Scientific letters

Peripheral access ultrafiltration as a treatment for cardiorenal syndrome with inadequate diuretic response. Initial experience

Ultrafiltración de acceso periférico como tratamiento del síndrome cardiorrenal con insuficiente respuesta diurética. Experiencia inicial

To the Editor,

Ultrafiltration (UF) is a dialysis modality consisting of the removal of water and solutes through a semipermeable membrane. It can be used in patients with decompensated heart failure (HF) with volume overload despite maximum diuretic therapy. Its use on hospital wards, using peripheral venous access, facilitates its availability. We analyzed the experience with UF via peripheral venous access performed on hospital wards in patients with advanced HF refractory to diuretics.

This was a retrospective study. From March 2019 to December 2021, the procedure was performed in 16 patients admitted with congestion resistant to diuretics (congestive signs and symptoms despite treatment with high-dose intravenous furosemide with sequential nephron blockade). UF was performed using a 5-Fr venous line with 18-G dual lumen (PowerMidline, Bard Access Systems, USA) shortened to 10 cm and placed in the basilic vein or two 18-G peripheral venous lines (BD Nexiva Diffusics Closed IV Catheter System, USA), normally in the same arm. The device used was Aquadex SmartFlow System (Nuwellis Inc, USA). The starting parameters were: blood flow, 40 mL/min; UF rate, 150 mL/h. During UF (programmed for 24 h), all diuretics were stopped.

The patients had a mean age of 73.6 years, and 75% were men. The predominant underlying heart disease was chronic ischemic heart disease. The most common reason for admission was systemic congestion alone or with associated pulmonary congestion. The mean time until starting UF was 7 days. The previous mean IV furosemide dose was 250 mg/day.

When comparing the stable baseline status with the admission for decompensation (baseline vs admission), we saw that, in the period leading up to the admission, there was a reduction in the diuresis volume (> 300 mL/day) and a weight a gain (> 6 kg). Both variables improved with UF (pre-UF vs post-UF). Thus, this treatment reduced the mean weight by 4 kg and increased the diuresis volume by 500 mL. The weight loss from UF was maintained at the time of discharge (table 1 and figure 1).

Renal function (creatinine and glomerular filtration rate) showed a significant deterioration ($p < .05$) during the decompensation episode (baseline vs admission). At discharge (pre-UF vs discharge), these parameters had improved ($P < .05$) (table 1).

Table 1
Ultrafiltration parameters and changes in the parameters of interest in the different stages

Ultrafiltration parameters and complications					
UF parameters	Duration, 24 [14] h; rate, 119.5 [30] mL/h; volume removed, 3450 [2500] mL; diuresis during UF, 1925 [1025] mL; total volume lost, 5975 [3213] mL				
*Complications**	Pressure alarm (1). Coagulation of any part of the system (4). Coagulation of any part of the system + hypotension (1)				
Changes in parameters					
	Baseline	Admission	PreUF	PostUF	Discharge
Weight, kg	75.9 ± 12.5	82.5 ± 12.7	81.1 ± 12.6	77.3 ± 12.1	76.5 + -12.1
Diuresis, mL/d	1869 ± 432	1509 ± 588	1484 ± 758	1973 ± 926	2066 ± 831
Creatinine, mg/dL	1.86 ± 0.99	2.22 ± 1.18	2.46 ± 1.15	2.37 ± 1.25	2.16 ± 1.26
GFR, mL/min/1.73 m²	42.2 ± 21.2	35.6 ± 19.7	28.9 ± 13.2	31.6 ± 15.6	36.1 ± 17.7
Hemoglobin, g/dL	12.0 ± 2.2	11.0 ± 2.4	10.8 ± 2.4	10.4 ± 2.6	11.0 ± 2.4
Hematocrit, %	36.6 ± 6.3	34.1 ± 6.6	33.5 ± 6.6	32.3 ± 7.7	34.2 ± 7.2
Potassium, mEq/L	4.2 ± 0.6	4.3 ± 0.7	4.1 ± 0.9	4.0 ± 0.7	4.2 ± 0.6
Sodium, mEq/L	139.4 ± 3.8	137.2 ± 4.5	138.8 ± 7.2	137.6 ± 7.4	138.3 ± 6.8
Diuretic treatment					
Oral furosemide	14 (88)	0	0	0	13 (81)
IV furosemide + 3%HSS	0	14 (88)	14 (88)	13 (81)	0
Thiazide	11 (69)	7 (44)	7 (44)	3 (19)	6 (38)
MRA	11 (69)	9 (56)	11 (69)	9 (56)	8 (50)
Tolvaptan	5 (31)	6 (38)	7 (44)	3 (19)	4 (25)
Acetazolamide	2 (13)	2 (13)	4 (25)	2 (13)	2 (13)
SGLT2i	6 (38)	5 (31)	5 (31)	5 (31)	5 (31)

3%HSS, 3% hypertonic saline solution; IV, intravenous; MRA, mineralocorticoid receptor antagonists; SGLT2i, sodium-glucose cotransporter type 2 inhibitor; UF, ultrafiltration.

* The pressure alarms only required a check of the system (kinking of the line, etc). In the coagulation alarms, 2 of the 4 patients required a change of system; in the others, more than 24 h of UF had already passed with a satisfactory result and the procedures were deemed to be finished. The system setup (including flushing) takes between 5 and 10 minutes.

The values had a normal distribution. The values are expressed as mean ± standard deviation or median [interquartile range]. The treatment is expressed as the number of patients who received it and the percentage of the total in parentheses.

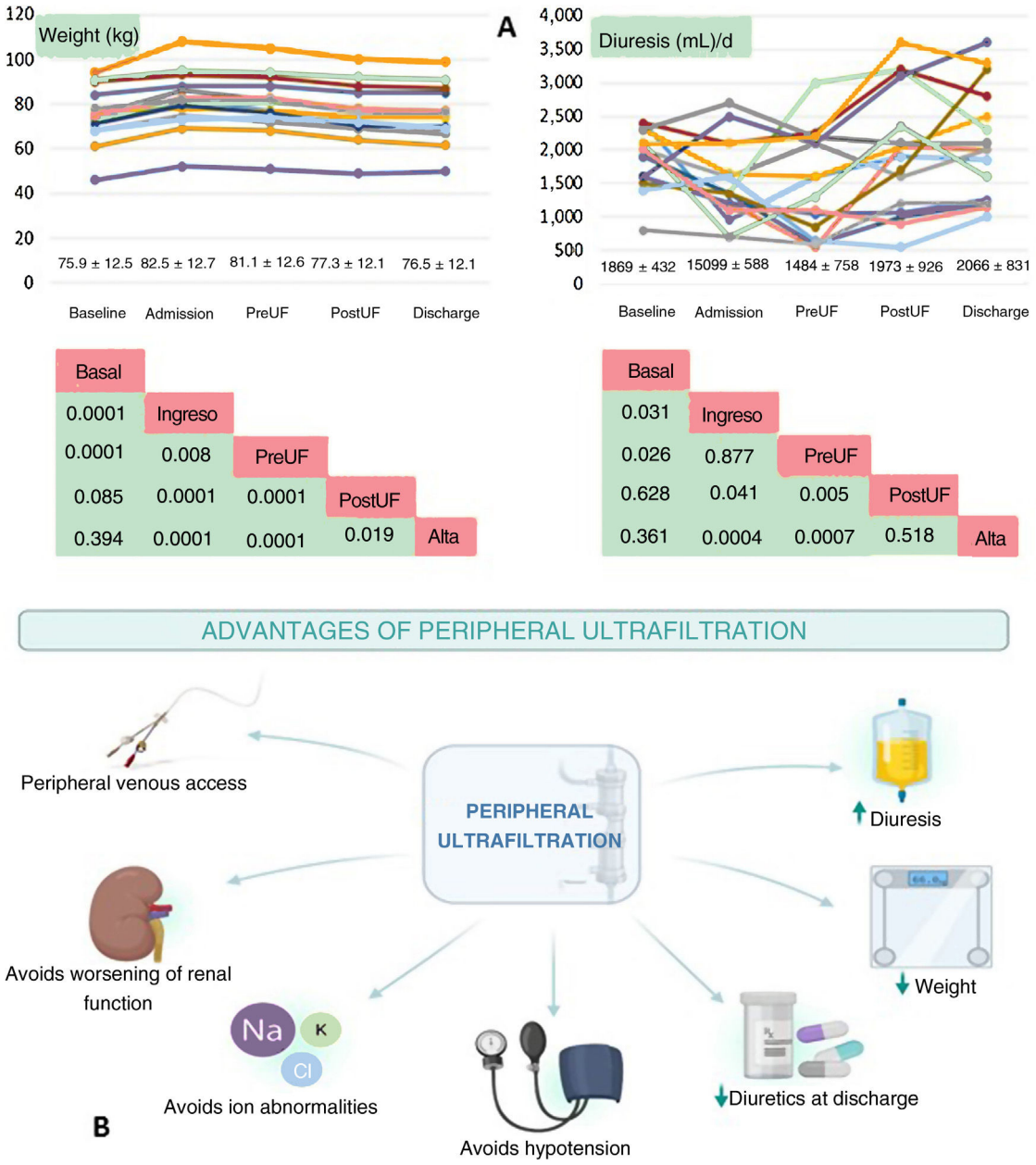

Figure 1. A: changes in body weight and diuresis in the different study phases. B: advantages of peripheral ultrafiltration. PostUF: after ultrafiltration; PreUF: before ultrafiltration. The values in the lower part represent the *p* values between the different study phases.

There was a reduction in almost all drugs with a diuretic effect at discharge compared with the stable baseline situation before the decompensation (table 1). The mean UF rate was 120 mL/h, with a total extraction volume from UF of around 3.5 L. The total volume loss was almost 6 L. There were no significant complications related to the procedure (table 1).

In this study we have been able to confirm the effectiveness of peripheral UF in terms of a substantial weight reduction due to the negative balance caused by UF and the increase in diuresis that occurs with it, without a deleterious effect on renal function.

Of note, most studies have been carried out with conventional UF, which requires high flows, a central line, and dialysate.[1,2] However, for several years now, peripheral access UF devices have been available, which allow the treatment to be carried out with low flows and provide a slow UF, which is better tolerated by patients with HF.

The advantages of UF (figure 1B) include better control of the speed and volume of fluid removal, greater net sodium loss (the ultrafiltrate product is isotonic), and less neurohormonal activation.[3] Stopping diuretics allowed the nephrons to rest,[3–5] which, added to the decongestion, promotes the recovery of their sensitivity to diuretic therapy.[4–6] Therefore, the patients in this series were discharged on lower diuretic doses than their baseline, with a lower weight than at admission, and a greater diuresis than baseline and admission. There are other techniques that are used in the long-term treatment of these patients, such as peritoneal dialysis, but this therapeutic option requires preparation and abdominal surgery. UF is a good technique for the maintenance of patients who are candidates for peritoneal dialysis until it can be started.

This study has some limitations, in particular the small number of patients and the lack of a randomized control group.

Nonetheless, we did not find any studies in the literature that systematically perform this technique using peripheral access.

In conclusion, UF in patients with decompensated HF and congestion resistant to combined diuretic therapy is effective, safe, and simple to perform on a conventional hospital ward and using peripheral venous access.

FUNDING

None.

AUTHORS' CONTRIBUTIONS

All the authors involved in the study have made substantial contributions, collaborated on the writing or critical review of the article, have reviewed and approved the final version, and agree with all aspects of the study to ensure that questions related to the accuracy or integrity of any part of this study may be investigated and resolved appropriately.

R. López-Vilella: study design, performing the study, data collection, data analysis, manuscript writing, manuscript review. I. Sánchez-Lázaro: study design, performing the study, data collection, data analysis, manuscript review. B. Guerrero Cervera: study design, performing the study, data collection, data analysis, manuscript writing. V. Donoso Trenado: study design, performing the study, data collection, data analysis, manuscript writing. A. Soldevila Orient: data analysis, manuscript writing, manuscript review. L. Almenar Bonet: study design, performing the study, data collection, data analysis, writing the manuscript, manuscript review.

CONFLICTS OF INTEREST

None.

Aleksandra Mas-Stachurska,[a,b,c,d,*] Berto J. Bouma,[e] Rianne de Bruin Bon,[e] Barbara Mulder,[e] Bart Bijnens,[c,f] and Marta Sitges[a,b,c,g,h]

[a]*Institut Clínic Cardiovascular, Hospital Clínic de Barcelona, Barcelona, Spain*
[b]*Departamento de Medicina, Universitat de Barcelona, Barcelona, Spain*
[c]*Institut d'Investigacions Biomèdiques August Pi i Sunyer (IDIBAPS), Barcelona, Spain*
[d]*Institut Hospital del Mar d'Investigacions Mèdiques (IMIM), Barcelona, Spain*
[e]*Cardiology Department, Amsterdam University Medical Centers, Location Academisch Medisch Centrum, Ámsterdam, Países Bajos*
[f]*Institución Catalana de Investigación y Estudios Avanzados (ICREA), Barcelona, Spain*
[g]*Centro de Investigación Biomédica en Red de Enfermedades Cardiovaculares (CIBERCV), Spain*
[h]*Centres de Recerca de Catalunya (CERCA), Generalitat de Catalunya, Barcelona, Spain*

[*] Corresponding author:
E-mail address: astachur@gmail.com (A. Mas-Stachurska).

Available online 3 June 2022

REFERENCES

1. Costanzo MR, Guglin ME, Saltzberg MT, et al. Ultrafiltration versus intravenous diuretics for patients hospitalized for acute decompensated heart failure. *J Am Coll Cardiol.* 2007;49:675–683.
2. Bart BA. Treatment of congestion in congestive heart failure: Ultrafiltration is the only rational initial Treatment of volume overload in decompensated heart failure. *Circ Hear Fail.* 2009;2:499–504.
3. Kazory A. Ultrafiltration therapy for heart failure: Balancing likely benefits against possible risks. *Clin J Am Soc Nephrol.* 2016;11:1463–1471.
4. Costanzo MR, Ronco C, Abraham WT, et al. Extracorporeal ultrafiltration for fluid overload in heart failure: current status and prospects for further research. *J Am Coll Cardiol.* 2017;69:2428–2445.
5. ter Maaten JM, Valente MA, Damman K, Hillege HL, Navis G, Voors AA. Diuretic response in acute heart failure-pathophysiology, evaluation, and therapy. *Nat Rev Cardiol.* 2015;12:184–192.
6. Felker GM, Mentz RJ. Diuretics and ultrafiltration in acute decompensated heart failure. *J Am Coll Cardiol.* 2012;59:2145–2153.

https://doi.org/10.1016/j.rec.2022.04.013
1885-5857/

Specific electrocardiographic findings in patients with pectus excavatum

Hallazgos electrocardiográficos específicos en pacientes con pectus excavatum

To the Editor,

Pectus excavatum (PE) was previously considered to be a relatively common esthetic malformation; however, in the past decade it has been acknowledged to potentially affect cardiac function due to external compression on the right chambers of the heart.[1] The protocol used for risk stratification and to assess preoperative eligibility usually includes functional heart studies such as exercise stress echocardiography (ESE).[2] Electrocardiography (ECG) performed during ESE, using 12 thoracic leads, is often the only test available for these patients. However, there is scant information on its characteristics. Our aim was to analyze the ECG characteristics of patients with PE who underwent ESE as part of an eligibility assessment prior to surgery.

This retrospective, cross-sectional, observational study included patients diagnosed with PE who were assessed at an institution specializing in thoracic wall malformations and who had an indication for ESE to evaluate eligibility for a specific treatment. Patients were excluded if their ECG information was incomplete or of poor quality, if they had known lung or cardiovascular conditions, if there was a history of prior thoracic surgery, if they were currently receiving vacuum bell therapy, or if they did not grant informed consent for the use of their data (*habeas data*). The control group comprised young healthy participants with medical evaluations prior to participating in recreational amateur sports who showed no evidence of heart disease or thoracic malformations and who underwent ESE based on the same methodology as the PE patients. All procedures complied with the ethical standards of the teaching and research committee and with the Declaration of Helsinki of 1964 and its subsequent addenda. All patients underwent ESE using a bicycle in the supine position, based on a modified Astrand protocol.

The ECG analysis was performed by an experienced cardiologist blinded to the patients' clinical characteristics and the results of