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Omental Transplantation for Peripheral Vascular Disease - Our Experience

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ABSTRACT

Introduction /Aim: The objective of this paper is to study the efficacy of omental transplantation in peripheral vascular disease.

Results: This study is a prospective study done on a group of 30 patients. This study constituted patients of the age group between 23- 50 years. The patients were all male. The patients were Beedi smokers (A beedi is a rolled up tobacco without filter) and on an average the patients smoked between 10- 30 beedis per day. The chosen cases did not have posterior tibial, anterior tibial and dorsalis pedis artery pulsations. In 20 of our cases, popliteal artery pulsation was absent. 11 cases had non-healing ulcers and 20 had dry gangrene of toe/toes or forefoot, with rest pain. The patients were assessed at post operative day 7, at 1 month and 3 months after the procedure. Intermittent claudication was relieved in 25 patients (83%). Rest pain which was present in 15 patients (50%) before the procedure was relieved in all the patients at the end of 3 months (100%). Healing of ulcer occurred in 10 out of 11 patients (91%). The healing of amputated toe site occurred in 15 out of 20 patients during 3 months follow-up (75%). The O2 saturation measured by pulseoximetry measured in all patients increased from 72% on an average to 94% after 3 months of follow-up.

Conclusion: Patients presenting with terminal limb ischemia due to Thromboangitis Obliterans often have no hope for limb salvage, for such cases, omental transplantation offers a procedure which can result in improved limb circulation and limb salvage. The level of omental transplantation had no bearing on the improvement in symptoms thereby supporting the potency of omental pedicle graft to induce neoangiogenesis and thereby improving circulation of surrounding tissues.

Keywords: Omentum, Omentoplasty, Omental transplant, Omental transposition, Peripheral Vascular disease, Burgers disease, Thromboangitis Obliterans

Introduction

Daniel (1971) hoped omental transfer for revascularization of extremities will postpone amputation. Casten and Alday first studied omental transplantation¹⁹. Alday and Goldsmith gave an excellent description of technique of omental lengthening.

Morrison described omentum as “Policeman of the abdomen”. As it wraps around the structures like gall bladder, appendix and revascularises these structures when deprived of their blood supply.

Hoshino¹⁸ classified the omentum as

Type I –Single layered omentum

Type II –Double layered omentum

Goldsmith discovered lipid fraction from the omentum which exerts angiogenic properties. Omentoplasty acts by increasing the collateral circulation as it contains Angiogenic factor.^{20, 21}

Mechanism of Action

When the procedure was introduced for patients with atherosclerosis by Casten and Aldy¹⁹, it was thought that omental transposition works by supplying extra blood to the ischemic limb. However, this is difficult to believe, as the diameter of omental vessels is roughly one-tenth of the popliteal artery. Later studies^{6, 7, 8,9,10} have demonstrated that the possible mechanism of action of omental transfer is an increase in local collateral circulation rather than any significant increase in blood flow. Goldsmith et al. have demonstrated that the omentum contains a lipid fraction which promotes neovascularisation. Thus a local action on limb musculature with increased local collateral circulation may be a possible mode of action.^{20, 21}

Omentum has been known to adhere to surrounding structures and develop connections with them, Hoshino et al. have seen in limbs amputated after omental transplantation that there were vascular connections of omentum with limb vasculature¹⁸. Babu et al have seen, in the limbs amputated after omental transplantation, revascularization of muscle from omental vessels growing into it.¹⁵

Aggarwal et al. performed postoperative angiography in 50 patients who underwent omental grafting and observed increase number of collaterals at graft site with filling

of vessels distal to the block in the limbs. In an extension of the same study, 20 dogs underwent allograft omental transfer in limbs after ligation of the femoral artery in 10 of these, at the end of three weeks exploration of the graft site revealed increased number of collaterals at the graft site with filling of vessels distal to the site of the block. The authors concluded that even a blood group and human leukocyte antigen mismatched omental graft is taken up and revascularises the ischemic limb.¹⁴

Subodh et al. performed post-operative Doppler studies and selective celiac axis angiography to study the circulation in the omental graft. In 18 of their 20 cases, the arterial pulsations were heard till the knee on Doppler study. In 2 cases in which they were not heard, there was no improvement in symptoms. However on celiac-axis angiography, the omental vessels were visualized till the thigh in only six and upto the knee in only four patients. The authors concluded that omental transposition probably works by promoting local collateralization. Similar conclusions were drawn in another study comparing free versus pedicled omental graft.¹⁶

Materials and Methods

A total of 30 patients were part of this study. The age group of the cases was between 23-50 years. All the cases studied were male. The patients were Beedi smokers (A beedi is a rolled up tobacco without filter) and on an average the patients smoked between 10- 30 beedis per day. The chosen cases did not have posterior tibial, anterior tibial and dorsalispedis artery pulsations. In 20 of our cases, popliteal artery pulsation was absent. 11 cases had non-healing ulcers and 20 had

dry gangrene of toe/toes or forefoot, with rest pain. (Table 2)

Obese and diabetic patients have not been selected since, the delineation of omental vascular pattern is difficult in obese patients and diabetic would usually have associated coronary disease and are more prone for infection. (Figures 1, 2, 3)

In the post operative period, patient were given parenteral nutrition for 48 hours and switched on to oral feeds once the peristalsis returns. Routine antibiotics and analgesics were given. Patient was advised to keep the limb in extension for 2-3 days and allowed to bear weight on 4th or 5th day onwards. On 10th day, sutures were removed and patient is made to walk.

All patients underwent a Doppler scan of the lower limb prior to Surgery. The Doppler study was done to mainly demonstrate the block and the flow in the distal vessels

Assessment of the Effect of Omentoplasty

The criteria used to assess
Subjective: Symptomatic improvement.

Objective:

- 1) Improvement in the local skin temperature
- 2) Healing of ulcers and amputation site.
- 3) Measurement of oxygen saturation by pulseoximetry

The patients were assessed after 7 days, 1 month and 3 months after undergoing the procedure.

In all patients pulseoximetry was used to measure pre and post-operative O₂ saturation.

Results

Observations

The youngest patient in the study was 23yrs old and the oldest 50yrs old. All of the studied patients were male. All of the patients were from low socio-economic status. Most of them were manual labourers.

Clinical Presentation

None of the patients were on any medications except oral analgesics before admission. All the patients in the study were non-diabetic and normotensive at the time of admission.

Habituations

All the patients in our study were beedi smokers (100%) (Beedis are rolled up tobacco without a filter) .15 (50%) of them were also occasional alcoholics. 5 (17%) of them also used smokeless tobacco in pan chewing.

Duration of smoking

Around 54% of patients smoked beedis for 10-20 years

Amount of smoking

77% of patients smoked 10-30 beedis/day

Peripheral arterial pulsations

The pulses were assessed both by clinical examination and a hand held Doppler probe.

Correlation of symptoms with signs

All the patients in the study presented with symptoms involving only one lower limb. But during clinical examination, 50% of patients, also had involvement of opposite lower limb also 3% of them had clinical involvement of upper limb also.

Level of omental transplantation

See Table 8.

Complications

In post operative period, 10 patients had post operative infection of wounds. All of these patients were treated with regular dressing and antibiotic according to culture and sensitivity reports. 70% of these patients responded with this treatment. In 30% of these patients infection was associated with necrosis of omentum.

Duration of Hospital Stay

Duration of hospital stay varied from 18-90 days. Most of the patients stayed for 20-35 days. The length of post operative stay was increased in the patients due to wound infections and due to no improvement following the procedure in 3 patients.

During follow-up the patients were assessed at 7th day, 1 month and 3 months following intervention.

O₂ Saturation by pulseoximetry was also measured in toes during follow-up examination in 10 patients.

Analysis

All the 30 patients in this study were males in the age group of 23-50 yrs. Mean age of the patient being 36.5 yrs (**Table 1**). History of smoking was present in all the cases. Around 70% of patients smoked for more than 10 yrs (**Table 4**). About 77% of patients smoked 10-30 beedis/day (**Table 5**). Chief symptoms were intermittent claudication, rest pain, gangrene of toes and ulceration at tip of toes or foot (**Table 2**).

No patient underwent lumbar sympathectomy prior to omental transplantation. Clinical manifestations of the affected limb revealed absence of dorsalis pedis and anterior tibial in all the 30 patients, absence of posterior tibial

in 28 patients and popliteal in 20 patients. Femoral pulsations were present in all patients. The disease was restricted to one lower limb only in 50%. In 47% it involved bilateral lower limbs and only in 3% bilateral lower limbs with upper limb (**Table 6**).

Omental transplantation along with lumbar sympathectomy was done as a single stage procedure in 66% of patients. In 33% of patients only omental transplantation was done. The procedure was well tolerated by all the patients and there was no intra and post operative mortality. Omental transfer was possible up to below the knee in 71% of patients. However, in 23% of patients, omentum could be lengthened only up to above knee level. The time taken for surgery ranges between 2-3hrs (**Tables 7-8**).

Amputation of toes was done simultaneously in all the 20 patients who presented with gangrene of toes.

The patients were assessed post operatively in form of;

Subjective – Improvement in intermittent claudication and rest pain.

- Improvement

i. Objective - Increase in skin temperature

- Increase oxygen saturation as measured by pulseoximetry

During follow up, the patients were assessed at post operative day 7, at 1 month and 3 months after the procedure. Intermittent claudication was relieved in 25 patients (83%). Rest pain which was present in 15 patients (50%) before the procedure was relieved in all the patients at the end of 3 months (100%). Healing of ulcer occurred in

10 out of 11 patients (91%). The healing of amputated toe site occurred in 15 out of 20 patients during 3 months follow-up (75%). The O₂ saturation measured by pulseoximetry measured in all patients increased from 72% on an average to 94% after 3 months of follow-up (**Tables 10 – 11**).

In 10 patients in our study, a postoperative complication in form of wound infection was noticed. In 7 of these patients (70%) the wound infection was minor and responded to the treatment given. In rest 3 of these patient (30%), necrosis of the omentum occurred which was associated with wound infection. In these patients the symptoms did not subside. All of 3 patients eventually required major amputations. No other complication was encountered in this study (**Table 9**).

Discussion

Burger's disease (Thromboangitis Obliterans) continues to be a major surgical problem. Its treatment has remained an enigma and multiple strategies have been employed. Drug therapy is of benefit only in early stages. Surgical treatment options have consisted of sympathectomy, direct arterial surgery, adrenalectomy and amputation as a last resort. With the exception of smoking, none of these measures is curative and conflicting results have been obtained.

However, in patients with critical limb ischemia, surgery is required to salvage the limb. Traditionally, patients who have ischemic signs and symptoms have been offered sympathectomy despite the fact that relapses are frequent due to normalization of vasomotor tone within 2 weeks to 6 months after operation. Arterial reconstruction is usually impossible due to distal nature of the disease and carries a high failure rate. In patients who are in imminent danger of

requiring major amputation, omental pedicled transplantation is a viable alternative for limb salvage and also significantly improves signs and symptoms.

Greater omentum is a primitive part of gastrointestinal system containing a vast network of blood supply and lymphatics, even if deprived of its own blood supply it might survive by attacking arteries in the vicinity. Goldsmith et al.^{20,21} discovered a lipid fraction from the omentum with angiogenic influences. This property of omental pedicle graft to induce neo angiogenesis and thereby improving circulation of surrounding tissues has been well established. Hence omentum has been used to revascularise the ischemic limb^{7, 8, 9, 10, 11}. Nishimura et al. showed an increase in muscle blood flow during exercise and reactive hyperemia by using xenon (Xe 133) clearance study².

Babu, Menon, Vaidyanathan (in 1990) obtained relief in intermittent claudication in 92% patients with TAO, relief in intermittent claudication in 92% patients with TAO, relief from rest pain in 86% , healing of ulcers in 100% of their patients. 14% of their patients required major amputation¹⁵

Ranwaka, Sharma (in 1999) obtained relief in intermittent claudication in 86.6%, relief from rest pain in 66.6% and healing of ulcers in 80% in their patients.¹⁷

The results in our study are consistent with these results of some previous studies as shown in Table 12.

The mechanism by which omentopexy increases vascularity of the ischemic limb is not exactly known. Probably omental transposition works by promoting local collateralization, since omentum is known to possess angiogenic factor, which stimulates the formation of capillary channels making

available collateral channels in the existing circulation.

Subodh et al. (1994)¹³ tried to find out the mechanism by which the omental graft increases the blood supply to the limbs. They performed Doppler ultrasound studies and celiac digital subtraction angiography to study the circulation through the omental graft. Only in 6 out of 12 patients could they visualize omental vessels till mid-thigh and only in four up to the knee joint. They concluded that omental transposition acts not by significantly supplying extra blood to the limbs but by acting locally on the limb musculature and probably causing increased collateral circulation.

Although in the absence of such investigating facilities and financial constraints, we were not able to visualize omental vessels but we could certainly appreciate an excellent symptomatic relief obtained in these patients. There was immediate relief of pain; the progression of gangrene stopped, and ulcers healed, a major amputation was avoided in 90% of patients.

Another interesting finding in the present series was that most of the patients experienced pain relief, immediately following surgery. Possible causes may be (i) Psychological relief that operation has been performed (ii) Bed rest (hospital admission) (iii) Supervision and almost complete stoppage of smoking leading to remission of the disease (iv) lumbar sympathectomy performed simultaneously in 2/3rd of the patients.

In the present study, objective tests were carried out to see improvement in circulation. Skin temperature increased in 90% of patients. Pulseoximetry, an excellent method of assessing limb perfusion revealed a clear benefit in tissue oxygenation after pedicled omental transplantation.

Conclusion

- Patients presenting with critical limb ischemia due to thromboangitis obliterans often have no hope for limb salvage, for such cases, omental transplantation offers a procedure which can result in improved limb circulation and limb salvage.
- The level of omental transplantation had no bearing on the improvement in symptoms thereby supporting the potency of omental pedicle graft to induce neoangiogenesis and thereby improving circulation of surrounding tissues.
- This is a fairly simple operation, which can be performed by general surgeons. This operation does not need special instruments and can be done in all general hospitals. The postoperative care is also simple; post operatively Ryle's tube aspirations are done periodically due to presence of Gastric ileus. Secondly, wound inspection should be done to look for any infection/ discharge from the wounds.
- Single stage lumbar sympathectomy and omental transplantation is a better procedure in end state Thromboangitis obliterans with the advantages of a single stage operation and low cost.
- Immediate improvement in symptoms cannot just be explained in psychological basis as was demonstrated by increase in skin temperature and improved tissue oxygenation by pulseoximetry.
- The present study has shortcomings in form of (i) short duration of follow up (ii) no Doppler or angiographic evidence during follow up (iii). No histological

proof of neovascularization of muscles. The present study, however, proved beyond doubt, the role of omental transplantation in clinical improvement and as a limb salvage procedure in Burger's disease.

- By this surgery the pathological progress of the disease cannot be stopped but it can be delayed significantly.

However much work needs to be done in this field. The question regarding the mechanism of action of omentum needs to be answered. Long term prospective randomized and controlled trials with longer follow up are required to establish this procedure as the first line of management in patients with Burger's disease.

Conflict of Interest: None

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Table 1: Age groups of patients studied

Age group(in years)	No. of patients	Percentage (%)
20-30 yrs	6	20%
30-40 yrs	13	43.3%
40-50 yrs	11	36.6%

Table 2: Clinical Presentations of various cases

Symptoms	No. of patients	Percentage (%)
Intermittent claudication	30	100%
Rest pain	15	50%
Ulceration	11	37%
Gangrene	20	66%
Sensory symptoms (e.g.: paraesthesias)	7	23%

Table 3: Habituations of the patients

Addiction	No. of patients	Percentage (%)
Smoking	30	100%
Alcohol	15	50%
Smokeless tobacco	5	17%

Table 4: Duration of Smoking

Duration of smoking (in yrs)	No. of patients	Percentage (%)
≤10 yrs	9	30%
10-20 yrs	16	53.3%
20-30 yrs	5	16.6%

Table 5: Duration and amount of smoking

Duration of beedis smoked	No. of patients	Percentage (%)
<10 yrs	6	20%
10-20 yrs	12	40%
20-30 yrs	11	37%
>30 yrs	1	3%

Table 6: Peripheral arterial Pulses

Arterial Pulsation	Absent	Weak	Normal
Dorsalis Pedis Artery	30	—	—
Anterior Tibial Artery	30	—	—
Posterior Tibial Artery	28	2	—
Popliteal Artery	20	8	2
Femoral Artery	—	3	27

Table 7: Extent of the disease

	No. of patients	Percentage (%)
Disease restricted to one limb	15	50%
Disease involving B/L lower limbs	14	46.6%
Disease involving B/L lower limbs and upper limbs	1	3.3%

Table 8: Level of omental transplantation

Level of transplantation	No. of patients	Percentage (%)
Above knee	7	23%
Below knee	21	71%
Above ankle	2	6.0%

Table 9: Duration of Hospital stay

Duration of hospital stay	No. of patients	Percentage (%)
<2 days	1	3%
20-30 days	20	67%
30-40 days	4	13.5%
>40 days	5	16.5%

Table 10: Follow up Results

Symptom	At time diagnosis		7 th day		1 st Month		3 rd Month	
	No.	%	No.	%	No.	%		
Intermittent claudication	30	100%	20	66%	8	27%	5	17%
Rest pain	15	50%	8	27%	5	17%	-	-
Healing of ulcer	11	37%	11	37%	8	27%	1	3%
Healing of amputated site	20	66%	20	66%	13	43%	5	17%

Table 11: Oxygen Saturation of the limb during follow up

O ₂ Saturation of limb	At the time of diagnosis	7 th day	1 st month	3 rd month
	72%	80%	90%	94%

Table 12: Comparison of Our Study with previous results

Symptoms	% improvement		
	In present study	Baby(1990)	Ranwaka (1999)
Intermittent claudication	83%	92%	86.6%
Rest pain	100%	86%	66.6%
Ulcer healing	91%	100%	80%



Figure 1: Omentum being mobilized



Figure 2: Omentum mobilized to reach till below knee



Figure 3: Skin incisions made on the limb for subcutaneous tunneling of the Omentum