Open-Label, Single Arm, First-In-Human Pilot Initiation Study For The SC+ Haemodialysis System

Dr. Charlotte Bebb[1], John E. Milad[2], Dr. Hardip Nagra[2], Peter Hoyer[2], Andrew Gardner[2], Ben Opena[2] , Rekha Sangar[2] and Amy Degen[2]

[1]Renal Unit, Nottingham City Hospital, Hucknall Road, Nottingham, NG5 1PB, UK. [2]Quanta Dialysis Technologies, Tything Road, Alcester, B49 6EU, UK.

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INTRODUCTION

Quanta Dialysis Technologies, a pioneering developer of advanced haemodialysis (HD) systems, has completed its first study to demonstrate the safety and efficacy of the SC+ HD system. This first-in-human study demonstrated safety, performance and usability in a clinical setting.

Adequate clearance was achieved in all subjects based on a standard in-centre treatment regimen.

Figure 1: SC+ Haemodialysis System

BACKGROUND

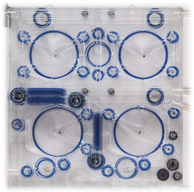

Figure 2: SC+ Disposable Dialysate Cartridge

The CE-marked SC+ is a portable, cartridge-based haemodialysis system providing high flow rates typically used in treating subjects in-centre. This study assessed the safety, efficacy and usability of the system in-centre, at 1 UK site in 6 subjects during 10 dialysis treatments in the haemodialysis-dependent, end-stage renal disease (ESRD) subject population.

The system was operated by a Quanta nurse. Clinical performance was assessed by measuring clearance (Kt/V and URR) and ultrafiltration achieved.

STUDY DESIGN

- An open-label, single-arm, post market clinical follow-up study on ESRD subjects meeting the criteria of a body mass above 50kg, male or female, and an age of ≥18 years. The clinic's principle investigator selected the subjects on a volunteer basis. Each dialysis therapy was performed on an outpatient basis with a target dialysis time of 240 min (4 hours) using a bicarbonate-based dialysate at a dialysate flow rate (Qd) of 500 ml/min.

- Vital signs were nominally recorded every 30 minutes and subject symptoms were monitored during every treatment. Blood samples for clinical laboratory evaluations, including blood clinical chemistry and haematology, were taken pre and post-dialysis in 8 of the 10 dialysis sessions. Data collection of free-text treatment notes, subject symptoms, usability observations and adverse events was also performed.

- Other data collected included subject weight (pre- and post-dialysis), fistula type and location, needle gauge, time points (start of prime, subject connect, therapy start and end), SC+ machine specifications (serial number, UF Rate limit setting, blood pump speed, and venous and arterial pressure alarm window settings), dialysate conductivity and temperature, washback volume, and information on consumable materials (dialysate, bicarbonate, and blood cartridge lot numbers, dialyser type and lot number, ET filter lot number, concentrate type and lot number).

STUDY RESULTS

Subject ID	A			B			C	D	E	F
Date of Dialysis:	30-Jun-2015	3-Jul-2015	6-Jul-2015	2-Jul-2015	9-Jul-2015	14-Jul-2015	8-Jul-2015	10-Jul-2015	13-Jul-2015	13-Jul-2015
subject Age	52	52	52	79	79	79	68	40	59	75
subject Sex	Male	Male	Male	Male	Male	Male	Female	Female	Male	Female
Dry Weight (kg)	154.5	154.5	154	79.5	79.5	79.5	87.5	153.0	82.0	100.0
Anti-Coagulant Type	Warfarin	Warfarin	Warfarin	Enoxaparin	Enoxaparin	Enoxaparin	Enoxaparin	Enoxaparin	Enoxaparin	Warfarin & Enoxaparin
Anti-Coagulant Total Dose (mg)	N/a	N/a	N/a	40	40	40	40	60	20	40
Needle Size (G)	14	14	14	15	16	16	15 Buttonhole	15	15 Buttonhole	15 Buttonhole
Vascular Access	Right Radial AVF	Right Radial AVF	Right Radial AVF	Right Side Brachial Cephalic AVG	Right Side Brachial Cephalic AVG	Right Side Brachial Cephalic AVG	Left Side Brachial Cephalic	Left Side Brachial Cephalic	Left Brachial Cephalic AVF	Left Brachial Cephalic AVF
Blood Pump Speed Qb (mL/min)	400	400	400	300	300	300	340	400	350	300
Dialyser	FX-100	FX-100	FX-100	FX-80	FX-80	FX-80	FX-100	FX-100	FX-80	FX-80
Dialysate Flow Rate Qd (500 mL/min)	500	500	500	500	500	500	500	500	500	500

AVF = Arteriovenous Fistula; AVG = Arteriovenous Graft

Table 1: Dialysis specification for each treatment

- The 6 study subjects with dry weights ranging from 79.5 to 154.5 Kg completed all 10 initiated dialysis therapies. Table 1 summarises the specifications for each therapy.
- All subjects, with the exception of subject A, used enoxaparin as anticoagulant for dialysis with doses ranging from 20 to 60 mg. Subject A, who was already receiving Coumadin (Warfarin) as a maintenance medication, did not use an anticoagulant as part of the dialysis regimen. All subjects received their HD therapy using upper extremity arteriovenous fistulas (AVF) or arteriovenous graft. (AVG). Cannulation was achieved using either 14G, 15G, 15G buttonhole, or 16G needles.
- Per protocol specifications, the dialysis flow rate (Qd) was 500 ml/min for all therapies; maximum ultrafiltration rate limit was set to 1000 ml/hour for all therapies. Blood pump speed (Qb) varied by subject from 300 ml/min for dialysis therapies completed for subjects B and F to 400 ml/min for dialysis therapies for subjects A and D. The dialyser type used was either FX-100 (subjects A, C, and D) or FX-80 (subjects B, E and F).

TECHNICAL PERFORMANCE

Subject ID	A			B			C	D	E	F	Mean	Median	Min	Max
Date of Dialysis:	30-Jun-2015	3-Jul-2015	6-Jul-2015	2-Jul-2015	9-Jul-2015	14-Jul-2015	8-Jul-2015	10-Jul-2015	13-Jul-2015	13-Jul-2015	N/A	N/A	N/A	N/A
Dialysate Temp (°C)	37.0	37.0	37.0	37.0	37.0	37.0	36.5	36.5	37.0	37.0	36.9	37.0	36.5	37.0
Dialysate Conductivity (mS/cm)	13.9	13.9	13.7	13.9	13.7	13.9	13.7	13.9	13.9	13.9	13.8	13.9	13.7	13.9
Target Treatment Time (min)	240.0	240.0	240.0	240.0	240.0	240.0	240.0	240.0	240.0	240.0	240.0	240.0	240.0	240.0
Total Treatment Time (min)	240.0	240.0	240.0	240.0	279.0	240.0	240.0	245.0	245.0	240.0	244.9	240.0	240.0	279.0
Washback Volume (mL)	-	350	365	350	250	300	340	400	350	340	338.3	350.0	250.0	400.0

Table 2: Technical performance of the SC+ measured by stability of the dialysate temperature and conductivity; total therapy time and washback volumes within normal range.

SC+

URR AND UF RESULTS

Subject ID	A		B		C	D	E	F	Mean	Median	Min	Max
Date of Treatment	30-Jul-15	3-Jul-15	2-Jul-15	9-Jul-15	8-Jul-15	10-Jul-15	13-Jul-15	13-Jul-15	N/A	N/A	N/A	N/A
Dialysis regimen (times per week)	5	5	3	3	3	3	3	3				
URR (%)	62.1	63.2	78.7	74.0	79.3	71.6	76.1	75.2	72.5	70.7	62.1	79.3
Single Pool Kt/V	1.08	1.12	1.73	1.51	1.82	1.36	1.67	1.58	1.49	1.45	1.08	1.82
Standardised Kt/V	3.22	3.29	2.43	2.28	2.48	2.12	2.38	2.32	2.57	2.71	2.12	3.29

Table 3: Percentage Urea Reduction Ratio (URR), single pool Kt/V and standardised Kt/V (stdKt/V) achieved on the 8 treatments where pre and post bloods were collected.

Subject: Date	Pre-treatment weight (kg)	Wash-back volume (Kg)	Fluid Intake (kg)	Post-treatment weight (kg)	Est. UF (kg)	Target UF (kg)	Est. UF Error (kg)	Est. UF Error Rate (kg/hr)
A: 30-Jun-15	156.50	0.360	0.00	155.70	1.160	1.0	0.160	0.0400
A: 3-Jul-15	153.30	0.350	0.25	152.10	1.800	1.5	0.300	0.0750
A: 6-Jul-15	155.50	0.365	0.40	154.30	1.965	1.6	0.365	0.0900
B: 2-Jul-15	78.60	0.350	0.40	78.70	0.650	0.6	0.050	0.0125
B: 9-Jul-15	80.40	0.250	0.30	79.85	1.100	0.9	0.200	0.0500
B: 14-Jul-15	80.15	0.300	0.30	79.90	0.850	0.9	-0.050	-0.0125
C: 8-Jul-15	89.00	0.340	0.30	87.80	1.840	2.1	-0.260	-0.0650
D: 10-Jul-15	150.70	0.400	0.50	150.80	0.800	0.6	0.200	0.0500
E: 13-Jul-15	83.75	0.350	0.30	81.95	2.450	2.4	0.050	0.0125
F: 13-Jul-15	101.25	0.340	0.30	100.80	1.090	1.5	-0.410	-0.1025

Table 4: An estimate of the actual UF was calculated by subtracting the post treatment weight from the sum of the following: the pre-treatment weight, washback, and any fluid intake during dialysis.

USABILITY OBSERVATIONS

- Open-response observations on the usability of the SC+ system collected from nurse operators of the system and study subjects post treatment:
  - Black background on the system graphical user interface and stepwise instructions on the dialysis process flow praised for ease of use – 4 instances
  - System size is small and compact – 6 instances
  - Subjects like the simplicity of the system for potential self-care – 3 instances
  - System is not as noisy as the other systems in the unit - 3 instances
  - Clip tidy and consumables tray are space saving – 1 instances
  - 1 subject requested to view their total blood clearance following the treatment (feature to be added)
- Overall, the clinical staff and subject usability assessments did not reveal any significant usability issues with the SC+ system.

CONCLUSIONS

- The Quanta SC+ Haemodialysis system performed safely with acceptable clinical and technical performance in the haemodialysis-dependent ESRD subject population. There was no measured loss of therapy time, UF error was acceptable, no significant usability issues were noted, and there were no safety issues or device-related adverse events in this subject population.
- Clinical performance was demonstrated by urea reduction ratio (URR), with all results surpassing the recommended guidelines of 65% for the 3 times per week dialysis, while all sessions with subjects on 3 times per week schedules demonstrated over 70% URR.
- Clinical performance was further demonstrated by all subjects attaining StdKt/V greater than 2.1 for all sessions, recommended as a weekly adequacy equivalence by Gotch; the maximum achieved StdKt/V was 3.29.
- All dialysis sessions attained the full therapy time prescribed, with no sessions prematurely terminated due to any technical or clinical issues.

Email: enquiries@quantadt.com **Tel:** +44 (0) 1789 400043