, it was elevated from the surrounding structures, (Fig. 3), and circumferentially dissected distally and proximally then divided using the diathermy hook. At least second and third ganglions were resected.

The same team performed all the operations and all

sympathetic segments removed by either open or endoscopic approaches were sent for confirmatory histology.

Postoperatively, patients were followed up by one specialist who was blind to the type of approach and was not allowed to expose the surgical wound. The wound was followed by other members in the team. Therefore, assessment for the need of painkillers and decision of discharge were blind regarding the type of approach.

According to The World Health Organization Analgesic Ladder[25] and the Royal Colleges of Anesthetists and Surgeons,[25] pain control was achieved by the use of 100 mg diclofenac sodium suppository (Voltaren), given at the time of the operation.[26] This was followed by oral paracetamol, when patient allowed to drink, in a dose of 1000 mg / 6 hours during the first day then on when required basis in the following days. Diclofenac Sodium (Voltaren) intramuscular injection was used as if pain still persist, with a maximum dose of 75 mg /8 hours.[24]

Patients were discharged home when able to compensate operative pain, eat and drink satisfactorily and mobile. Patients were seen after 2, 4 and 6 weeks at the outpatient clinic.

Study outcome were: operative time, intraoperative complications (bleeding, injury to the ureter, inferior vena cava or peritoneal perforations), the need for painkillers for the operative wound (measured by the number of days during which the patient required Paracetamol in addition to the total number of Diclofenac injections) and postoperative complications on follow up; as haematoma, wound infection or incisional hernia. Additionally, success of the approach was proved by histological confirmation of the resected sympathetic segment.

RESULTS

Out of 124 patients seen during the study period, we were able to recruit 31 patients eligible to this study. They were 28 male and 3 females. Their age ranged between 26 and 65 years with a mean of 47.3 years, Table 1.

This table also shows that seven of our patients (22.6%) had no associated chronic illness, while 3 patients (9.7%) were diabetics, 12 patients (38.7%) were hypertensives and the remaining 9 (29%) had both diabetes and hypertension. None of the patients had diabetic neuropathy.

Regarding the presenting disease, 11 patients (35.5%) suffered from atherosclerotic disease where 20 patients (64.5%) had Burger's disease. Looking to the severity of presentation, 19 patients (61.3%) presented with ischemic rest pain, 8 (25.8%) with ischemic ulcers and 4 patients (12.9%) with distal focal gangrene, Table 1.

Regarding the side of the operation, we had performed 17 (54.8%) sympathectomy on the right side, 11 open and 6 endoscopic and 14 (45.2%) sympathectomy on the left side, 5 open and 9 endoscopic, Table 2.

Estimated operative time, (Fig. 4), ranged between 50-70 minutes with a mean of 60 ± 5.5 minutes for group (A) and between 60 and 140 minutes with a mean of 98.3 ± 27 minutes for group (B). Subdividing the operative time according to the operative side is shown in Table 2. For the open approach, mean operative time was 60.9 and 58.1 minutes for the right and left side respectively and for the endoscopic approach it was 93.1 and 95.8 minutes for the right and left side respectively. This difference was not statistical significant.

None of the patients in both groups had intraoperative bleeding or injury to the surrounding structures. None of the endoscopic procedures turns to open and all removed segments of both groups, proved histologically to be sympathetic chains.

To control the operative wound pain, one patient out of 16 (6.2%) in group (A) required Paracetamol for 2 days, 5 (31.2%) for 3 days and 10 (62.5%) required Paracetamol for 4 days. Additionally, four out of 16 patients (25%) required 2 Diclofenac injections, 7 (43.7%) required 3 injections, 2 (12.5%) required 4 injections and 3 (18.7%) required 5 injections. Regarding group (B), 11 patients out of 15 (73.3%) did not require painkillers more than paracetamol in the first day, while 4 patients (26.7%) continued to require Paracetamol for the second postoperative day. None of group (B) patients' required Diclofenac injections. This difference in the need for painkiller was statistically significant as shown in Table 3.

Regarding the hospital stay, it ranged in group (A) between 6 and 9 days with a mean of 6.8 days, while in group (B), it ranged between 1-2 days with a mean of 1.4 days which was statistically significant, Table 4.

Regarding the result of the operation, rest pain disappeared in 11 out of 19 patients (58%), ischemic ulcer healed in 5 out of 8 patients (62.5%) and gangrene demarcated and did not progress in 1 out of 4 patients (25%). Table 5 shows these results in both groups. There was no statistical significance in recovery between group (A) and (B). In the remaining 14 patients, eight patients had transmetatarsal amputation, four had above knee amputation and two patients had below knee amputation.

None of the patients in either group had postoperative complications for 6 weeks follow up.

Table 1. Characteristics of the studied population.

	Number (out of 31)	%
Male / female	28/3	-
Mean age	47.3 (26-65) years	-
No chronic illness	7	22.6
Diabetes	3	9.7
Hypertension	12	38.7
Hypertension + Diabetes	9	29
Atherosclerotic disease	11	35.5
Burger's disease	20	64.5
Rest pain	19	61.3
Ischemic ulcer	8	25.8
Distal gangrene	4	12.9

Table 2. Correlation between operative time and operative side.

	Operative side		Total	Mean operative time		P Value
	Right	Left		Right	Left	
Open sympathectomy	11	5	16	60.9	58.1	0.342
Endoscopic sympathectomy	6	9	15	93.1	95.8	0.929
Total	17	14	31			

- P > 0.05 (not significant).

Table 3. Distribution of the study population according to painkillers received.

Type of painkiller	Number of patients (%)		P Value
	Open (N=16)	Endoscopic (N=15)	
P for one day only	0	11 (73.3)	0.005*
P for 2 days only	1 (6.2)	4 (26.7)	
P for 3 days only	5 (31.2)	0	
P for 4 days only	10 (62.5)	0	
D 2 injections	4 (25)	0	0.00*
D 3 injections	7 (43.7)	0	
D 4 injections	2 (12.5)	0	
D 5 injections	3 (18.7)	0	

- P: Oral Paracetamol.
- D: Diclofenac injections in addition to the oral paracetamol.

* P < 0.05 (significant).

Table 4. Hospital stay in both groups.

Days	Group (A)	Group (B)	P value
1	0	9	
2	0	6	
6	8	0	
7	4	0	
8	3	0	
9	1	0	
Mean ± St (days)	6.8 ± 0.9	1.4 ± 0.5	0.00

- P Value < 0.05 (significant).
- St = Standard deviation.

Table 5. Result of the operation in both groups.

	Preoperative		Total	Recovered		Total	P value
	Open	Endoscopic		Open	Endoscopic		
Rest pain	6	13	19	4	7	11	
Ischemic ulcers	7	1	8	4	1	5	
Distal gangrene	3	1	4	1	0	1	
Total	16	15	31	9	8	17	0.876

- P > 0.05 (not significant).

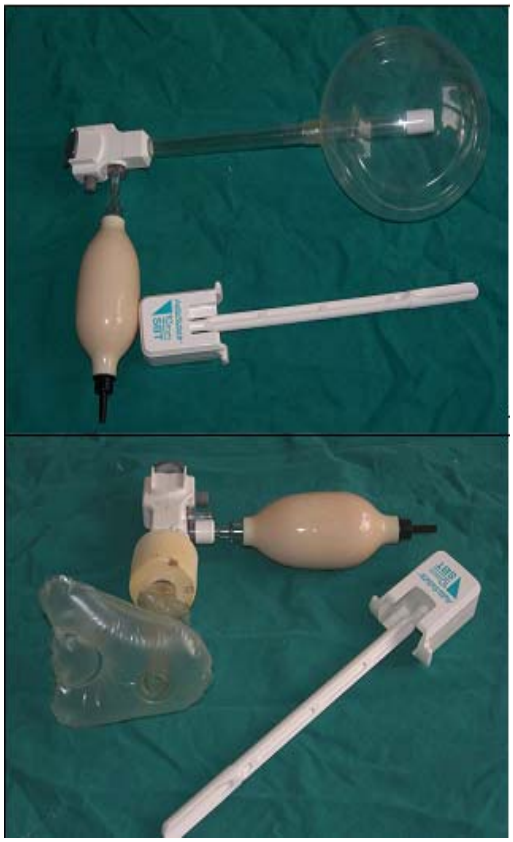

Fig 1. The dissecting balloon (top) and the horseshoe balloon bottom.

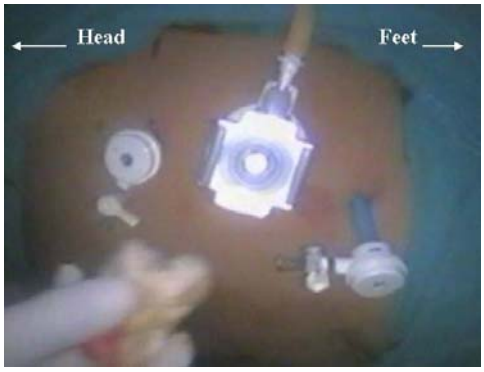

Fig 2. Three ports in position, in a right side operation.

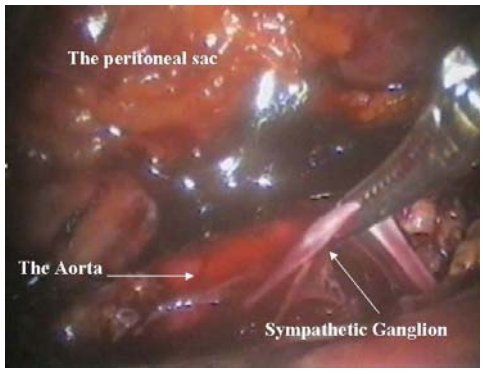

Fig 3. The sympathetic chain grasped before being cute.

DISCUSSION

Being widely replaced by revascularization operations, lumbar sympathectomy have been consistently demonstrated in multiple cohort studies to be indicated as a last resort before amputation for patients with critical leg ischemia.[2,6,7,21] Open lumbar sympathectomy is the gold standard approach,[2] but recent reports suggested a better postoperative recovery using an endoscopic approach.[19,21]

To test this hypothesis, we recruited 31 patients indicated for lumbar sympathectomy. These patients share the same medical characteristics in comparable studies such as age range, presentation and associated medical illness.[9,27,28,29]

The open operative approach is established and did not change long time ago. On the other hand, endoscopic approach is basically the same in reviewed literatures but few differences were noted in detailed steps. We used the described basic technique[29,30] with the aid of 2 different purposes balloons. Only Ming Yuan protected the ureter by retrograde catheterization,[20] which seems to be an unnecessary step.

In creating a working space, Wander et al. used blunt dissection followed by gas insufflations,[21] by not using a balloon, he faced peritoneal perforation that lead to pneumoperitoneum causing compression of the retroperitoneal working space. Min Yuan used a surgical glove as a dissecting balloon,[20] this was not perfect as the dissection was not under vision and not symmetrical. Nahum et al used a dissecting balloon with a camera inserted through it.[30] We used this technique as it allows dissection to be guided by vision. Marcelo et al introduced the retroperitoneal ports guided by intraperitoneal view,[31] a step that has not been mentioned by any other authors and will deprive the procedure from the benefit of being totally extraperitoneal.

All previously mentioned authors stood in front of the patient.[2,20,21,31] They look to an unfamiliar upside down view of the operative field. In this study, we stood behind the patient, looking to the view usually seen in open approach.

The first impression regarding the mean operative time is in favor for the open approach over the endoscopic one
(60 versus 98 minutes), however considering the learning curve, experience gained with the endoscopic approach lead to decline in the operative time to be nearly equal to the open one in the last 5 cases (60 – 70 minutes). This is logic and agrees with Wander et al. who experienced a decline in the endoscopic operative time from 121 minutes in his initial case to 87 minutes in his last few cases.[21] Our operative time, in the last few cases, was shorter compared with that achieved by Wander et al and Nahum et al (87 and 136 respectively),[21,30] we assumed this is due to the more oriented view obtained by standing behind the patient rather than in front of him.

It was believed that, because of the Inferior Vena cava, right sympathectomy is more difficult and time consuming than the left sympathectomy.[2] However, in the present study, it was interesting to recognize that operative time for open or endoscopic approaches showed no statistical differences when related to operative side Table 2. This agrees with Wander et al[21] who suggested that obesity and retroperitoneal fat amount that affect accessibility of the operation and therefore its duration.

Brancaccio et al reported a chylous fistula following open lumbar sympathectomy,[32] Wander et al reported a groin hypoesthesia after one endoscopic sympathectomy[21] and Rulli Francesco et al. reported a massive intestinal infarction after retro peritoneal endoscopic sympathectomy.[33] These are very rare complications, more common intraoperative complications include injury to the ureter or lumbar vessels.[2,34] We did not face any intraoperative complication with both approaches. This confirms safety of the endoscopic approach in addition to the open one. This was achieved by careful dissection and the aid of retraction by the horseshoe balloon.

Sympathectomy lead to improvement in 58% of patients with rest pain, ulcer healed in 62.5% of the patients and gangrene was demarcated in 25% of them. This is agrees with the expected results of sympathectomy in patients with similar indications in literatures; rest pain response range between 47% to 78%, ulcers should heal in 35-65% of the patients and gangrene should demarcate in 35% of the patients.[2,28,29] There was no significant statistical difference in response to sympathectomy between both approaches. This is because resected segments from all patients proved by histological examination to be sympathetic chains, which considered to be an end point for the success of the operation in both groups.

Operative wound pain is very subjective and depends on the patient tolerance to pain. Blindly assessed, the need for painkillers for the operative wound was significantly less after endoscopic approach than open one Table 3. This agrees with Wander et al.[21] and can be explained by the smaller wound in the endoscopic approach.

Hospital stay was significantly shorter in the endoscopic than the open approach (1.4 versus 6.8 days respectively). This short stay observed with the endoscopic approach was reported by Nahum et al to be 1.4 day,[30] and one day by Ming-Yan et al[20] that is suggested to be directly related to the well tolerated operative wound pain.[35]

In conclusion this study confirms that endoscopic lumbar sympathectomy is a feasible minimally invasive

procedure. Compared to the open approach, endoscopic approach showed better results regarding operative wound pain control and hospital stay with no differences in complications or success and therefore, should be considered as an alternative to open lumbar sympathectomy.

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