Egyptian Journal of Surgery Vol. (22), No. (4), Oct., 2003

SARTORIUS MUSCLE ROTATION-TRANSFER (SMRT) IN PROPHYLAXIS AGAINST GRAFT INFECTION AFTER REOPERATIVE GROIN VASCULAR PROCEDURES

By

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Aim of Work: *to study the feasibility of the use of sartorius muscle twist or SMRT as a prophylactic step against graft infection following reoperative vascular procedures of the groin, especially in diabetic patients.*

Patients and Methods: *between March 1999 and December 2002 fifty eight patients in whom different vascular grafting procedures including anastomoses at the groin, presented with either graft thrombosis, haematoma or seroma in the groin during the first postoperative month and needed re-exploration of the groin. In 16 diabetic patients, sartorius muscle "twist" or SMRT was added at the end of the re-exploration (group A), while for the other 42 patients this procedure was not added (group B). SMRT was done by retraction of the upper end of the groin incision or extension of it upwards and laterally, and then the tendenous origin of the muscle is detached and the loose areolar attachments of the lateral portion of the muscle were incised and then it was rotated 180o along the medial border, so that the anterior surface of the muscle is now covering the femoral vessels. The proximal portion of the muscle was then sutured to the inguinal ligament and the "new" medial border was sutured to the perivascular or subcutaneous fascia. Suction drain was applied to drain the dead space at the original bed of the muscle. The number of vascular pedicles ligated in each case, the time needed to complete the SMRT procedure, any intraoperative or postoperative complications were recorded. Cases were followed up for a maximum of 6 months or until groin graft infection, secondary hemorrhage or thrombosis occurred.*

Results: *In group (A) extension of the groin incision was needed in 38% of cases and in 56% of cases one vascular pedicle was ligated. The average time needed to complete the procedure was 22 minutes and there was no operative or postoperative mortality related to the procedure, however, wound haematoma occurred in one patient and it was drained. Only 14 patients were followed up, and of them one patient developed graft infection due to extension of infection from the subcutaneous track of in-situ saphenous bypass, while the other 13 patients passed very smooth postoperative course with healed groin incisions. In group (B), 39 patients were followed up. Graft infection developed in 23% of cases, treated with above knee amputation in 17%, with obturator bypass in 3%, and with ligation of the graft and the femoral artery above and below the anastomosis in 3%.*

Conclusion: *sartorius muscle "twist" or SMRT is a useful procedure to prevent graft infection after reoperative vascular procedures of the groin, especially in diabetic patients. The procedure is easy to perform, safe and leaves the patient with no disability.*

INTRODUCTION

Vascular graft infections are among the most threatening complications faced by vascular surgery patients and are often among the most technically challenging problems confronting the vascular surgeon. The impact of an infected vascular graft on the patient is often devastating, with high mortality and limb loss rates [(1).] This feared vascular complications occurs most commonly in the groin and has resulted in predictably high rates of graft failure, loss of limbs, and even mortality [(2&3).]

Reoperation for haematoma or graft thrombosis represents one of the important causes of graft infections in the groin and it reflected the higher frequencies of arterial wall and wound colonization with bacteria, and increased rates of wound complications [(4).] Reoperative vascular procedures represent one of the important causes of both early and late-appearing graft infections.

Based on the fact that vascularized flaps, usually including skeletal muscle, can "sterilize" infectious foci, the

sartorius muscle rotation-transfer (SMRT) or "twist" has been used successfully to treat localized groin wound complications after various vascular procedures [2&5]. The aim of this article was to study the feasibility of the use of SMRT as a prophylactic step against graft infections after reoperative vascular procedures of the groin, especially in diabetic patients.

PATIENTS AND METHODS

Between March 1999 and December 2002, fifty-eight patients in whom ilio-femoro-popiteal, femoro-popliteal or femoro-distal bypasses were done presented with either thrombosis of the graft, haematoma, or seroma in the groin during the first postoperative month and so the groin was re-explored and the underlying pathology (thrombosis or haematoma) was corrected. In 16 diabetic patients (out of 58), SMRT was added to cover the anastomosis in the groin at the end of operation (group A), while this additional procedure was not done in the other 42 patients (group B). There were 12 men (75%) and 4 women (25%) in group A (male: Female = 3:1), and 30 men (71%) and 12 women (29%) in group B (male : female = 2.5:1). The mean age in group (A) was 57.56 (+ 4.97), while it was 57.64 (+5.91) in group (B). Diabetes was a risk factor in 100% (16 patients) of group A, and in 67% (29 patients) of group (B). The types of bypasses in group (A) were: Femoro-upper popliteal bypass with PTFE in 3 cases (18.75%) and femoro-popliteal bypass with reversed saphenous vein in 7 cases (43.75%) femoro-infrapopliteal bypass with in-situ saphenous vein in 3 cases (18.75%), ilio-femoro upper popliteal bypass with Dacron graft in 3 cases (18.75%). So, in group (A) native vein (saphenous vein) was used in 10 limbs (62.5%), while synthetic graft was used in 6 limbs (37.5%). In group (B) the types of bypasses were: femoro-upper popliteal bypass with PTFE in 9 limbs (21.4%), femoro-lower popliteal bypass with reversed saphenous vein 18 limbs (42.8%), femoro-infrapopliteal bypass with in-situ saphenous vein in 10 limbs (23.8%) and ilio-femoro-popliteal bypass with Dacron graft in 5 limbs (11.9%). So, in group (B), the saphenous vein was used in 28 limbs (66.6%), while synthetic graft used in 14 limbs (33.3%).

The cause of re-exploration of the groin in group (A) was thrombosis of the graft in 13 limbs (82%), accumulating haematoma in 2 limbs (12%) and seroma in one limb (6%). Thrombosed grafts were managed by thrombectomy and correction of the narrow proximal anastomosis with vein-patch angioplasty in 4 limbs (25%), thrombectomy and release of constricting bands in the tunnel in 3 limbs (18%) , thrombectomy and "bridge" graft between the graft and a lower patent artery in 5 limbs (31%), and thrombectomy alone in one limb (6%) as thrombosis was due to postoperative haemodynamic instability. In the 2 limbs presented with postoperative groin haematoma, the bleeding points at the groin anastomosis were secured with sutures, after drainage of the haematoma, while in the case of seroma, it was evacuated and sclerosing material was injected locally. In group B, the causes of re-exploring the groin were thrombosed graft in 37 limbs (88%), and haematoma in 5 limbs (12%). Thrombosed grafts were also managed with thrombectomy and correction of groin anastomosis in 7 limbs (17%), correction of the tunnel in 11 limbs (26%), and bridge graft, as before, in 19 limbs (45%). Haematoma in the remaining 5 patients (12%) was also managed as before.

In group (A) only, SMRT was done at the end of the vascular procedure. Adequate exposure of the tendenous origin of the muscle from the anterior superior iliac spine could be done by retraction of the superior aspect of the groin incision or its extension laterally and superiorly. The tendinous origin was transected by electrocautery, and the loose areolar attachments of the lateral portion of the muscle were incised. As the sartorius muscle is supplied in a segmental fashion (type IV) [6], from 8:11 segmental vascular pedicles, which arise from the superficial femoral artery in the thigh and enter the muscle from its postero-medial surface [5], it could be mobilized medially by means of blunt and sharp dissection and rotated 180 degrees along its medial border. Division of the most cephaled pedicle is occasionally required to permit complete rotation of the muscle flap and this could be accomplished without compromising the viability of the muscle, if the remaining blood supply is left undisturbed. As this was done, the anterior surface of the sartorius muscle is now covering the exposed groin vessels and the attached graft. The proximal portion of the muscle was then sutured to the inguinal ligament and the "new" medial border was sutured to the perivascular or subcutaneous fascia. Suction drain was applied to drain the dead space at the original bed of the muscle and then the wound was closed in layers [5] (Fig.1:4). The number of vascular pedicles ligated in each case to allow free twist of the lateral border of sartorious along the medial border was recorded and the additional time needed to do SMRT in each operation was calculated, together with any intraoperative or postoperative complications related to this procedure. The hospital stay after SMRT was also calculated. Cases were followed up for a maximum time of 6 months, or until groin graft infection, secondary hemorrhage or thrombosis and the incidence of graft infection was compared to those of group (B).

RESULTS

The average time needed to complete SMRT procedure was 22 minutes on the average (range from 15 to 33 minutes). Extension of the groin incision superiorly and laterally was needed in 6 patients (38%) only. In 9 cases (56%) one vascular pedicle was ligated in each case while in the 7 cases (44%) no vascular pedicle was ligated to

allow free twist.

There was no operative or postoperative mortality related to the SMRT. No operative complications was recorded, however, wound haematoma developed in spite of the presence of a suction drain in one patient (6%), and was due to bleeding from unsecured proximal vascular pedicle. Two cases (12%) developed graft thrombosis again in the early postoperative period due to outflow obstruction and above knee amputations were done for them.

As regards to the other 14 cases, only one patient (7%) developed graft infection due to extension of infection along the subcutaneous track of the in-situ saphenous femoro-infrapopliteal bypass and needed ligation of the graft and the artery and then above knee amputation. revealed a well-vascularized flap.

However, exploration of the sartorius flap in this case The other 13 patients (93%) passed very smooth postoperative course with healed groin incisions, and discharged from the hospital at 17 days on the average (range 12:21 days). In group (B), graft rethrombosis ending in above knee amputations occurred in 3 patients, so 39 patients were followed up. Graft infection developed in 9 patients (23%) treated with above knee amputation in 7 patients (17%), and with obturator bypass in one patient (3%), while in one patient (3%), ligation of the graft and the femoral artery above and below the anastomosis was done and heparin therapy succeeded to keep the limb viable. Exploration of the femoral triangle in the 9 cases revealed localized supurative infection eroding the suture lines in all the cases.

Table (1): ***Descriptive statistics.***

		Group A	*Group B*
Sex	Male	12 (75%)	30 (71%)
	Female	4 (25%)	12 (29%)
Mean age		57.56 ± 4.97	57-64±5.91
Diabetes		16 (100%)	(29) 69%)
Types of bypasses			
Femoro-upper popliteal with TFE		3 (18.75%)	9 (21.4%)
Femoro-lower popliteal with reversed saphenous		7 (43.75%)	18 (42.84)
Femoro-infrapopliteal with in-situ saphenous		3 (18.75)	10 (23.8%)
Ilio-femoro-upper popliteal		3 (18.75)	5 (11.9%)
Total types of grafts			
Saphenous vein		10 (62.5%)	28 (66.6%)
Synthetic		6 (37.5%)	14 (33.3%)
Causes of re-exploration			
Thrombosis		13 (82%)	37 (88%)
Haematoma		2 (12%)	5 (12%)
Seroma		1 (6%)	

Table (2) ***:Results of SMRT procedure.***

Item		
Number of ligated vascular pedicles:	one	9 (56%)
	no	7 (44%)
Added time to the procedure		22 minutes (15:33 minutes)
Need to extend the incision		6 cases (38%)
Mortality (operative and postoperative)		0 (0%)
Postoperative haematoma		1 patient (1/16 = 6%)
Follow up		14/16 patients (88%)
Graft infection		1/14 (7%)
Hospital stay		17 (12:21 days)

Fig.(1): The origin of the sartorius muscle is transected (arrow). The graft connected to the femoral artery appears in the medial aspect of the incision (dashed arrow).

Fig.(2): The sartorius muscle, lateral border is twisted medially to cover the femoral vessels.

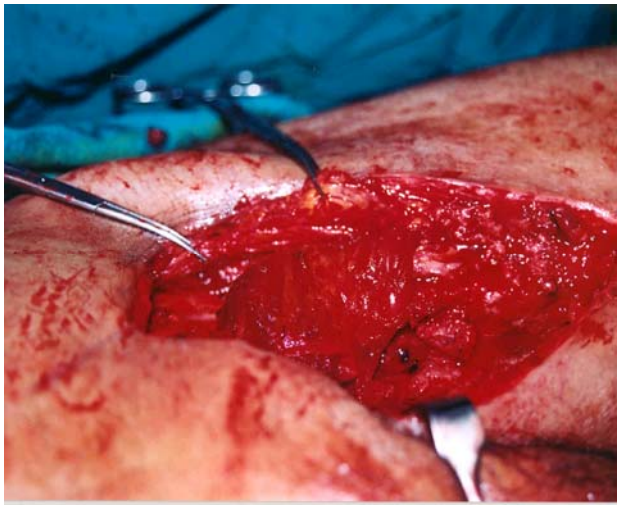

Fig.(3): The lateral border is sutured medially to completely cover the vessels

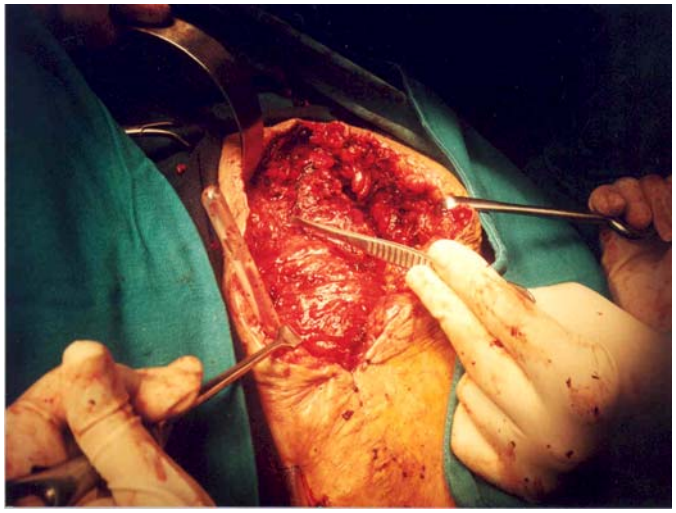

Fig.(4): Another case of sartorius "twist" covering the femoral vessels

DISCUSSION

The most common site for graft infections in reconstructive peripheral vascular surgery is the groin [3&7]. Groin wound infections can jeopardize patency and function of vascular bypass grafts anastomosed to the femoral artery [8].

Reoperation for management of vascular complications represents one of the important predisposing factors of early graft infection of the groin. The increased risk of infection after reoperative vascular procedures reflects the higher frequencies of arterial wall and wound colonization and increased rate of wound complication [4]. Reoperation in itself represents a break in preventive measures the vascular surgeon usually do to prevent graft infection. The usual preoperative measures against graft infection includes short preoperative hospital stay to avoid skin colonization with bacterial flora resistant to commonly used antibiotics (hospital-acquired strains), prophylactic antibiotics administration, attention to meticulous sterile techniques during surgery, and closure of the wound in layers to

prevent dead space formation [4]. Reoperation is usually associated with a significant period of hospital stay, and so more bacterial colonization, re-closure of the inguinal wound in layers may be difficult due to tissue edema already developed during previous surgery, or insufficient local subcutaneous tissues especially in diabetic obese subjects, and the poor general condition because of the cause indicating reoperation. Because of all of that, reoperation should be treated as a high risk factor for development of graft infection, and groin wound in this case, should be considered "potentially infected" wounds.

Since, May et al [9] demonstrated that muscle flaps can "sterilize" infectious wounds, there was accumulating evidence in the literature to support its use in treatment of graft infections of the groin, which gives many advantages. It provides a well-vascularized bed for the protection and incorporation of the graft. Muscle flaps increase local tissue oxygenation and phagocytic activity, decreasing bacterial counts, augmenting the delivery of antibiotics to the site, and eliminating dead space [2]. Muscle flaps provide an excellent base should secondary grafting be required [5]. The use of sartorius muscle to cover the femoral arteries and grafts anastomosed to them seems appealing idea because of the unique anatomic relationship to the femoral vessels in the groin and the thigh. As the sartorius muscle forms the roof of the adductor subsartorial canal through which the superficial femoral vessels pass through, and also through which the femoro-distal grafts are intended to pass through, but do not include the common femoral arteries where anastomosis are usually done, rotation of the upper most part of the sartorius medially to cover these latter vessels, seems as if the subsartorial canal is elongated proximally. The usual groin incision needs only retraction at its uppermost part or some extension to detach the origin of the sartorius muscle. The procedure is easy to be done and not time consuming. It also does not need other incisions for it to be done, as other flaps e.g. rectus abdominal flap, and it maintains hip function after its use. The use of sartorius muscle offers also very good results in long-term follow-up and it is simple, safe and durable [2,5,10,11,12].

The sartorius muscle is supplied from 8-11 segmental vascular pedicles (type IV)[6], which arise from the superficial femoral artery in the thigh and enter the muscle from its postero-medial surface [5], the best technique to preserve most of the sartorius vascular pedicles and to cover a good area of the femoral vessels is the rotation-transfer technique, as that modified by Meyer et al [5].

In this study, SMRT was used to cover the femoral vessels and the grafts anastomosed to them, in 16 diabetic, patients in whom reoperation during the first postoperative month was indicated and the procedure was proved to be effective in prevention of graft infection in 92% of the patients who were followed up to a period of 6 months (13 patients out of 14). The procedure failed to prevent graft infection in one case, and this was not due to failure of the procedure itself, as the muscle remained vascularized. The infection started in the subcutaneous tract where the in-situ saphenous bypass passed through and then extended to the groin.

Adding SMRT to the reoperative vascular procedure did not complicate the original procedure. As SMRT does not need special surgical expertise, it can be done by the main vascular surgeon or one of his team under his supervision. The procedure, in this study, only took 22 minutes on the average to be completed (range from 15 to 33 minutes). The only needed complementary step was to put a suction drain at the original bed of the sartorius muscle, which could also be used to drain the femoral triangle around the femoral vessels and the graft anastomosed to them. The functional deformity after detachment of the sartorius from its origin was negligable.

The criticism raised against the use of sartorius to cover groin vascular graft is mainly due to its shortage in prevention of infections starting above the inguinal ligament e.g. in aorto-femoral bypass [13]. It is thought that the main danger in these cases is graft infection occurring in the groin, it is the comments type and the groin is always the main station in lower limb revascularization either this procedure is original one or reoperation. Necrosis of the sartorius muscle is another criticism after sartorius myoplasty [14], however, this can be expected to occur if the procedure was done by the old technique of cutting and ligation of the upper vascular pedicles connected to the medial border and medial rotation of the whole muscle, as in this case, the lower vascular pedicles might be unable to provide adequate blood supply to the upper most segment of the muscle, and so it might die. On the other hand, the use of SMRT procedure preserve almost all of the blood supply to the muscle and proved to be in this study as well as in other literature, the procedure of choice. In this study, no more than one vascular pedicle was ligated and so most of the arterial supply to the muscle was preserved.

On the other hand, the use of sartorius twist or SMRT on a prophylactic basis has many advantages; the most important is the coverage of the exposed vessels and elimination of dead space, from the wound [1]. Formation of dead space allows the accumulation of potentially infected fluids around the vessels especially lymphatic fluids from unrecognized injured lymphatics and so allows the development of bacterial flora. Another advantage is that it limits the bad sequel of groin wound disruption, as it prevents exposure of the vessels in this case. Moreover, it provides a bed for skin coverage if indicated.

The prophylactic use of sartorius muscle to cover the femoral vessels was the original use of this muscle as

described by Baronofsky in 1948[15] after inguinal node dissection, and it is also recommended by Meyer et al [5].

Reoperative vascular procedures of the groin, especially in diabetic patients, is one of the highest risk factors of graft infection, which might endanger the life of the patient, or at least jeopardize the function of the limb. Because of that, every effect should be done to guard against its occurrence. SMRT procedure should be considered one of the armamentaria available for the vascular surgeon to be used in such situation. The procedure is safe, effective and does not complicate the original vascular procedures.

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