DISTAL REvascularization – INTERVAL LIGATION: AN EFFECTIVE TREATMENT FOR LIMB SALVAGE AND MAINTENANCE OF DIALYSIS ACCESS IN ISCHEMIC STEAL SYNDROME

By
Amro H. Morsy*, MD., Mohamed A. Bayomi**, MD.,
and Mohamed K. Alamary***, MD.
Department of Surgery *El-Minia Faculty of Medicine,
**Al-Azhar University and ***South Vally University

ABSTRACT:

Purpose:
Dialysis access associated steal syndrome is an uncommon complication after creation of an arteriovenous fistula specially proximal one. Manifest steal syndrome has been managed with several procedures in the form of banding or ligation. Unfortunately, these techniques usually result in loss of a functional vascular access, inconsistent limb salvage or both. We report our experience with an alternative method of limb revascularization that eliminates steal while maintaining continuous dialysis access.

Methods:
A retrospective review was performed for reports of all patients who underwent distal revascularization-interval ligation (DRIL) procedure for access induced hand ischemia. The study was conducted between June 2000 and April 2004. Data regarding type of vascular access, timing of hand ischemia, access and bypass patency, limb salvage and patient survival were collected.

Results:
We reported an incidence of 2.5% of hand ischemia following proximally situated autogenous access procedure. We performed 18 DRIL procedures in 18 patients (11 female and 7 male), mean age 59 years (21 to 82 years). Hand ischemia was diagnosed within 30 days of the access procedure in 6 patients. Twelve patients had chronic ischemia, with tissue loss in 2, dry finger gangrene in 2, and dialysis induced ischemic pain in 8 patients. Primary access procedures were brachio-cephalic in 14 patients and brachio-basilic with superficialization in 4 patients. Follow up period was ranged from (1-36 months), mean 8 months. Immediate relief of ischemic manifestation was in all patients. Patency rate of bypass graft was 94%, with 89% patency rate for primary access procedure. Minor limited amputation was performed in 2 patients due to preoperative finger gangrene with complete stump healing.

Conclusion:
DRIL procedure is a durable and effective procedure in fulfilling the dual challenges of access induced ischemic steal syndrome, including persistent relief of ischemic steal syndrome and continued access patency.

KEY WORDS:
Hand ischemia         Steal syndrome        DRIL        AVF
INTRODUCTION:
Critical hand ischemia following angioaccess is a potentially devastating complication. Extremity ischemia may develop as a result of phenomenon of steal, in which not only is significant arterial blood flow shunted directly into the venous outflow of the arteriovenous fistula (AVF) or graft but also a portion of the collateral flow to the distal extremity is stolen by the access.

Most of the patients with a functioning AVF are estimated to have physiologic steal, which is compensating by multiple mechanisms. These mechanisms include development of abundant arterial collaterals and distal vasodilatation. However, if these mechanisms are insufficient to maintain adequate distal perfusion pressure, clinically significant steal develops.

Ischemic symptoms and signs occurred in about 10% of all patients receiving an AVF. In most cases, the ischemia is mild and improves within few weeks without any intervention.

Sever symptoms that required intervention appear in about 1% of patients with distal forearm AVF, and 3-6% of patients with AVF or graft originating in brachial artery.

The reported risk factors are peripheral arteriosclerosis, diabetes, female gender, old age, previous ipsilateral AVF, and high flow AVF.

Early diagnosis and treatment are essential in order to prevent this complication. Delay in the treatment of these cases can result in irreversible damage to the affected extremity.

The aim of this 4 years study was to address the incidence of hand ischemia following autogenous AVF and to review the outcome of the intervention by using distal revascularization-interval ligation (DRIL) procedure.

PATIENTS AND METHODS:
Retrospective review of charts of all patients who underwent DRIL procedure for ischemic steal syndrome related proximally AVF in Alnoor Specialist Hospital, King Saudi Arabia from June 2000 and April 2004 was performed. Specific notation was made for the type of AVF, the timing of symptoms in relation to access procedure. Operative details were recorded along with any intraoperative evaluating procedures. Clinical outcome after revascularization was followed. Proximal AVF was considered any access procedure having the brachial artery as the donor artery.

The diagnosis of hand ischemia that necessitating intervention was based on clinical grounds includes rest pain, motor and sensory impairment, finger cyanosis, tissue loss, and gangrene.

Duplex ultrasound was done for all patients for both fistula and whole arterial tree before surgery. We used the same revascularization procedure (DRIL) that described by Schanzer which consisted of a bypass graft that originates from the native arterial inflow proximal to the access site and inserts into an outflow artery distal to the access site, then ligation of the artery distal to the access but proximal to the distal anastomosis of the bypass graft. Vein graft was used for revascularization in all patients using reversed saphenous vein in 16 (89%), and basilic vein in 2 (11%).
RESULTS:
During the 46-month period of the review, 18 patients underwent the DRIL procedures for the access induced upper limb ischemia. Hand ischemia that required intervention represents 2.5% of the 720 new arteriovenous access performed during the same time. Patient’s demographic data are summarized in table (1).

Table (1): demographic data of the patients for DRIL. 18 patients (n=18)

<table>
<thead>
<tr>
<th>Variable</th>
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<tbody>
<tr>
<td>Sex:</td>
<td></td>
</tr>
<tr>
<td>male</td>
<td>7 (40%)</td>
</tr>
<tr>
<td>female</td>
<td>11 (60%)</td>
</tr>
<tr>
<td>Age: (yr; mean)</td>
<td>59</td>
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<tr>
<td>Ischemia onset:</td>
<td></td>
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<tr>
<td>Acute (within 30 days)</td>
<td>6 (33%)</td>
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<tr>
<td>Chronic (dialysis-dependant)</td>
<td>8 (45%)</td>
</tr>
<tr>
<td>(dialysis-independent)</td>
<td>4 (22%)</td>
</tr>
<tr>
<td>Type of access:</td>
<td></td>
</tr>
<tr>
<td>Brachio-cephalic</td>
<td>14 (78%)</td>
</tr>
<tr>
<td>Basilic vein transposition</td>
<td>4 (22%)</td>
</tr>
</tbody>
</table>

The DRIL procedure was performed for 7 males (40%), and 11 females (60%), with a mean age 59 (range 21-82 years).

Hand ischemia developed within 30 days of access in 6 patients, 2 of them had profound ischemia at the time of access construction manifested as absence of the Doppler flow over distal arteries. Transient access occlusion by vascular clamp provided return of good Doppler flow over distal arteries. Immediate DRIL procedure was performed at the time of fistula construction with good signals detected over palmar arches. The remaining 4 patients who developed ischemia within 30 days of access complained of sever rest pain, and paraesthesia in 2 and fingertips cyanosis in the other 2 patients. Very minimal Doppler flow was detected in these patients.

Twelve patients (77%) had chronic ischemia, with tissue loss in 2 patients, dry gangrene of fingers in 2, and 8 patients with sever dialysis induced ischemic pain.

Preoperative duplex ultrasound was performed in all patients with near flat waveform in distal radial and ulnar arteries, with improvement of waves by fistula compression.

The access types responsible for ischemic symptoms in 18 patients included 14 (78%) brachio-cephalic, and 4 (22%) brachio-basilic AVF.

Our 18 patients underwent the following bypass procedures: 13 out of
18 (72%) brachio-brachial bypass, 4 (22%) brachio-radial bypass, and one (6%) brachio-ulnar bypass depending on the preoperative duplex results.

Follow up period was ranged from 1-36 month (mean 8 months). None of our patients died in the immediate postoperative period. Four patients (22%) died during the follow up period. All 4 patients died from end stage renal disease complications. All 18 patients experienced immediate relief of the ischemic manifestations. Patency rate of the DRIL procedure was (94%), with one (6%) brachio-radial bypass thrombosed. Two patients (11%) developed access thrombosis after more than eleven months post DRIL with fistula patency rate of 89%. Amputation of fingertip for one patient and transmetacarpal amputation for another patient was performed 2 weeks after revascularization because of the preoperative gangrene.

**DISCUSSION:**

The most common reason for a patient with ESRD to seek medical care is for maintenance of haemodialysis access\(^1\). Access induced ischemia presents dual challenges to the clinician: resolving the ischemic manifestations and maintaining the vascular access function.

Steal that is clinically silent, has been shown to be nearly universal and reportedly occurs in 80% to 94% of arteriovenous access\(^1,13,14\). Although physiological asymptomatic steal is nearly universally, clinically significantly steal develops only when inherited compensatory mechanisms are inadequate to maintain distal arterial perfusion pressure to a level sufficient to meet peripheral metabolic requirements.

We reported incidence of 2.5% of steal syndrome in proximally situated AVF. This incidence meets several retrospective reviews that showed an incidence rate between 1% and 8\(^1,14,15\).

The concept of treating significant access induced ischemia with a bypass graft and ligation of the artery was first reported by Schanzer et al in 1988\(^3\). In our series, we report a bypass patency rate of 94%. This result is equally the same as reported by Schanzer and his colleagues with an expanded series in 1996, with bypass patency rate of 95.6% at 2 years\(^16\). Unfortunately, despite these of near universal success in relieving the ischemia and maintaining access patency, this technique still received little recognition. The interval ligation eliminates the pathway for flow reversal and therefore steal. The bypass graft function improves perfusion pressure in the brachial arteries distal to the AVF.

This report impacts the design of DRIL procedure and the choice of distal artery bypass. We prefer to perform the distal anastomosis to the brachial artery, if there is at least one continuous vessel to the hand. We perform 72% of the bypass into brachial artery, 22% in brachial artery and 6% into ulnar artery. The decision was based on preoperative noninvasive duplex ultrasound.

Our report establishes the long-term durability of DRIL technique in fulfilling the dual challenges of access induced ischemic steal syndrome. In this report, all of the 18 patients (100%) showed significant relieve of symptoms with 94% patency rate of the bypass graft.
Two out of 18 patients (11%) experienced access thrombosis after more than eleven months with fistula patency rate of 89% post DRIL.

REFERENCES:
علاج فعال لنقص تروية اليد الناتج عن عملية التوصيل الشرياني الوريدى عن طريق ربط للشريان أسفل الوصلة الشريانية الوريدية
مع عمل توصيل شريان شريانى

عمرو حمدى حلمى مرسى* - محمد عاطف أحمد بيومى** - محمد خليل العمارى***
أقسام الجراحة *كلية طب المنيا - **جامعة الأزهر - ***جامعة جنوب الوادى

نقص تروية اليد بعد اجراء جراحة توصيل شريانى وريدى لمرض الفشل الكلوي من
المضاعفات التي قد تحدث نتيجة انحراف مسار الدم بعيدا عن مساره الطبيعي تجاه اليد راجعا
عن طريق الوريد.

تزداد نسبة حدوث نقص التروية عند اجراء هذه الجراحة باستخدام شريان الساعد.
في هذا البحث أجرينا جراحة توصيل الشريان باستخدام طعم وريدى مع ربط الشريان أسفل
مكان التوصيل بالوريد وذلك لتقليل نسبة انحراف المسار الدم تجاه الوريد وقد أجريت هذه الجراحة
من خلال إجراء هذا النوع من الجراحات وجد أن نسبة أربعة وتسعون في المائة من وصلة
الشريان شريانى تعمك بكفاءة. يتضح من خلال دراستنا للنتائج أن هذا النوع من الجراحة يحافظ
على كفاءة الوصيل الشرياني الوريدى وكذا تروية اليد.