

Unusual vascular access methods for chronic renal failure

Kronik böbrek yetmezliğinde sıra dışı damar erişim yöntemleri

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ABSTRACT

Background: This study aims to investigate alternative vascular access methods in patients in whom conventional hemodialysis methods fail.

Methods: Between January 2007 and March 2011, a total of 15 patients (6 males, 9 females; mean age 40 years; range 28 to 78 years) who were diagnosed with superior and inferior vena cava occlusion and underwent alternative vascular access methods were included. None of the patients underwent hemodialysis and were eligible for peritoneal dialysis. A permanent parasternal right atrial dialysis catheter was inserted in eight patients and a permanent translumbar vena cava dialysis catheter was inserted in five patients. A 6 mm polytetrafluoroethylene dialysis graft was placed between the right axillary artery and right atrium in two patients.

Results: None of the patients had postoperative mortality or morbidity. As of the second postoperative hour, the patients were taken to hemodialysis. Catheter occlusion was detected in four patients, while no complication was observed in the other patients during two-year follow-up period.

Conclusion: Unusual vascular access methods can be used as a last life-saving resort in chronic renal failure patients in whom conventional methods fail.

Keywords: Chronic renal failure; hemodialysis; vascular access.

ÖZ

Amaç: Bu çalışmada, klasik hemodiyaliz yöntemlerinin başarısız olduğu hastalarda alternatif damar erişim yöntemleri araştırıldı.

Çalışma planı: Ocak 2007 - Mart 2011 tarihleri arasında superior ve inferior vena kavada tıkanıklık tespit edilen ve alternatif damar erişim yöntemleri uygulanan toplam 15 hasta (6 erkek, 9 kadın; ort. yaş 40 yıl; dağılım 28-78 yıl) çalışmaya alındı. Hastaların hiçbiri hemodiyalize alınmamıştı ve periton diyalizi için uygun değildi. Sekiz hastaya parasternal sağ atriyal kalıcı diyaliz kateteri ve beş hastaya translumbar vena cava inferior kalıcı diyaliz kateteri takıldı. İki hastada ise, sağ aksiller arter ile sağ atriyum arasına 6 mm politetrafloroetilen diyaliz grefti yerleştirildi.

Bulgular: Hiçbir hastada ameliyat sonrasında mortalite veya morbidite gelişmedi. Ameliyatın ikinci saatinden itibaren, hastalar hemodiyalize alındı. İki yıllık takip dönemi süresince, dört hastada kateter tıkanıklığı tespit edilirken, diğer hastalarda herhangi bir komplikasyon gözlenmedi.

Sonuç: Sıra dışı damar erişim yöntemleri, klasik yöntemlerin başarılı olunamadığı kronik böbrek yetmezliği olan hastalarda hayat kurtarıcı bir son tercih olarak uygulanabilir.

Anahtar sözcükler: Kronik renal yetmezlik; hemodiyaliz; damar erişim.



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End-stage renal disease (ESRD) is a chronic fatal condition, characterized by electrolyte imbalances and accumulation of toxic metabolic waste products in the body. Unless renal transplantation fails, renal replacement should be maintained to survive, which can be achieved using hemodialysis or peritoneal dialysis.^[1]

Vascular access is the mainstay of the hemodialysis in this patient population. It has been proved that autogenous arteriovenous fistulas (AVFs) are superior than the prosthetic arteriovenous grafts or central venous catheters.^[2]

In recent years, there is a trend in the formation of AVFs in a timely manner in patients requiring hemodialysis. In addition, several studies have demonstrated superiority of AVF formation, compared to the prosthetic arteriovenous grafts or central venous catheters with long-lasting nature and lower morbidity and mortality rates, as well as lower thrombosis and infection rates; therefore, clinical practice guidelines have strongly recommended AVFs in these patients.^[3-5]

The right internal jugular vein (IJV) is the preferred access route, followed by the left IJV.^[6] In this study, we aimed to investigate alternative vascular access methods in patients in whom conventional hemodialysis methods failed.

PATIENTS AND METHODS

Between January 2007 and March 2011, a total of 640 patients were operated to create a new vascular access for hemodialysis in our clinic. Fifteen patients (6 males, 9 females; mean age 40 years; range 28 to 78 years) in whom conventional vascular access methods were unable to be performed had central vein stenosis or occlusions. These patients were ineligible for peritoneal dialysis, either. Conventional vascular access methods were previously applied to each patient for five to six times.

A written informed consent was obtained from each patient. The study protocol was approved by the institutional Ethics Committee. The study was conducted in accordance with the principles of the Declaration of Helsinki.

Surgical technique

Permanent parasternal right atrial catheter placement:

All patients were operated under general anesthesia and endotracheal intubation. Right anterior mini-thoracotomy was performed through the sixth intercostal

space with a 4-5 cm transverse incision. After the right lung was retracted, the pericardium was opened and a purse string suture with 2.0 ti-Cron™ (Covidien, Mansfield, MA, USA) was inserted in the right atrial auriculum. A 12f x 28 to 32 cm intra-atrial permanent silicone, double-lumen hemodialysis catheter was inserted through a small atriotomy. The right atrium appendix was ligated using 1/0 silk suture. A permanent hemodialysis catheter was, then, placed out of the thorax through the sixth intercostal space and tunneled subcutaneously to the anterior axillary line in the fifth intercostal space, and fixed to skin with 1/0 silk suture (Figure 1).

Permanent translumbar catheter placement:

A 40-cm-long PermCath™ dual lumen catheter (Med Comp, Inc., Harleysville, PA, USA) was used for percutaneous placement directly into the inferior vena cava by a translumbar approach. The patient was placed in the left lateral decubitus position and conscious sedation was administered. With the patient under local anesthesia, an 18-gauge needle was advanced into the infra-renal vena cava from a posterolateral point just above the iliac crest, 8 to 10 cm from the midline. The needle was exchanged for a 5-French (F) straight end-hole catheter over a 0.035-inch extra-stiff Amplatz wire under the fluoroscopic guidance. A subcutaneous tunnel was, then, created with a semi-rigid tunneling device (Davol Tunnelbor, Davob Inc., Cranston, RI) from the initial posterolateral to a lateral subcostal skin entry point. The catheter was tunneled from the lateral subcostal point to the posterior entry point subcutaneously. The percutaneous inferior vena cava tract was dilated with progressive dilators up to 18-F over the 0.035-inch extra-stiff Amplatz wire. An 18-F



Figure 1. A postoperative X-ray image showing the position of the catheter. The tip of the catheter was noted in the right atrium.

peel-away sheath was, then, advanced into the inferior vena cava. The Amplatz wire was removed, and the PermCath was advanced through the peel-away sheath into the inferior vena cava. The sheath was peeled away and the skin entries were sutured.

Polytetrafluoroethylene (PTFE) dialysis graft placement:

Under general anesthesia, a 5 cm skin incision was made transversely on the right subscapular region and the right axillary artery was reached. We were able to reach the pericardium via the third intercostal space without entrance into the pleural cavity. The mediastinal pleura was reached, and the phrenic nerve was pushed laterally into the right atrium. The pericardium was incised vertically 3 cm in length, and aorta was, then, deviated to the left. The right atrium purse suture was placed. A Satinsky clamp (Braun-Tuttlingen, Germany) was placed on the right atrium appendage. A 6 mm PTFE graft which is used for dialysis was sutured on the right atrium appendix. The paroxysmal part of the graft was anastomosed to the right axillary artery with 6/0 prolene sutures, giving a loop-shape under the skin. The thrill was able to be palpated on the graft (Figure 1).

RESULTS

The mean hemodialysis duration was 7 (range, 3 to 18) years. The mean follow-up was 10.2 (range, 3 to 15) months.

A permanent parasternal right atrial dialysis catheter was inserted in eight patients, while a permanent translumbar vena cava dialysis catheter was inserted in five patients. A 6 mm PTFE dialysis graft was placed between the right axillary artery and right atrium in two patients (Table 1). Following surgery, no antiaggregant or anticoagulant therapy was administered.

None of the patients had postoperative mortality and morbidity. As of the second postoperative hour, all of the catheter-inserted patients were immediately taken to dialysis after the recovery from anesthesia and were successfully dialyzed. Catheter occlusion

was detected in four patients, while no complication was observed in the remaining patients during two-year follow-up period. The graft-inserted patients were able to receive dialysis six hours after the operation. At one year, occlusion was observed in six of 13 patients in whom a permanent catheter was inserted. At one-year, the primary patency rate was 54% (n=7) in the catheterized group. One of the graft-inserted patients died, while entering dialysis. The other patient experienced no problems during one-year follow-up. All other patients were transferred to the nephrology clinic on the first postoperative day.

DISCUSSION

Recent developments and widely adopted use of novel techniques in hemodialysis treatment have significantly increased the life expectancy of ESRD patients on dialysis. Nearly 300,000 patients annually in the USA need hemodialysis.^[7] The upper limb autologous AVF is the gold standard option for patients; however, it is not suitable in all patients. Although subclavian and jugular venous structures are the most common used veins for vascular access, they can be often occluded due to recurrent venous catheterization (approximately 40% over two years).^[8] In the long-term, central vein stenosis becomes the major cause of the difficulty of finding vascular access for dialysis. It is not always possible to re-open the central vein stenosis by various methods such as balloon angioplasty or stent. Sometimes, loss of the patient is inevitable, if peritoneal dialysis is not possible. Therefore, it is necessary to find alternative ways for hemodialysis.^[9,10]

About 1 to 2% of dialysis patients die due to the inability of vascular access option for dialysis.^[11] It usually occurs due to the occlusion of the jugular, subclavian, and femoral veins due to several insertions during catheterization. When peritoneal dialysis is unable to be done, exitus can be inevitable. In such cases, many unusual vascular access methods have been described, to date.^[8,12] Parasternal permanent

Table 1. Surgical methods and outcomes

Methods	n	Anesthesia	Occlusion	Primer patency rate	Mortality
			n	%	n
Right atrial permanent catheter placement	8	General	4	50	2
Translumbar VCI permanent catheter placement	5	Local	2	40	1
Polytetrafluoroethylene dialysis graft placement	2	General	0	100	1

VCI: Vena cava inferior.

hemodialysis catheter placement is preferred as the last option. Archundia *et al.*^[12] first defined the right parasternal approach. Restrepo Valencia *al.*^[13] inserted the catheter into the right atrium in patients in whom all supra- and infradiaphragmatic ways failed. We consider that as the pleura is not open, it does not pose a technical challenge. In the present study, we inserted a permanent parasternal atrial dialysis catheter in eight patients and no postoperative mortality and morbidity was observed. As of the second postoperative hour, the patients were taken to hemodialysis. During two-year follow-up, four patients had no occlusion, while the catheter was replaced in two patients. The other two patients died due to the reasons which were not related to vascular access problems.

In another study, Kuralay *et al.*^[14] inserted a trans-sternal catheter into the superior vena cava using the upper mini-sternotomy technique. The authors concluded that this technique was simple in patients who did not undergo cardiac surgery previously, while translumbar methods were more challenging with possible severe complications. In our study, five patients were implanted a permanent translumbar inferior vena cava dialysis catheter, and no postoperative mortality and morbidity was observed. As of the second postoperative hour, the patients were taken to hemodialysis, and no occlusion was observed during two-year follow-up.

Nonetheless, the methods of vascular access techniques which we applied in our study should never be the first choice. These techniques should be reserved only for patients requiring immediate dialysis who are ineligible for dialysis due to bilateral occlusion of the main veins draining to vena cava superior or vena cava inferior. Before applying these methods, therefore, conventional vascular and interventional radiology access methods should be first attempted.

In conclusion, graft interposition, placement of permanent dialysis catheter to the right atrium and vena cava inferior are life-saving methods in patients in whom all conventional vascular access methods fail.

Declaration of conflicting interests

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