CLINICAL STUDY

Unmasking of Previously Asymptomatic Central Venous Stenosis following Percutaneous Transluminal Angioplasty of Hemodialysis Access

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ABSTRACT

Purpose: To determine the frequency of new-onset symptoms of central venous stenosis (CVS) after percutaneous transluminal angioplasty (PTA) of a hemodialysis access–related stenosis in patients with previously asymptomatic CVS and to identify risk factors for this phenomenon.

Materials and Methods: Retrospective review was performed of patients treated with PTA for an access-related stenosis (excluding central vein interventions) between 2001 and 2016 who returned within 3 months with symptoms of CVS (ie, "unmasking"): 39 patients met these criteria. A control group of 122 patients who had untreated asymptomatic CVS and did not experience unmasking was selected. Fistulograms were graded for degree of CVS. A total of 51% of the unmasked group was male, with an average age of 65 years; 57% of the control group was male, with an average age of 63 years.

Results: The incidence of unmasking among patients with untreated asymptomatic CVS was 4.9%. A total of 90% of the unmasked group (35 of 39) had upper-arm access, compared with 77% of the control group (94 of 122; $P = .017$). A total of 28% of unmasked-group patients (11 of 39) underwent thrombectomy, vs 4% of controls (5 of 122; $P < .0001$). A total of 54% of unmasked-group patients (21 of 39) had significant brachiocephalic vein stenosis, vs 26% of controls (32 of 122; $P = .001$). A total of 8% of unmasked-group patients (3 of 39) had superior vena cava stenosis, vs none of the 122 controls ($P = .01$). A total of 64% of unmasked-group patients (25 of 39) had extensive collateral vessels, vs 24% of controls (29 of 122; $P < .0001$).

Conclusions: The incidence of unmasking of asymptomatic CVS is low. Prophylactic treatment of asymptomatic CVS therefore remains generally inadvisable. However, patients undergoing declotting with extensive collateral vessels might warrant treatment of asymptomatic CVS.

ABBREVIATIONS

BCV = brachiocephalic vein, CVS = central venous stenosis, EIV = external iliac vein, PTA = percutaneous transluminal angioplasty, SCV = subclavian vein, SVC = superior vena cava

Central venous stenosis (CVS) is a common complication of hemodialysis access and central venous catheter use. When symptomatic, it is characterized clinically by edema and pain of the arm, shoulder, breast, and face ipsilateral to the access (1). Historically, clinical practice guidelines (2–4) advocated that CVS be treated by angioplasty if imaging evidenced greater than 50% stenosis of a central vein and clinical indications for treatment were present (eg, decreased access flow, high dialysis pressure, and abnormal physical examination findings).

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More recent studies (5,6) have shown that treatment of asymptomatic CVS may lead to worse outcomes than foregoing treatment (5) and that withholding treatment of asymptomatic CVS does not worsen access outcomes (6). On the basis of emerging literature, the National Kidney Foundation Kidney Dialysis Outcomes Quality Initiative 2006 guidelines (7) recommended percutaneous transluminal angioplasty (PTA) only for symptomatic CVS.

A potential concern is that interventions on the dialysis access might precipitate or unmask clinical symptoms in a patient with previously asymptomatic CVS. It is well established that increased flow through the central veins following the initial placement of dialysis access can lead to the "unmasking" of latent CVS (1,8,9). It follows that improved flow following intervention in dialysis access might also cause an asymptomatic CVS to become symptomatic.

The purpose of the present study was to determine the incidence of such unmasking and attempt to identify any risk factors that might predispose patients to the development of symptomatic CVS shortly after treatment.

MATERIALS AND METHODS

This retrospective cohort study was carried out in compliance with the Health Insurance Portability and Accountability Act. Institutional review board approval was obtained along with an informed consent waiver. A primary quality improvement database (Hi-IQ; ConexSys, Lincoln, Rhode Island) was used daily to acquire a prospective database of hemodialysis access interventions. Hemodialysis interventions were performed on a total of 9,560 patients at a single institution over a 15-year period (2001–2016). From this database, patients who underwent a procedure on their dialysis access and then returned within 3 months with symptoms of CVS (extremity, shoulder, breast, and face edema or superior vena cava [SVC] syndrome) were identified over this 15-year period. Patients were excluded if they had clinical symptoms of CVS at the time of the intervention on their dialysis access or if a procedure was performed on the CVS itself at that time. If a patient had multiple incidents of unmasking, only the first unmasking event was included in the study. Our search methodology to identify the cases of unmasking is depicted in **Figure 1**.

A control group was drawn from a cohort that was used in a previous study (10), consisting of 250 consecutive patients with arteriovenous fistulae and 250 consecutive patients with arteriovenous grafts between 2009 and 2013. Patients were excluded (n = 378) if they had inadequate central imaging, symptomatic CVS, no CVS at all, or treatment for CVS on the selection date, or returned for treatment of symptomatic CVS within 3 months. Therefore, the control group is composed of 122 patients with untreated asymptomatic CVS who did not return for treatment of symptomatic CVS within 3 months.

Demographic characteristics of the unmasked and control groups are displayed in **Table 1**. In the unmasked group, 51% of patients (20 of 39) were male, and the mean age was 65 years (range, 42–90 y). In the control group, 57% of patients (70 of 122) were male, and the mean age was 63 years (range, 26–94 y). In the unmasked group, 51% (20 of 39) had fistulae (with the remainder accounted for by grafts [46%; 18 of 39] and hybrids [3%; 1 of 39]), compared with 66% of the control group (80 of 122). A total of 54% of the unmasked group (21 of 39) had left-sided access, compared with 70% of the control group (85 of 122).

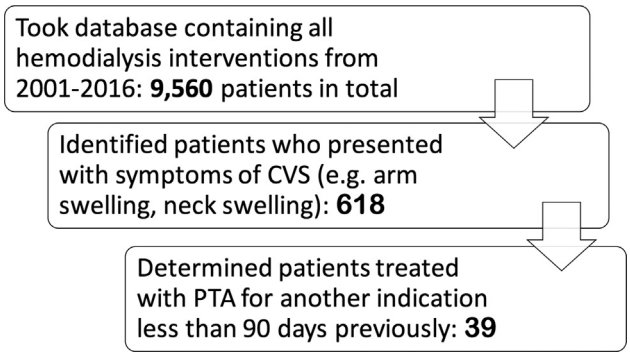

Figure 1. Flow diagram for patient selection.

Table 1. Demographic Data

Variable	Patient Group			*P* Value
	Unmasked	Control	All	
Cohort size	39	122	161	–
Male sex (%)	51	57	56	.50
Mean age (y)	65	63	63	.39
Graft (%)	49	34	38	.11
Access location				
Left side (%)	54	70	66	.07
Upper arm	35	94	129	.02
Forearm	2	28	30	–
Femoral	1	0	1	–
Chest	1	0	1	–

Fistulograms were obtained by one of 19 board-certified attending physicians with 1–25 years' experience in hemodialysis access interventions or supervised trainees by using a 4-F coaxial access set (Micropuncture; Cook, Bloomington, Indiana) or an 18-gauge Angiocath (Becton-Dickinson, Franklin Lakes, New Jersey). Iodinated contrast medium or carbon dioxide was hand-injected during serial digital subtraction imaging with a fixed C-arm imaging system. At least one subtracted image was stored for each imaged portion of the access. A series of representative fistulograms is shown in **Figure 2**. Central veins were excluded from the fistulogram only if contraindicated or, rarely, if contrast agent sparing was indicated and central imaging was not relevant (eg, no arm swelling). Lesions in symptomatic patients were treated with PTA primarily, supplemented as needed with stents or stent grafts. For