

# Immediate use of an arteriovenous prosthetic graft for life-saving dialysis in a child

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## Abstract

**Background** Autologous arteriovenous fistulas (AVFs) are the current gold standard for vascular access in hemodialysis (HD). However, in pediatric patients, specific clinical settings may contraindicate the procedure, thus mandating the use of a prosthetic graft (PG).

**Case-Diagnosis/Treatment** We report a case of successful polycarbonate urethane graft implantation and subsequent resumption of HD 12 h after the procedure in a young girl with end-stage renal disease (ESRD), challenging vascular anatomy and the absence of vascular access.

**Conclusions** The use of polycarbonate urethane PGs in children with ESRD and difficult vascular accesses may represent a valid alternative for early resumption of HD.

## Introduction

In children, prosthetic grafts (PGs) are rarely used to create arteriovenous fistulas (AVFs) for hemodialysis (HD). When

implanted, a “maturation” of at least 14 days before cannulation is recommended. New polycarbonate urethane PGs allow for early HD resumption after implantation, but no reports detail their immediate use. We report the successful use of a polycarbonate urethane prosthesis in a small child with difficult central venous (CV) access who required emergency dialysis.

## Case report

A 3-year-old girl with end-stage renal disease (ESRD) secondary to collapsing focal segmental glomerulosclerosis was started on HD on a CV catheter at 4 months of age and later shifted electively to peritoneal dialysis (PD). Coagulation workup showed a homozygous *MTHFR* mutation and normal protein S and C levels, while serum albumin was within normal limits. Twenty months after the initiation of PD, the patient developed acute pancreatitis complicated by peri-pancreatic abscesses and portal vein thrombosis, and the peritoneal catheter had to be removed. A double-lumen catheter was placed in the right jugular vein (Hemoaccess® 6.5 F, 7.5 cm, Gambro Kathetertechnik, Hechingen, Germany); this catheter was replaced by a Quinton® 28-cm dual-lumen catheter (Tyco Healthcare, Mansfield, MA, USA). Because of a malfunction, this catheter was then removed. Three attempts at Quinton® catheter placement in the left jugular vein failed. Hemodialysis was then performed by catheterization of the right femoral vein with Hemoaccess®.

At the subsequent assessment of the vascular anatomy, complete thrombosis of the superior vena cava and the azygos vein was found, which was likely a complication of previous multiple CV lines. A bovine PG was then used to create an AVF between the left femoral artery and vein. During the period of PG endothelialization, HD was performed through a CV catheter in the right femoral vein. This device was used

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for 17 months until an acute thrombosis occurred. Two local fibrinolysis attempts were unsuccessful. A further assessment of the vascular anatomy showed left common iliac vein partial thrombosis, common right iliac vein and vena cava patency, and venous drainage occurring through the retroperitoneal veins and the azygos system. Because the right iliac axis should be spared for kidney transplant implantation and the peritoneum was unusable (previous peritonitis and portal hypertension), a second PG AVF was surgically inserted at the site of the previous PG (left femoral vessels). Because the child needed urgent HD, a polycarbonate urethane PG (AVFlo® 35 mm to 6 mm, Nicast, Israel) was used to allow for a rapid puncture and HD following surgery.

At the time of the operation, the previous PG was removed, and the anastomotic sites were identified and preserved. After preparation of the latter sites, the PG was positioned in a classical U shape and anastomosed onto the artery and vein using 6/0 Prolene sutures. At the time of surgery, the patient weighted 12.7 kg. Doppler ultrasound showed regular patency of the PG; some hemodynamic limitations to high flow were observed and were likely due to the altered venous outflow secondary to the iliac thrombosis.

The first device cannulation was performed successfully 12 h after surgery with immediate HD resumption. PG puncture was made with a 45° inclination, according to the manufacturer's recommendations. Seven months after PG implantation, no complication with cannulation or HD was observed. A Doppler ultrasound of the graft was performed, and some posterior wall alterations were noticed that were likely due to the mechanical trauma of repetitive access, however, these alterations did not compromise the flow. Since polycarbonate urethane PG implantation, anticoagulation was achieved with low-molecular-weight heparin (LMWH). Dialysis efficacy was excellent: Kt/V right after PG replacement was 7 per week and this did not change in the following months. It is noteworthy that such an efficacy was achieved using simple-needle HD with a 17-G needle and 3-h session length at four sessions/week. It is important to note that high Kt/V values were also due to the small patient volume. At the time of publication, the patient was on the waiting list for kidney transplantation.

## Discussion

In patients with ESRD, the creation of an AVF is a primary goal [1]. However, in the pediatric age group, AVF creation can be challenging due to the weight of the patient and the vessel size. Small children with prolonged disease are the most difficult to care for, due to vessel trauma by indiscriminate repetitive venipuncture and complications of long-term CV lines. In this setting, establishing adequate HD access can be challenging. To our knowledge, few data have been

reported in the literature regarding the use of PG in pediatric patients [2]. Ideally, PGs should be easy to handle, immunologically inert and non-thrombogenic, resistant to infections and puncture trauma, able to retain tensile strength, and manufactured and sold at reasonable costs [3]. The most commonly used PGs are made of polytetrafluoroethylene (PTFE); they have a shorter incorporation time compared to both autologous AVF and other PG materials (e.g., Dacron®, Gore-Tex®), but a “maturation” time of at least 14 days is recommended before cannulation to allow wound healing and endothelialization of the graft [4].

More recently, polycarbonate urethane PGs have been proposed to further reduce the time of the first puncture after surgery. The specific technical characteristics of this material result in the wall structure reassembling itself when a needle is removed, with a spontaneous and fast “seal” of the PG wall, thus allowing the use of the device very shortly after implantation [5–8].

In children affected by ESRD presenting with difficult vascular access, establishing HD through PG AVF creation, followed by immediate use could be an advantage compared to combined procedures, such as autologous AVF creation and temporary CV dialysis. In the reported case, the patient suffered from advanced ESRD and was dependent on chronic HD with diffuse thrombosis of the superior vena cava system, partial thrombosis of the femoro-iliac veins and the impossibility of resuming PD. Polycarbonate urethane PG was considered to reuse a previously operated site and to quickly resume HD. The device functioned adequately, allowing cannulation of the graft within 12 h after the procedure, which is a much shorter time period compared to other PGs previously reported. In this respect, Wijeyaratne et al. [5] mentioned a low complication rate after polycarbonate urethane PG cannulation as early as < 8 days after implantation in 56 % of a series of 17 consecutive patients.

In conclusion, when CV catheter placement is challenging or impossible, PUPG implantation may become a valid alternative. However, costs and benefits should be compared with those of dialysis with CV approach, and the role of polycarbonate urethane PG as an elective chronic device used in the pediatric age group should also be defined.

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