As standard renal replacement therapies could not be used due to the blood pressure (BP) levels, we tried another depurative technique.

The ECMO system haemofilter was used as dialysis membrane (1.4 m² poly-ethersulfone membrane; Cobe cardiovascular, Mirandola, Italy). Dialysis fluid was provided by two 5 l bags suspended above the patient (Figure 1). A ‘Y’ tube system was used to deliver a kalium-free dialysate (Na 140 mmol/l, bicarbonate 34 mmol/l). To control dialysis flow speed, two plastics locks provided by the manufacturer alternatively closed and opened the system. From the filter, another ‘Y’ tube collected the drainage fluid in two 5 l bags below the patient. Each bag was weighed, using an electronic newborn scale, to calculate the ultrafiltration volume. A ‘Y’ line returned the blood from the ECMO: the main branch directly to the patient and the other to the haemofilter. The dialysis flow was maintained at 291 ml/min for 2 h and decreased to 83 ml/min for 3 h (mean flow 166 ml/min). Patient’s net balance throughout the procedure was zero and temperature 35.5°C. After 5 h, BP increased to 76/45, pH to 7.4, kaliemia decreased to 6.2 mmol/l, lactate to 8.5 mmol/l and bicarbonate remained stable. In the absence of a positive fluid balance, improvement of kaliemia was attributed to dialysis. Improvement of BP could be due to the decrease in potassium levels and the slightly lower core temperature [5]. Lactate decrease was probably due to a better tissue perfusion, rather than a dialytic effect [6]. Gravity dialysis could then be changed to conventional CRRT.

In summary, the technique of continuous dialysis by gravity using the ECMO filter could be a therapeutic option in critically unstable patients, unable to tolerate CRRT and requiring urgent management of electrolytic disturbances (Figure 2).

Conflict of interest statement. None declared.

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**Does a fibrin sheath formed around a catheter embolize upon removal of the catheter?**

Sir,

Central venous catheters (CVC) are commonly used in haemodialysis patients. Encasement of the catheter by a fibrin sleeve is a well known complication which can interfere with catheter function and prevent effective haemodialysis [1]. These sleeves do not come with the catheter upon removal, but remain in the vein. Although millions of CVC are inserted and removed every year, there are few clinical reports describing what happens to the sleeve remaining inside the venous lumen upon removal [2,3]. We conducted a prospective study to assess whether fibrin sheath formed around a short-term haemodialysis catheter embolizes or not during removal of the catheter.

The study was approved by the institutional review board, and informed consent was obtained from all patients before the procedure. Forty consecutive patients [25 women (63%), 15 men, mean age 58 ± 21 years] with a short-term haemodialysis catheter were evaluated for presence of pericatheter fibrin sheath and possible embolization upon
removal of the catheter. We included patients with non-
tunnelled catheters, because this was the most frequently
used catheter type at our dialysis centre. All catheters were
removed because of the establishment of other working
accesses.

The short-term catheters were 11.5F 15–20 cm long stiff
polyurethane catheters (Duo-flow catheter, Medcomp,
Harleysville, PA, USA). All procedures were performed with
a digital subtraction angiography unit. The patients were
monitorized by pulse, blood pressure and oxygen saturation
during and immediately after the procedure. The catheter
was checked for patency and pulled back 4–5 cm proximally.
Ten millilitre of non-ionic contrast media (Ultravist,
Schering, Berlin, Germany) was then slowly injected, while
digital subtraction images were obtained. This first step of
the procedure was to diagnose the presence of fibrin sheath
around the catheter and ensure filling of the sheath with
contrast media. Fifteen millilitre of non-ionic contrast media
was then injected manually, while the catheter was slowly
removed and serial digital angiographic images without
subtraction were obtained. The acquisition of images was
continued 2–3 s after removal of the catheter. For each case,
presence of pericatheter fibrin sheath and possible emboliza-
tion upon removal of the catheter were evaluated. Oxygen
saturation of patients before, during or immediately after
removal of the catheter was recorded. Patients were asked if
they felt any pain, anxiety or shortness of breath during
or immediately after catheter removal.

A total of 25 out of 40 consecutive patients (63%) had fibrin
sheath formation around the catheter. Contrast media filled
around the catheter to diagnose the presence of fibrin sheath
in these 25 patients, but cleared immediately in six of them.

There were 19 patients for the assessment of possible fibrin
sheath embolization (Figure 1). The catheters were placed in
the internal jugular vein and dwell time ranged from 12 to
48 days (mean, 29 days). Fibrin sheath embolization was
not observed or documented by venography in any patients.

Patients did not have symptoms or signs of pulmonary
embolism. Venography showed that the sheath remained
adherent to the vein wall at the catheter insertion site.

Fibrin sheath formation is seen in up to 76% of short-
or long-term CVC by pull-back venography [4,5], but
the rate reaches 100% in experimental studies after 1 week
of placement [6]. It starts as early as 24 h after insertion
of the catheter [3,6] which becomes encased along its
entire length within 5–7 days. The sheath begins as a
thrombus containing some fibrin in the first few days and
transforms to a cellular-collagen tissue after 1 week [6,7].
At this stage, the sleeve material is mostly smooth muscle
cells with a small amount of fibrin. The sleeve remnant
permanently attaches to the vein wall and its detachment
seems unlikely.

Fibrin sheath was debated to cause embolization during
or after removal of a CVC, but there are few reports [2,3,8,9]
that document its embolization. Brismar et al. [2] reported
pull-back venography findings of 60 CVCs. The fibrin sheath
mostly remained adherent to the vessel wall at the catheter
insertion site upon removal, but on several occasions, the
thrombus adherent to the fibrin sheath or the whole sheath
detached from the vessel wall and was carried away by flowing
blood. Three patients experienced pulmonary embolism
documented with lung scintigraphy [2]. Winn et al. [8] reported
a patient who had documented pulmonary embolism imme-
diately after completion of a fibrin sheath stripping procedure.
Rockoff et al. [9] reported fatal pulmonary embolism upon

Fig. 1. Pull-back venography findings of a fibrin sheath. (A) Digital
subtraction angiography shows a very long and slender fibrin sheath.
The tip of the catheter (arrow) was pulled back and contrast was
injected to demonstrate the whole sheath material. (B) Digital
angiography without subtraction shows that contrast was kept in the
sheath. (C) The catheter was removed completely and the sheath
remained attached to the vein wall and did not embolize.

removal of a CVC in a 1-year-old child. Contrary to these rare
findings, our study supports the hypothesis based on experi-
mental studies that the fibrin sheath is firmly attached to the
vein wall at the catheter insertion site and does not embolize
upon removal. The fate of these sleeves whether cleared by the
body’s thrombolytic activity or embolized into the pulmonary
arteries after a while is not known.

Our study suffers the drawback of a small patient
population from which a scientific conclusion is not possible.
Pulling back the catheter might have dislodged some portion
of the fibrin sheath before the second injection, which we
did not have control of. Pulmonary embolization was only
assessed with venography and pulmonary scintigraphy was
not done. Therefore, it is possible that some clinically silent
emboli could have gone unnoticed.

This study showed that fibrin sheath formation is a very
frequent finding and the sheath around the catheter seems to
be firmly attached to the vein wall and does not embolize into
the pulmonary arteries upon removal of the catheter.

Conflict of interest statement. None declared.
Serum phosphorus and the risk of progression of chronic kidney disease

Sir,

We read with interest the recent paper by Voormolen et al. [1], describing an association between higher serum phosphorus levels and faster decline in renal function, in 432 patients with advanced chronic kidney disease (CKD). The authors contend that their study is the first to describe such an association in a large number of pre-dialysis CKD patients.


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