Doppler Guided Hemorrhoidal Artery Ligation Versus Ligation Mucopexy: Treatment of Hemorrhoidsprospective Case Controlled Study

Hany M.S. Mikhail MD, Abdrabou N. Mashhour MD
Department of General Surgery, Faculty of Medicine,
Cairo University, Kasr Alainy Hospital, Cairo, Egypt,

ABSTRACT

Background: *Surgical treatment of hemorrhoid is usually painful. Recently, several novel treatment options have been developed to treat high-grade hemorrhoids with the intention of minimizing the drawbacks of conventional hemorrhoidectomy technique.* ***Objective:*** *compare Doppler Guided Hemorrhoidal Artery Ligation with mucopexy (DGHAL) versus Ligation mucopexy (HAL) technique.* ***Patient and Method:*** *A prospective case controlled study which included 40 consecutive patients with 2nd to 4th degree of hemorrhoids requiring surgery, in duration from June 2013 to September 2014 at Al Kasr Al Ainy hospitals. The patients were categorized into two groups; twenty patients were treated with haemorrhoidal artery ligation and mucopexy (HAL), the other twenty patients were treated with Doppler Guided haemorrhoidal artery ligation followed by mucopexy (DGHAL).* ***Results:*** *Using VAS there was astatistically significant differences in pain score between both groups (p=0.02), where the mean in DGHAL was 3.8 (±2.8), and in mucopexy was 1.2(±1.6). The mean operative duration in DGHAL group was 39.0 min (± 3.6) and 42.50 min (± 6.7) in the HAL group with no statistically significant difference (p =0.2). As regard to complications rate there was no statistically significant difference between both groups (p=0.2)*

Keywords: *Haemorrhoids, Mucopexy, Doppler Guided Hemorrhoidal Artery Ligation*

INTRODUCTION

Symptoms related to hemorrhoidal disease are frequently bothersome. However, patients are reluctant to undergo painful treatments for benign conditions such as hemorrhoidal disease.[(1).]
Recently, several novel treatment options have been developed to treat high grade hemorrhoids with the intention of minimizing the drawbacks of conventional hemorrhoidectomy technique[(1)]. The aim of these new treatments is to preserve hemorrhoidal tissue that is important for anal sensation and continence and to reduce postoperative morbidity [(1)]. One of thesenew methods is haemorrhoidal artery ligation (HAL). This technique can be done using Doppler-guided haemorrhoidal artery ligation (DGHAL) [(2)]or by anatomical ligation without Doppler [(3, 4, 5, 6).]

However this technique lacks the ability to control prolapse.[(1,7)]. Several additional techniques have been made, which address the hemorrhoidal prolapse by fixing it within the anal canal.These procedures include recto anal repair (RAR)[(8)], transanal hemorrhoid mucopexy[(9)], anal lifting and hemorrhoidal fixation technique.[(10)]

Aim of the study:

The aim of this work is to compare Doppler Guided Hemorrhoidal Artery Ligation with mucopexy(DGHAL) versus Ligation mucopexy (HAL) technique, with regard of operative duration, hospital stay, Postoperative pain and postoperative complications.

PATIENTS AND METHODS

This is a prospective case controlled study, which was conducted on 40 consecutive patients with 2nd to 4th degree of hemorrhoids requiring surgery, in the duration between June 2013 to September 2014 at Al Kasr Al Ainy hospital, Cairo university.

The patients were categorized into two groups; twenty patients were treated with haemorrhoidal artery ligation and mucopexy (HAL), the other twenty patients were treated with Doppler Guided haemorrhoidal artery ligation followed by mucopexy (DGHAL)

Patients with acute thrombosed hemorrhoids, external hemorrhoids, other concomitant anal diseases(such as fissure, fistula, or abscess), or previous history of anorectal surgery, were excluded from the study.

All patients had routine preoperative work up, colonoscopy orsigmoidoscopy was done when indicated according to the guidelines.

The study was explained to all the patients and an informed consent was signed from each patient.

Operative technique:The procedure was performed in lithotomy position under spinal, general or saddleanesthesia. Operative duration was calculatedfrom the time the surgical procedure was started till the end of the procedure.

Postoperative oral diet was allowed immediately after the operation. Postoperative medications included NSAID when needed, venoton, and antibiotics. The postoperative pain score was measured using Visual Analoge Scale (VAS) **(Fig. 1)**. A surgeon measured VASevery 8 hours and the maximum score recorded at the end of the first postoperativeday.

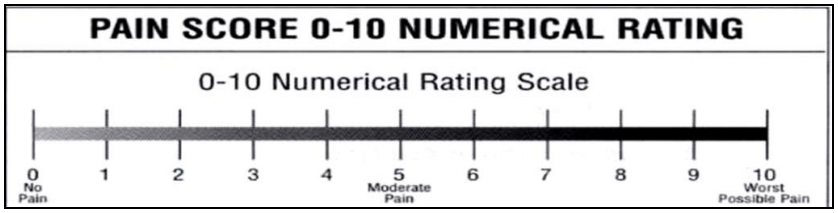

Fig. (1): Visual Analogue Scale to measure pain intensity in numerical manner

Both techniques were comparedregarding age, gender, degree of hemorrhoid, operative time, hospital stay, complications and short-term recurrence.

Ligation and Mucopexy technique (HAL):The skin tags corresponding to three principle sites of hemorrhoidal cushions, namely, 3, 7, 11 o'clock position were held with an artery forceps and retracted out to visualize the hemorrhoids. A transfixing stich was applied at the hemorrhoidal pedicle 4cm above the dentate line using absorbable suture (polyglactin 910 size 2/0). This was followed by a continuous suture line down formthe transfixing suture, descending in a continuous manner to include the haemorrhoidal mass mucosa and submucosathat was completed just 5mm before the dentate line (relatively insensitive area). Any secondary hemorrhoids found were treated as the primary hemorrhoids. No anal packing was done after the procedure.

Doppler guided hemorrhiodal artery ligation and mucopexy(DGHAL):

A specially developed anoscope with a side view Doppler probe was used to locate the submucosalterminal branches of superior hemorrhoidal artery(SRA). The anoscope was introduced to the anal canal, rotating it to capture good signal of SRA branch usually at 3-5 cm from the dentate line, a figure of eight stiches were performed using polygalactine 2/0 with a 5/8 circle needle to ligate the branches. The proctoscope was removed and a continuous descending suture around hemorrhoidal mass was done taken mucosa and submucosa down to 5mm above dentate line. Both ends of suture were tied to each other.

Proctoscope was introduced again to same level rotating it clockwise to detect new signal. Proctoscope was introduced to level higher or lower than previous one to detect any signal where may branch through its coarse may be deep at level but may be superficial at other level through its course. The ligated vessels ranged between 6 and 11.

RESULT

Both group were matching regarding gender and age distribution. Using VAS there was a statistically significant differences in pain score between both groups (p=0.02), where the mean in DGHAL was 3.8 (±2.8), and in ligation mucopexy(HAL) was 1.2(±1.6). (Fig. 2)

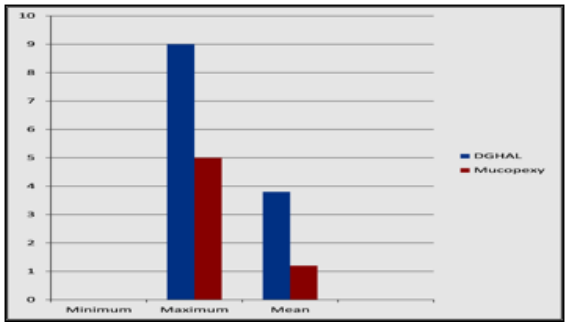

Fig. (2):VAS distribution in both groups

The mean operative duration in DGHAL group was 39.0 min (± 3.6) and 42.50 min (± 6.7) in the HAL group with no statistically significant difference (p =0.2). **(Fig 3)**

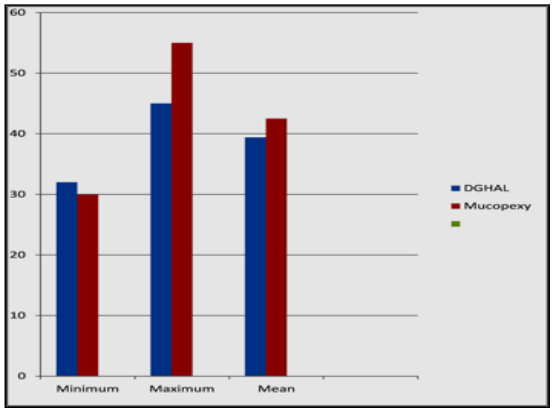

Fig. (3): Operative duration distribution in both groups.

As regard to complications rate there was no statistically significant difference between both groups (p=0.2). Complicated cases in DGHAL (30%) were presented as follow: 33.3% fecal impaction, 33.3% perianal oedema, and 33.3% mucosal polyps. **(Fig 4)**

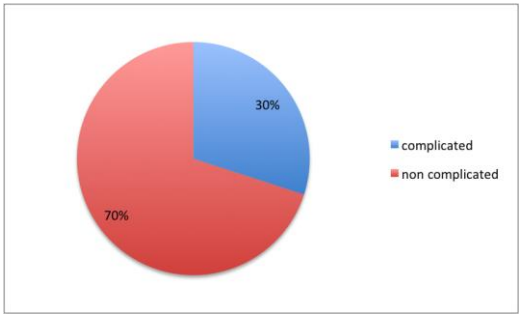

Fig. (4): Complication in DGHAL group

Complicated cases of ligation mucopexy (HAL) (10%) were presented as follow 50% infection, and 50% bleeding. **(Fig. 5)**

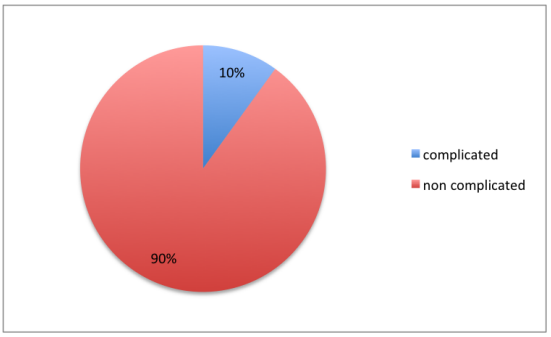

Fig. (5): Complication in HAL group

DISCUSSION

This study was conducted to compare Doppler guided hemorrhoidal artery ligation with mucopexy (DGHAL) in one group and ligation with mucopexy (HAL) in the 2nd group; throughthe short postoperative period, regarding pain, operative duration and complications. The study included 40 patients in Cairo University Hospital in the period from June 2013 to September 2014.

According to Goligher classification; Preoperative different degrees of hemorrhoid were included in the study. 5% of cases were 2nd degree, 45% were 3rd degree, and 50% were 4th degree. In DGHAL 40%were with 3rd degree, and 60% were with 4th degree. In mucopexy 10% were 2nd degree, 50% with 3rd degree, and 40% were with 4th degree. No significant differences were founded (p = 0.4).Other studies included patients with similar different degree of hemorrhoid, Wan et al., in 2011 had done his study on 97 patients where 13.4% of cases were with 2nd degree, 70.1% with 3rd degree, and 16.5% with 4th degree [(11)]. Another study conducted in 2011 included only 3rd, and 4th degree [(12)].

As regard to operative duration, the mean operative duration was 39.4 ±3.6 minutesin the DGHAL group and the mean operative duration of 42.5±6.7 minutes in HAL group, with no significant differences between both groups (p =0.2).However,Gupta, et al., in 2011 found a statistically differences in operative duration between both groups (P=0.003), which was longer

in the DGHAL group.[12], The difference between this study and the other studies in operative duration can be explained by the difference in surgeons performing the two procedures. Another explanation is the number of suture ligation used in DGHAL.

As regard to postoperative pain as measured by VAS, the mean was 3.80 (±2.8) in DGHAL group and 3.50 (±1.6) in Mucopexy group (p =0.02). Gupta et al proved the same in 2011 where the postoperative pain score was significantly higher in the DGHAL group using VAS (4.4 vs. 2.2, P=0.002). [12]

In the study, DGHAL showed a higher incidence of complication than the HAL. In DGHAL there was six complications: two cases complicated by perianal edema, two cases complicated by mucosal polyp, and two cases complicated by fecal impaction. In HAL group there was 2 complication; one case complicated bymoderate spontaneous bleeding on 2nd day postoperative, the second case was complicated by infection which started to appear on 7th day of operation and disappear with antibiotics and local disinfection solution after 4 days completely. No statistically differences (p=0.09) were found between the 2 groups regarding to postoperative complication. The same result were showed by Gupta, et al in 2011 where no significant difference between both groups (p=0.93) during one year follow up [12].

This study showed that HAL with mucopexy alone is a simple technique, which depends on a basic surgical maneuver to ligate the hemorrhoidal vessel followed by disappearance of symptoms.

Conclusion: HAL with mucopexy is less costly than DGHAL, where no need for special instruments. This study showed that HAL with mucopexy is having better short-term results over the DGHAL, in regard of postoperative pain.

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Below the Ankle Angioplasty is Spreading the Spectrum of Management of Critical Limb Ischemia (CLI)

Ahmed Sayed[1,2], Walied Eldaly[1], Ahmed Salim[2], Ahmed Taha[1,2]
[1]Vascular Surgery Division, General Surgery Department, Kasr Alainy Faculty of Medicine,
[2]Vascular Surgery Department, National Institute of Diabetes & Endocrinology

ABSTRACT

Introduction: *Endovascular revascularization is a mainstay in the management of patients with critical limb ischemia (CLI). Nonetheless, when employing standard approaches, success rate remain suboptimal. We aim to report the clinical results of revascularization of the below the ankle (BTA) arteries.* ***Patients and Methods:*** *This is a prospective study of patients presenting with CLI, where one of the pedal and/or plantar arteries were indicated for angioplasty aiming at foot salvage. BTA revascularization was performed as an adjunct to infragenicular angioplasty , but patients with more proximal lesions where excluded. Study endpoints were clinical improvement, limb salvage and primary patency.* ***Results:*** *49 patients underwent BTA angioplasty. Technical success was achieved in 46 patients (94%). Two of the unsuccessful cases underwent a below knee amputation and the third remained salvaged with incomplete wound healing. After one year primary patency was 62% secondary patency was 69%, and limb salvage was achieved in 89%.* ***Conclusion:*** *Midterm results show satisfactory outcome of the BTA angioplasty. The technique is emerging as an effective and safe treatment option to improve the results of revascularization.*
Key words: *Below the ankle - planter - dorsalis pedis - angioplasty*

INTRODUCTION

The wide spread of endovascular management for treatment of critical limb ischemia (CLI) led to an extension of vascular interventions to the leg and foot territory. Since the early 1990s the endovascular treatment of plantar arch obstructions has been popularized due to the availability of a new generation of low-profile over-the-wire (OTW) small-vessel long balloons which make possible an easy access to such remote territories[1].

In one of the largest series of management of CLI (1,624 patients) 71% of patients had foot disease[2]. The primary indications for tibial and foot arteries intervention is limb salvage, to avoid amputations. Patients with chronic leg ischemia face a gloomy future, in fact, long-term survival rate with CLI is significantly lower than that of a matched population. Limb salvage is of more importance to these patients. The most plausible explanation for this is that healing the wounds and/or infection will reduce the oxygenation demand[3].

This study aims to evaluate the feasibility and outcome of endovascular revascularization of the below-the-ankle (BTA) arteries.

PATIENTS AND METHODS

This is a prospective study of patients presenting to Kasr Alainy vascular surgery division and National institute of diabetes and endocrinology vascular surgery department with CLI (tissue loss) between Jan 2014 and Jan 2015. Eligibility criteria to be included in the study were the presence of infragenicular arterial disease associated with a BTA and indicated for pedal and/or plantar angioplasty. Patients with lesions proximal to the infragenicular arteries were excluded as well as patients with rest pain and/or intermittent claudication.

Patients' medical history, presentation, risk factors, imaging data, and procedure details were reported. Patients were scheduled for dorsalis pedis and/or plantar arteries angioplasty, if the lesion is suitable, to restore the continuity of blood flow to the foot. The indications of BTA angioplasty are the presence of tight stenosis (>70%) and/or a segmental occlusion.

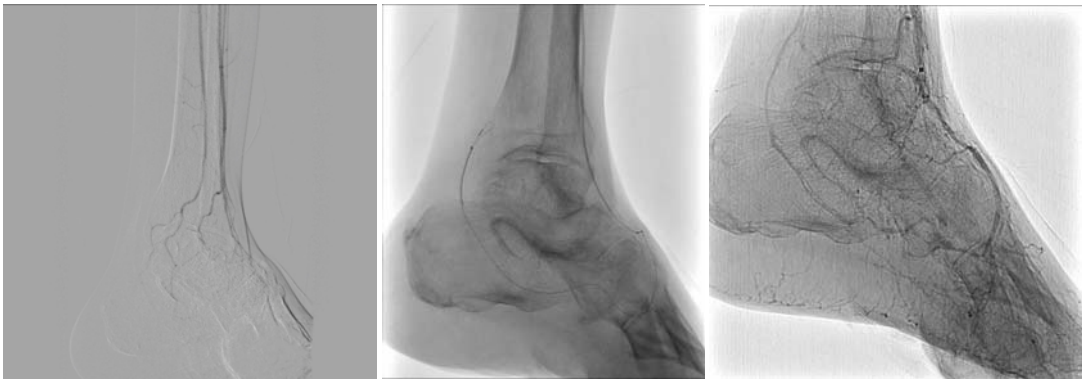

Fig. 1: Dorsalis pedis (DP) angioplasty. A) Foot angiogram showing poor pedal arch, B) Crossing of the DP total occlusion by).014" guide wire and balloon reaching the planter arch, C) Control angiogram showing successful recanalization of DP

Percutaneous angioplasty was performed in all cases under local anaesthetic. This was done always through an ipsilateral femoral using a 6F sheath. Any infragenicular lesion was treated in a standard way using the appropriate-sized semi-compliant balloons over an 0.014" wire. After that selective angiography is performed to evaluate the foot vessels and decide the need for pedal/planter angioplasty. Angioplasty was performed for the selected BTA vessel using an 0.014" guide wire supported by an appropriate-sized semi-compliant balloon through a transluminal route.

Vessel recanalisation was considered successful if direct flow was restored in the target vessel with no residual stenosis >30% of the vessel diameter along the whole artery. During the procedure, sodium heparin (5000 IU) bolus was infused into the arterial lumen; if vessel spasm occurred, 100µg nitroglycerin was injected intraarterially if the blood pressure allowed.

Patients were discharged after performing the necessary wound debridements/minor amputations within 48 hours. They received instructions on risk factors control and treatment including acetyl salicylic acid 150 mg/ day for life, enoxaparine for 2-3 days, Clopidogrel 75 mg/ day for at least 3 months.

The frequency of follow-up varied with the clinical status of the wound. Follow-up depended on clinical evaluation of the vascularity of the foot. Detecting the pulse, manually or by Doppler, or duplex scanning, in addition to signs of wound healing, was the main method of assessment.

Comparison between categorical data was performed using Chi square test. Statistical Package for Social Sciences (SPSS) computer program (version 19 windows) was used for data analysis. P value $\leq$ 0.05 was considered significant.

RESULTS

Forty nine patients fulfilled the inclusion criteria and were enrolled in the study. There were 33 males and 16 females with a mean age of 65.02 years. All patients had diabetes mellitus, 44 had hypertension, 32 were smokers, and 24 had additional cardiac disease. Table 1 shows patients' data.

Table 1: Demographic data and risk factors

	Number (%)
Males	33 (67%)
Females	16 (33%)
Diabetes mellitus	49 (100%)
Hypertension	44 (90%)
Smoking	32 (65%)
coronary artery disease	24 (49%)

All patients who underwent below the ankle angioplasty presented with tissue loss; whether Rutherford category 5 (n=32) or 6 (n=17). Diagnostic angiography prior to the procedure showed 42 occlusions and 7 stenoses. Angioplasty was attempted in 31 planter arteries and 18 dorsalis pedis arteries. The decision of revascularization was based on the pedal vessel most suitable for angioplasty and the arterial territory (angiosome) of tissue lesion. An

ipsilateral antegrade femoral access was used in all patients. All balloons used for dilatation had an appropriate diameter ranging between 1.5 - 2.5 mm on an 0.014" platform. All arteries were dilated through a transluminal route. BTA was associated with angioplasty of the corresponding tibial vessel in all cases , and with angioplasty of an additional tibial vessel in 10 cases. The main complication of the procedure was arterial wall dissection which was observed in 9 arteries and was managed by prolonged balloon inflations up to 3-5 minutes. The other three reported complications were: puncture site hematoma (n=1), vessel perforation with dye extravasation (n=1), and loss of the completeness of the foot arch (n=1). All of them were managed conservatively.

Technical success was achieved in 46 patients (94%). Two of the unsuccessful cases underwent a below knee amputation and the third remained amputation-free with incomplete wound healing. Three patient underwent a redo procedure within the first three months because of inadequate wound healing. Four patients died during the follow up period of the study of unrelated causes.

After one year of follow up by duplex primary patency was 62% (28 out of 45 patients), while secondary patency was 69% (31 out of 45 patients). Five patients underwent a below knee amputation; 2 of them following an unsuccessful procedure (initial technical failure), and 3 during the course of the study. Among these three cases one patient had occluded revascularization with extensive foot damage, not amenable for salvage, and one had patent revascularization but the foot was amputated due to spreading infection. The limb salvage rate achieved after one year was 89% (40 out of the 45 living patients).

We compared the outcome of the different morphologic patterns (occlusions versus stenoses). All 7 stenoses were technically successful, while all 3 failures were in occlusions (p=.575). Complications occurred in one stenotic case while the remaining 11 complications occured in the occluded cases (p=.570). In all stenotic cases achieved limb salvage was achieved after one year, while 5 of the occluded cases underwent a below knee amputation (p=.389). All these differences were statistically insignificant. Statistical significance was reached when the primary patency of the corresponding tibial vessel was compared. Primary patency was 100% in stenotic cases and 50% in occluded cases (p=.006).

When the outcome of planter arteries angioplasty was compared to dorsalis pedis angioplasty no significant difference was found (Table 2). Technical success, complications, and primary patency showed better figures following planter angioplasty, which did not reach statistical significance.

Table 2: Comparison of the outcome in planter and pedal angioplasty

	Technical success p=.302	*Complications p=.076*	*1ry patency p=.143*	*Limb salvage P=.386*
Planter angioplasty	97%	5/31	65%	87%
Dorsalis pedis angioplasty	89%	7/18	44%	94%

DISCUSSION

Gooden et al found that up to 25% of patients with heel ulcers ultimately underwent to a major lower extremity amputation despite a palpable pedal pulse[4]. Part of the failure is due to inadequate treatment of the wound postoperatively. However, wounds may also fail to heal because of inadequate local revascularization due to inadequate vascular connections between the revascularized artery and the local ischemic area[5].

Two principal circulatory pathways, the dorsal and the plantar circulations, compose the vascular anatomy of the foot. Both circulatory pathways, together with the peroneal artery branches, supply different regions of the foot[6]. The anatomic anastomosis between the dorsal and plantar circulations influences the distal runoff and the revascularization strategies. The main pedal-plantar connection is the pedalplantar loop, which consists of the anastomosis of the DPA in the first metatarsal space to the plantar arch and LPA via the deep perforating artery[2].

In patients with ischemic wounds due to CLI, restoration of direct in-line blood flow to the area of the lesion is considered the best treatment, obviating major amputation and preserving ambulation. With the recent introduction of guidewires and balloon catheters specifically designed for the treatment of below-the-knee vascular disease, recanalization of the pedal arteries has become a technically feasible procedure for restoring tibial vessel outflow and supply to the area of the wound[6].

We studied 49 patients with CLI who required angioplasty of one of the pedal arteries as part of their revascularization in order to get a straight in-line flow to the target lesion in the foot. Our results showed promising results demonstrated safety and efficacy of the technique. The study included 32 males and 17 females; all of them fell into Rutherford categories 5 and 6. Forty two patients had pedal occlusions and seven had stenoses. Technical success was achieved in 96% of patients, and limb salvage was achieved after 12 months in 89% of patients.

Very few studies addressed planter vessel angioplasty with similar results. Abdelhamid et al showed a technical success rate of 88% and a limb salvage rate of 82% at one year. Two patients required re-intervention. Four of their seven amputations were following failed angioplasty[7].

Similarly Palena et al had a Technical success in 87% with clinical improvement in all successful cases. Amputation-free survival was 81.5%. TcPO2 increased, from 10.367.6 to 50.768.2 mmHg[8].

In another study where bailout stenting was used, the technical success was 95.2 % (40 of 42 patients). Two patients died, and two major amputations occurred up to 3 years. At 1 year, overall primary vessel patency was 50%[9].

A recent study compared infrapopliteal angioplasty alone to infrapopliteal angioplasty with added planter artery angioplasty (PAA). The success rate of additional PAA was 93%. The overall survival (86% vs 73%, p=0.350), limb salvage (93% vs 83%,p=0.400), amputation-free survival (79% vs 53%, p=0.102), and freedom from reintervention (64% vs 73%, p=0.668) rates were similar in both groups. Wound healing rate (93% vs 60%, p=0.05) was higher and time to wound healing (86.0±18.7 vs 152.0±60.2 days, p=0.05) was shorter in the patients who received PAA[10].

In our study we performed pedal angioplasty only in adjunct with tibial angioplasty, but not with any proximal lesions. We believe that in patients with CLI correction of the proximal lesion should be sufficient to allow proper healing. So, our policy was to reserve pedal angioplasty for patients with infrapopliteal disease and concomitant pedal/planter lesions. This is in contrary to Abdelhamid et al who performed all levels of angioplasty together with the pedal angioplasty[7]. Moreover, we believe that the addition of the management of proximal lesions could have an influence on the outcome.

We used an ipsilateral femoral access in all patients and tackled the lesion in an antegrade way. Another technique is to access the pedal vessel in a retrograde fashion "Transmetatarsal Artery Access". This technique appears to be appears feasible and beneficial in cases with a failed antegrade recanalization[8].

The main pedal-plantar connection is the pedal-plantar loop, which consists of the anastomosis of the dorsalis pedis artery in the first metatarsal space to the plantar arch and lateral plantar artery via the deep perforating artery[1 6]. We tried in every patient to get the best angiographic view of these vessels. This was obtained by injection of 5mL of diluted non-ionic contrast (2.5mL contrast + 2.5mL normal Saline) into a Bernstein catheter in the lower popliteal artery while the foot is slightly externally rotated and the flat panel detector positioned to have a lateral view of the foot. If this is not adequate, another antero-posterior projection is used. This technique is similar to Manzi et al who obtained adequate visualization of the pedal vessels by administering 9 mL of a 50% solution of the nonionic isosmolar contrast medium iodixanol with a power injector at a rate of 3 mL/sec through the sidearm of the femoral sheath (Manzi et al 2011). But they believe that a single projection is inadequate for complete depiction of the pedal vascular anatomy. Standard anteroposterior and lateral oblique projections should be obtained in all cases to allow visualization of the complex vascular anatomy of the foot[6]. They have established two criteria for correct positioning of the image intensifier: First, the base of the fifth metatarsal bone must be seen to project outward from the base of the foot in the

lateral oblique view; second, the first proximal metatarsal interspace must be clearly visualized in the anteroposterior view[6].

We recanalized all vessels through a transluminal route, making sure that no loop is formed, as we believe that passing into the subintimal plane at these small vessels carries a great risk of damaging the run off. Other studies used the subintimal route when the transluminal crossing fails[7 8 10].

No stents were used in our study. To the best of our knowledge only one study examined stenting of the pedal arteries for bailout indications (half of their patients). Self-expanding bare metal stents showed significantly higher restenosis and poorer primary patency. Moreover, in patients with balloon-expandable stents, stent deformation was recognized in (5 of 11 ,45%) of patients by x-ray during their follow-up imaging. Four stents were compressed, while the remaining one had experienced a complete fracture. All of these cases were associated with significant lesion restenosis and/or reocclusion[9].

Comparison of the primary patency following revascularization of stenoses was higher than that following revascularization of occlusions. Technical success and limb salvage were also better in stenoses, but this was not statistically significant, probably due to small number of cases. Katsonas et al had fifteen (35.7 %) of 42 of the inframalleolar lesions with chronic total occlusions, while 30 (71.4 %) of 42 lesions appeared to be moderately to heavily calcified[9], but they did not compare the outcome of the different morphologic patterns.

We performed dorsalis pedis angioplasty in 18 patients and planter artery angioplasty in 31 patients. Dorsalis pedis angioplasty showed worse outcomes, but we could not conclude an advantage of performing planter artery angioplasty as these results was statistically not significant.

Interestingly in one of the studies, dynamic imaging showed that the dorsalis pedis artery is kinked during foot dorsiflexion, whereas the distal posterior tibial artery is kinked during plantar flexion of the foot. Thus the morphology of the arteries changes according to the dynamics of the ankle articulation[9].

Neville et al believe that direct revarscularization of the angiosome specific to the anatomy of the non-healing wound leads to a higher rate of healing and limb salvage[5]. In this context, familiarity with angiographic technique, normal pedal vascular anatomy, and major anatomic variations of the pedal vessels is essential. In addition, knowledge of the functional aspects of the pedal circulation (angiosomes) is required to obtain optimal clinical outcomes[6]. The quality of subsequent wound care is also a critical component in promoting healing and avoiding further tissue loss[5].

In normal conditions, typically this pedal arch ensures the preservation of foot circulation even in case of occlusion of one of the two tibial feeding arteries. Usually the peroneal artery does not contribute to the anastomotic circulation, except for its small collateral branches named anterior and posterior perforating branches, connected with the anterior and posterior tibial artery, respectively. Due to the well-known inability of diabetics in creating efficient collaterals, plantar arch arteries become in fact functional end arteries so favoring the chance of necrosis formation even in case of a single tibial artery occlusion or plantar arch interruption[1].

It's worth mentioning that many patients with CLI will need minor forefoot or midfoot amputations to gain tissue healing avoiding. In these cases, the original foot vessel distribution and network can be interrupted because the surgical wound can cut or close the natural connections between the main dorsal and plantar blood supply. The dorsal and plantar systems, well connected before the amputation, can become “terminal” systems after foot surgery, losing the supply that every tibial artery gives to the other one in case of single tibial artery failure[2].

Peregrin et al. demonstrated that “complete” revascularization is better than “partial” revascularization: limb salvage rate at one year increased from 56 % without direct blood flow to the foot (0 leg vessel open) to, respectively, 73 %, 80 %, and 83 % with 1, 2, and 3 leg vessels open[11].

Endovascular recanalization of tibial vessels and foot arteries should be the first line treatment in patients with CLI, because of its good technical and clinical outcomes. Bearing in mind that it is possible in most cases, with the known low complication rate of PTA. In cases in which endovascular revascularization failed, all surgical options remain open[3]. This aggressive strategy

may be a salvage procedure for patients with CLI[10]. Katsonas et al concluded below the ankle angioplasty for CLI treatment is safe and feasible with satisfactory long-term results. Operators should bear in mind the unique anatomical characteristics of the distal tibial arteries when attempting below the ankle foot recanalization procedures[9].

Technical success rate and clinical outcomes of Endovascular treatment of pedal disease are encouraging, support the endovascular revascularization as the first treatment option and demonstrate that is a reasonable and effective approach. And interventionalists are now treating increasingly complex and diffuse patterns of disease because of the development of various endovascular devices and techniques. Usually only one technical strategy is not enough to treat crural and foot arteries and a combination of techniques improve the results of the procedures and allow to achieve excellent clinical outcomes[3].

It is essential to emphasize that a direct blood flow through one tibial artery with a good distal distribution system into the foot vessels can be a good and conclusive result of the revascularization for the majority of the patients. A good distal distribution system must always be respected and, if possible, not touched. The benefit of BTA angioplasty must be balanced with the risk of damaging the forefoot distribution system by the crossing with wires and balloons[12].

CONCLUSION

Midterm results show satisfactory outcome of the BTA angioplasty. The technique is emerging as an effective and safe treatment option to improve the results of revascularization.

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