XVI Konferencja
Polskiego Towarzystwa Nefrologii Dziecięcej
11-13 maja 2017r.

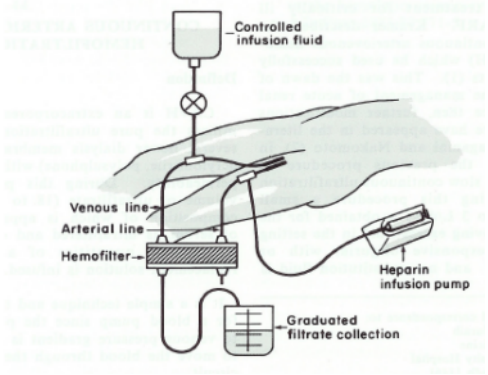
Co nowego w technikach ciągłych?

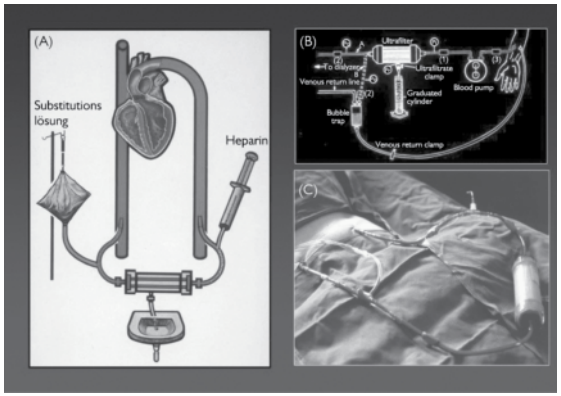
Sylwester Prokurat
Klinika Nefrologii, Transplantacji Nerek i Nadciśnienia Tętniczego
IPCZD Warszawa

CRRT ma 40 lat

Klin. Wschr. 55, 1121–1122 (1977)

Klinische Wochenschrift





Kurze wissenschaftliche Mitteilungen

Arteriovenous Haemofiltration: A New and Simple Method for Treatment of Over-hydrated Patients Resistant to Diuretics*

P. Kramer, W. Wigger, J. Rieger, D. Matthaei and F. Scheler

University Hospital, Department of Internal Medicine, Division of Nephrology, Göttingen

Arteriovenöse Hämofiltration: eine neue und einfache Methode zur Behandlung diuretika-resistent überwässerter Patienten

Zusammenfassung. Unter Ausnutzung des arteriovenösen Blutdruckgradienten wurden überwässerte Patienten, bei denen eine Ausschwemmung mit Diuretika nicht mehr zu erreichen war, mit einem Kapillarhämofilter entwässert. Mit einer Blutperfusionsrate von 100 ml/min lag die Ultrafiltrationsrate bei 200–600 ml/h und konnte bis zu 48 h ohne Wechsel des Hämofilters aufrechterhalten werden. Der besondere Vorteil der arteriovenösen Hämofiltration liegt in der einfachen Handhabung für den Arzt und dem geringen Risiko für den Patienten im Vergleich zur maschinellen Hämofiltration. Eine technische Investition ist nicht erforderlich. Auch bei Blutdruckwerten um 60 mm Hg ist eine negative Flüssigkeitsbilanz möglich.

Schlüsselwörter: Niereninsuffizienz – Diuretika – Dyspnoe – Ödeme – Flüssigkeitsbilanz – Hämofiltration.

Summary. Fluid withdrawal in over-hydrated patients resistant to diuretics was obtained by means of a capillary haemofilter, using the arterio-venous pressure gradient for blood perfusion at a rate of 100 ml/min. The ultrafiltration rate was 200–600 ml/h and could be maintained as long as 48 h without changing the haemofilter. This method, which needs no technical investment, is easy and simple to handle for the physician, bears only a very low risk for the patient, and ensures a negative fluid balance even at a mean blood pressure of only 60 mm Hg.

Key words: Renal failure – Diuretics – Dyspnoea – Oedema – Fluid balance – Haemofiltration.

Introduction

The management of the fluid overloaded patient who is resistant to diuretics is a problem occasionally encountered by the physician in intensive care units. These patients may require water removal by peritoneal dialysis or by the artificial kidney, if rotating tourniquets and phlebotomy are ineffective or not practicable. This report describes a very simple and safe method that will enable the physician to remove plasma water and sodium swiftly in a controlled and predictable manner without technical investment.

* Supported by the Deutsche Forschungsgemeinschaft SFB 89 Kardiologie Göttingen

Materials and Methods

An emergency dialysis catheter (Vygon, Écouen, France; Art. No. 1130.07) was inserted in one of the femoral arteries and in the contralateral femoral vein by means of the Seldinger technique. After i.v. injection of 10,000 IU of heparin an In-Line-Ultrafilter (Amicon corp., Lexington, Mass.) filled with heparinised saline (5000 IU heparin/l) was connected with the arterial and then after passage of the blood through the capillaries with the venous catheter as illustrated in Figure 1. Heparin was administered at a rate

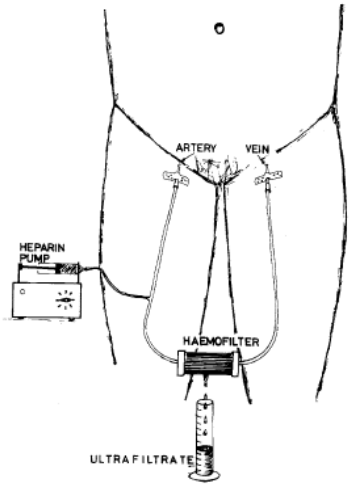
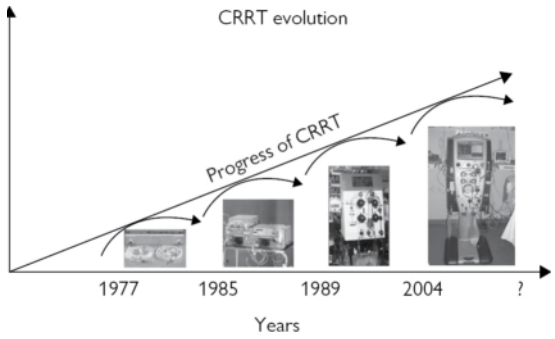
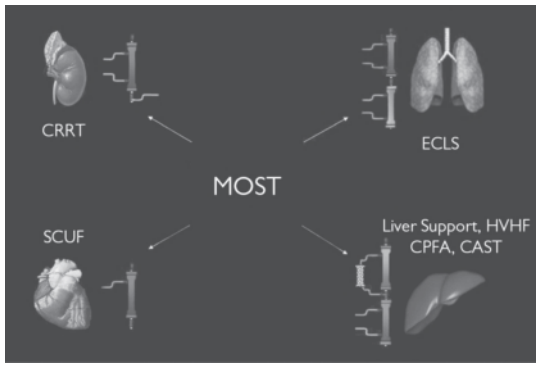


Fig. 1. Schematic representation of the arterio-venous haemofiltration technique. For details see text

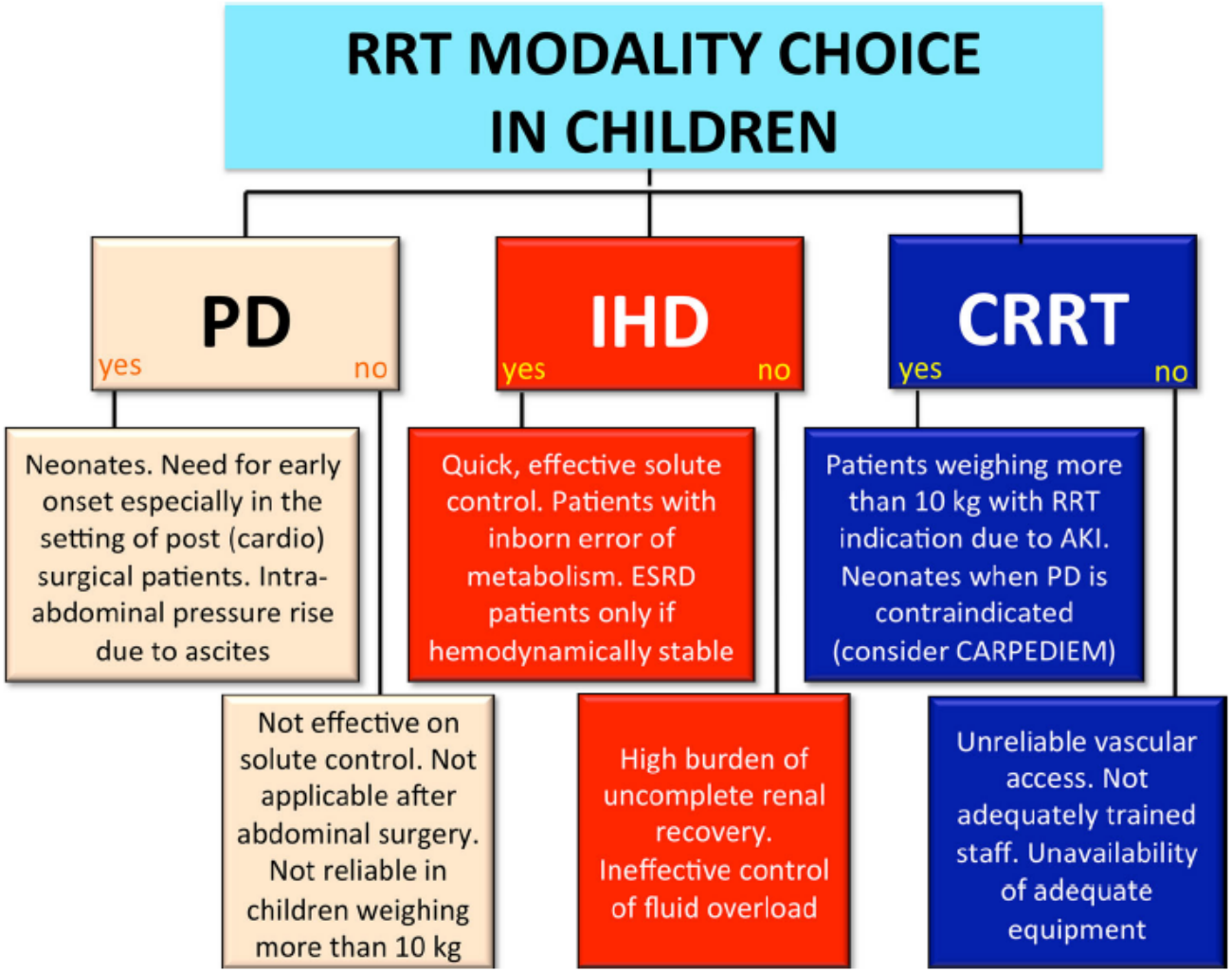




Pediatric continuous renal replacement: 20 years later

Intensive Care Med (2015) 41:985–993

Claudio Ronco
Zaccaria Ricci



Mehta *Critical Care* 2015, **19**:S9
http://www.ccforum.com/content/19/S3/S9

CRITICAL CARE

REVIEW Open Access

Challenges and pitfalls when implementing renal replacement therapy in the ICU

Ravindra L Mehta

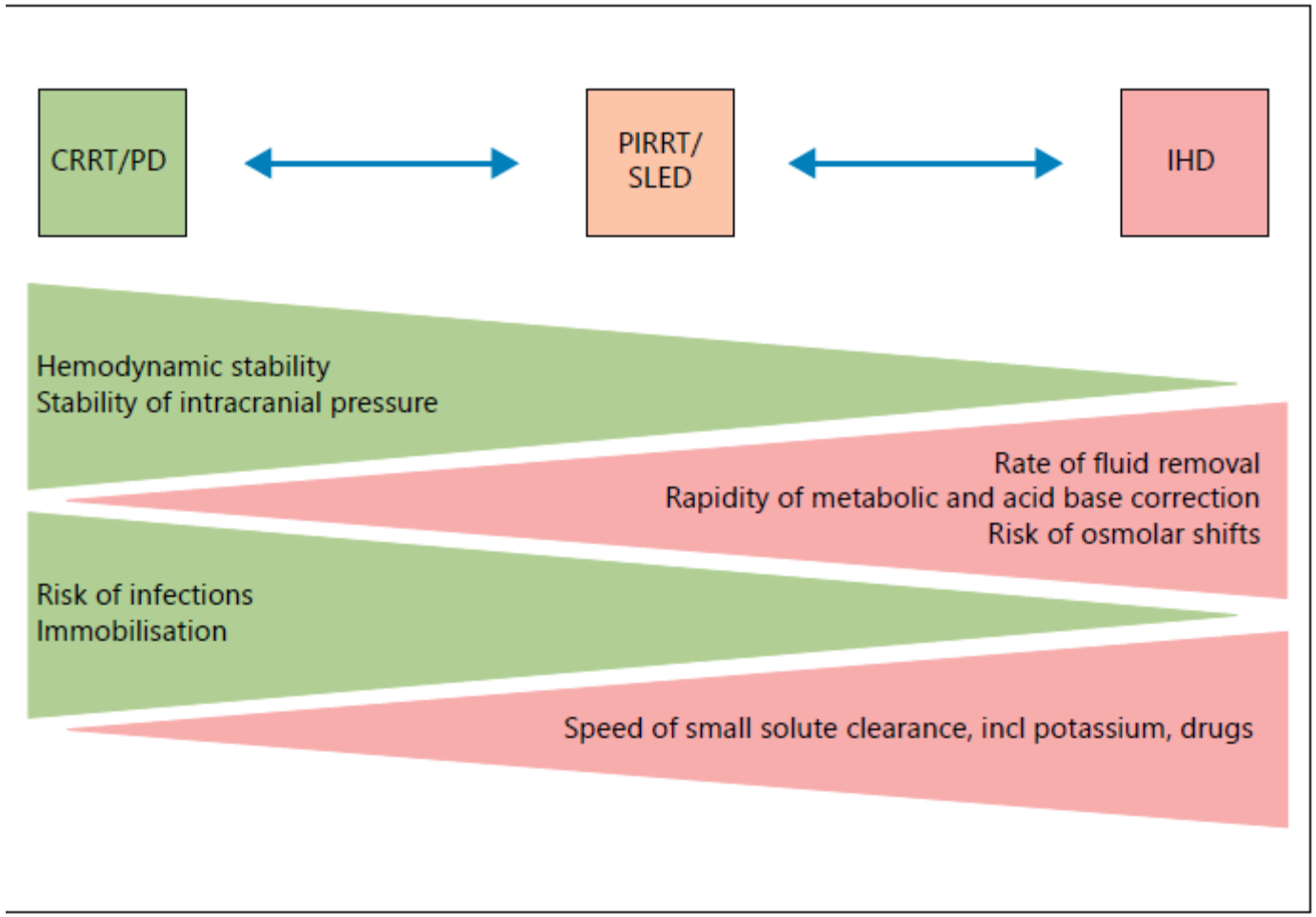
Defining the goals of therapy is a key consideration in the use of RRT in the ICU.

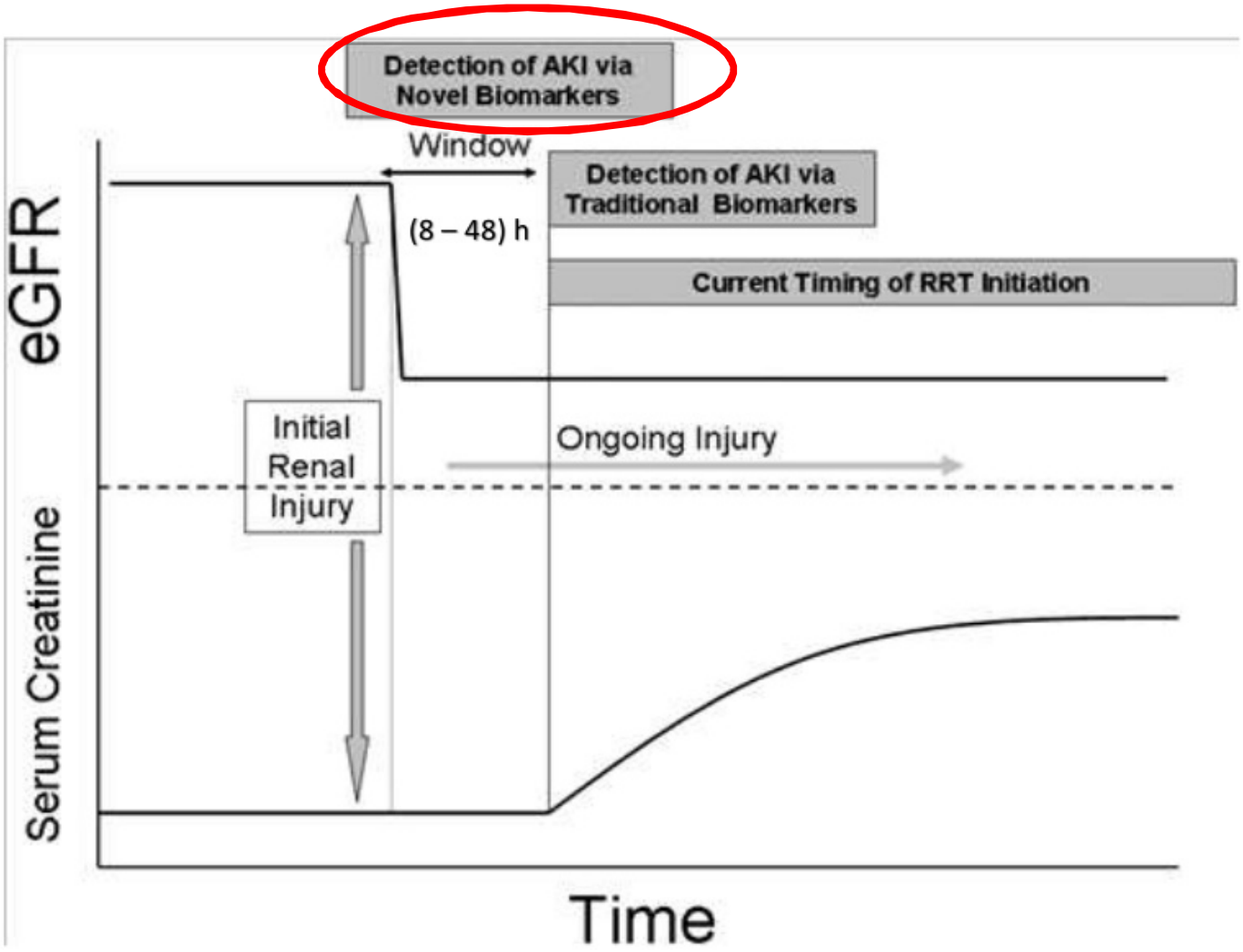
Unfortunately, there is no consensus on the goals for therapy with RRT in the ICU.

Patient Selection and Timing of Continuous Renal Replacement Therapy

Marlies Ostermann[a] Michael Joannidis[b] Antonello Pani[c] Matteo Floris[c]
Silvia De Rosa[d] John A. Kellum[e] Claudio Ronco[d] on behalf of the 17th Acute Disease Quality Initiative (ADQI) Consensus Group

Blood Purif 2016;42:224–237




Detection of AKI via Novel Biomarkers
Window
(8 – 48) h
Detection of AKI via Traditional Biomarkers
Current Timing of RRT Initiation
eGFR
Initial Renal Injury
Ongoing Injury
Serum Creatinine
Time

The impact of "early" versus "late" initiation of renal replacement therapy in critical care patients with acute kidney injury: a systematic review and evidence synthesis

Benjamin T. Wierstra[1], Sameer Kadri[2], Soha Alomar[2], Ximena Burbano[2], Glen W. Barrisford[2] and Raymond L. C. Kao[2,3*]

Wierstra *et al. Critical Care* (2016) 20:122
DOI 10.1186/s13054-016-1291-8

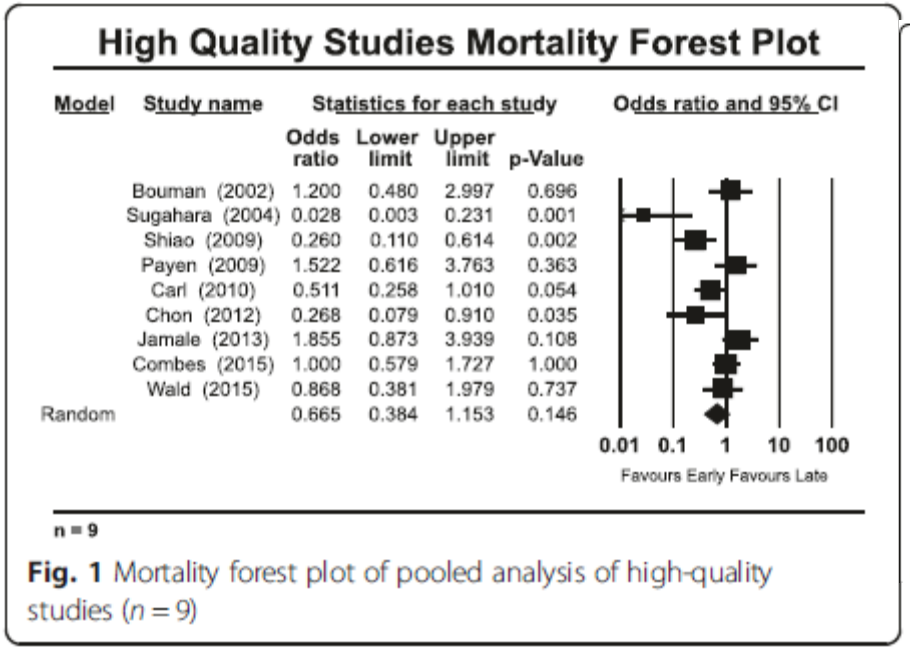


Fig. 1 Mortality forest plot of pooled analysis of high-quality studies ($n = 9$)

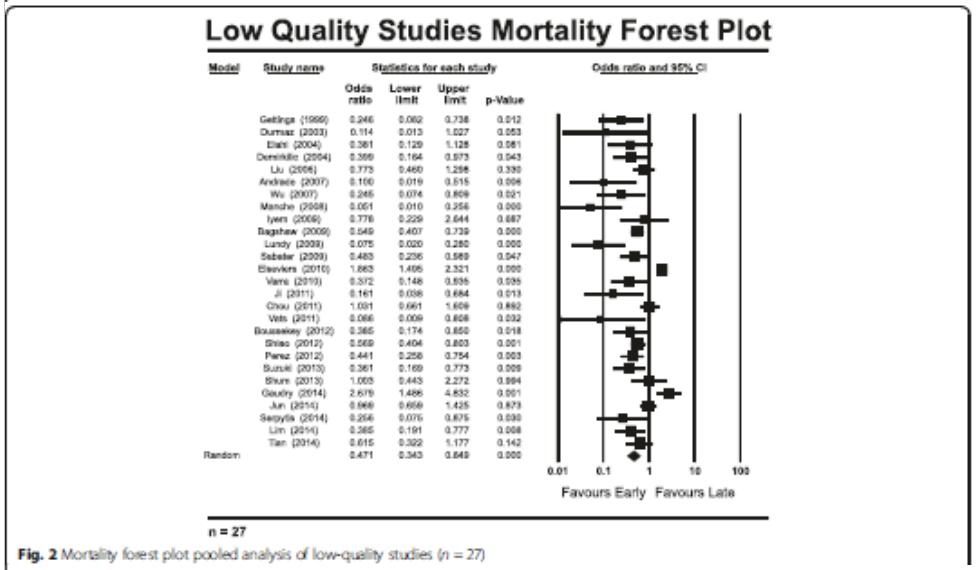


Fig. 2 Mortality forest plot pooled analysis of low-quality studies ($n = 27$)

The effect of continuous versus intermittent renal replacement therapy on the outcome of critically ill patients with acute renal failure (CONVINT): a prospective randomized controlled trial

CRITICAL CARE

Schefold *et al. Critical Care* 2014, **18**:R11

Joerg C Schefold[1*], Stephan von Haehling[2], Rene Pschowski[1,3], Thorsten Onno Bender[1], Cathrin Berkmann[1], Sophie Briegel[1], Dietrich Hasper[1] and Achim Jörres[1]

Table 3 Clinical outcome of study patients

		iHD group (n = 128)	CVVH group (n = 122)	*P* value
Survival at 14 days after RRT		39.5%	43.9%	0.81[a]
14-day mortality rate		43.6%	37.8%	0.63[a]
30-day mortality rate		52.4%	45.4%	0.60[a]
All-cause intrahospital mortality rate (last contact)		60.3%	54.6%	0.72[a]
Days until death		15.6 ± 44.5	18.5 ± 48.9	0.71
Days until death on ICU		15.5 ± 45.9	18.4 ± 50.0	0.73
Days until hospital discharge (in survivors)		51.2 ± 47.1	48.7 ± 49.7	0.78
Days in ICU		25.2 ± 40.1	22.3 ± 26.1	0.50
Days in hospital		33.9 ± 49.3	32.4 ± 37.4	0.79
Suspected reason for death (multiple possible)	Cardiac failure	31	22	0.42[a]
	Pulmonary failure	39	31	0.59[a]
	Sepsis	56	45	0.55[a]
	CNS	7	6	0.92[a]
	Hemorrhagy	5	4	0.93[a]
	Withdrawal of therapy	4	2	0.74[a]
Days on RRT		17.2 ± 37.1	13.7 ± 17.9	0.35
Dialysis-free days		4.2 ± 9.6	3.1 ± 9.0	0.38
RRT switch (number of patients)		25 (19.5%)	56 (45.9%)	0.002[a]
Number of patients on RRT (% of survivors, days after ICU admission)	At 21 days	20 (32.3%)	20 (29.9%)	0.97[a]
	At 60 days	14 (26.4%)	13 (22.8%)	0.90[a]
Serum creatinine at hospital discharge/last contact (in survivors; mg/dl)		2.18 ± 1.8	2.12 ± 1.7	0.85
Total days on vasopressors		4.3 ± 3.7	4.5 ± 3.7	0.75
Cumulative vasopressor dose (g)	Epinephrine	0.70	0.64	0.96
	Norepinephrine	19.1	18.5	0.30
	Dobutamine	150.2	137.9	0.56
Total days on mechanical ventilation		8.1 ± 8.8	7.2 ± 6.5	0.34
Total fluid balance (L)		20.5 ± 23.2	24.9 ± 28.4	0.19

Between-group *P* values are given. Independent samples *t* test except [a](χ^2). Means ± SD.

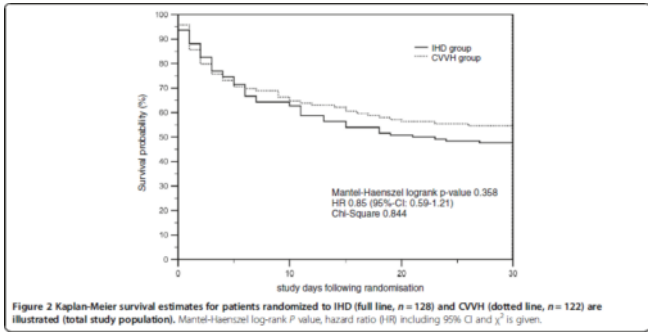


Figure 2 Kaplan-Meier survival estimates for patients randomized to IHD (full line, n = 128) and CVVH (dotted line, n = 122) are illustrated (total study population). Mantel-Haenszel log-rank *P* value, hazard ratio (HR) including 95% CI and χ^2 is given.

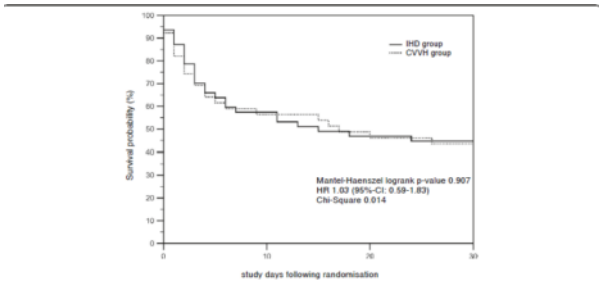


Figure 3 Kaplan-Meier survival estimates for the subpopulation of patients with high vasopressor need (overall sample; high vasopressor use defined as >0.3 μg/kg/min at any point in time during the study interval) in the IHD (full line, n = 47) versus CVVH (dotted line, n = 40) groups are illustrated. Mantel-Haenszel log-rank *P* value, hazard ratio (HR), including 95% CI and χ^2 is given.

ORIGINAL

Continuous renal replacement therapy versus intermittent hemodialysis in intensive care patients: impact on mortality and renal recovery

Anne-Sophie Truche[1,2,3], Michael Darmon[4,5], Sébastien Bailly[1,6], Christophe Clec'h[1,7,8], Claire Dupuis[1,9], Benoit Misset[10,11], Elie Azoulay[12,13], Carole Schwebel[2], Lila Bouadma[9], Hatem Kallel[14], Christophe Adrie[15], Anne-Sylvie Dumenil[16], Laurent Argaud[17], Guillaume Marcotte[18], Samir Jamali[19], Philippe Zaoui[3], Virginie Laurent[20], Dany Goldgran-Toledano[21], Romain Sonneville[9], Bertrand Souweine[22], Jean-Francois Timsit[1,9,23*] and OUTCOMEREA Study Group[1]

Intensive Care Med

Received: 24 February 2016 Accepted: 23 May 2016
Published online: 03 June 2016

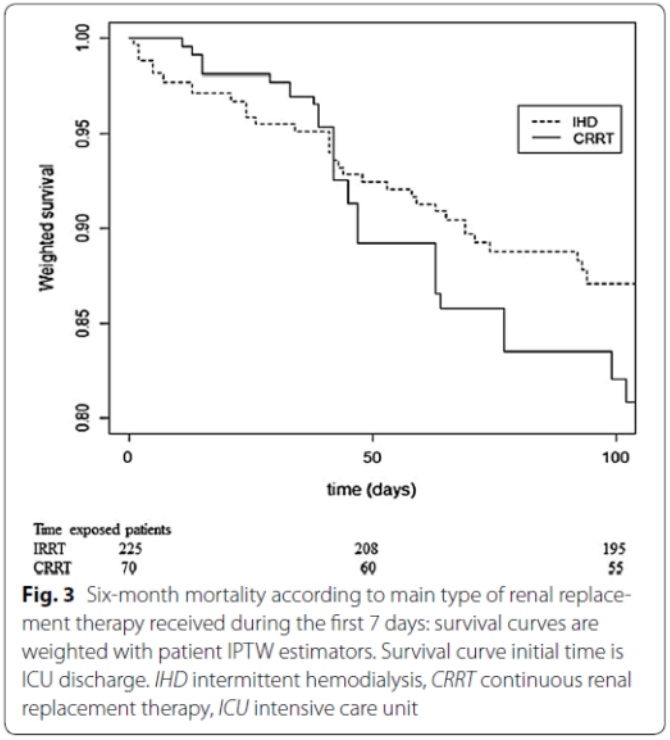


Fig. 3 Six-month mortality according to main type of renal replacement therapy received during the first 7 days: survival curves are weighted with patient IPTW estimators. Survival curve initial time is ICU discharge. *IHD* intermittent hemodialysis, *CRRT* continuous renal replacement therapy, *ICU* intensive care unit

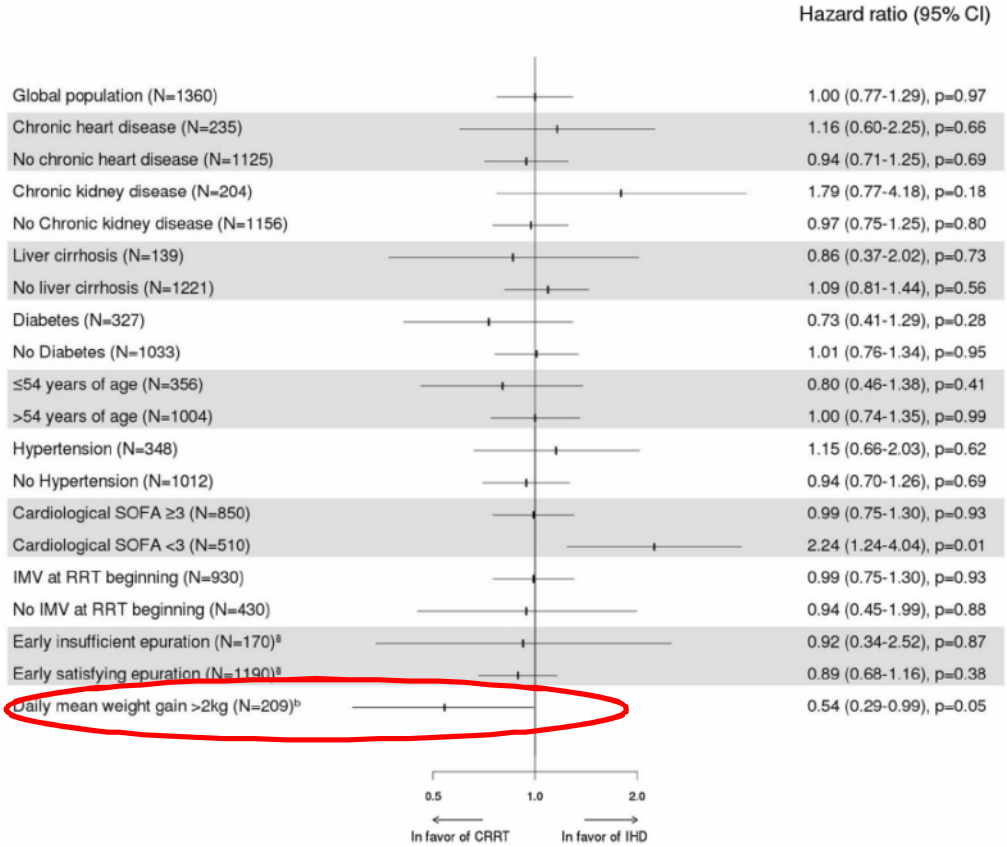
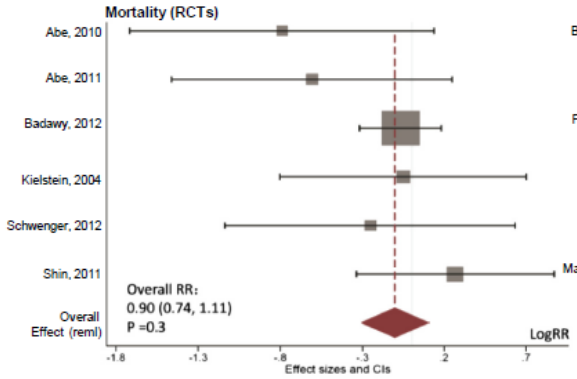


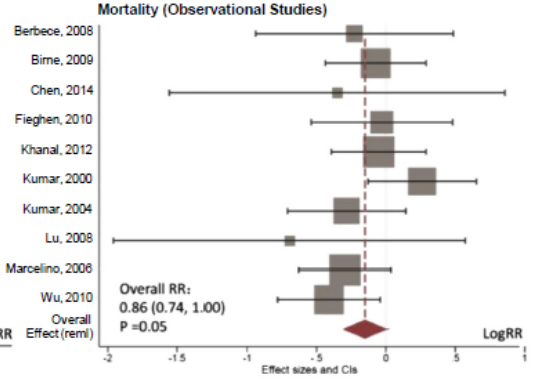
Fig. 2 30-day mortality and dialysis dependency according to renal replacement therapy technique received, in the global population and subgroups analyses. *a* At first RRT session. *b* Between ICU entrance and inclusion. *CI* confidence interval, *IMV* invasive mechanical ventilation, *SOFA* sequential organ failure assessment, *RRT* renal replacement therapy, *IHD* intermittent hemodialysis, *CRRT* continuous renal replacement therapy

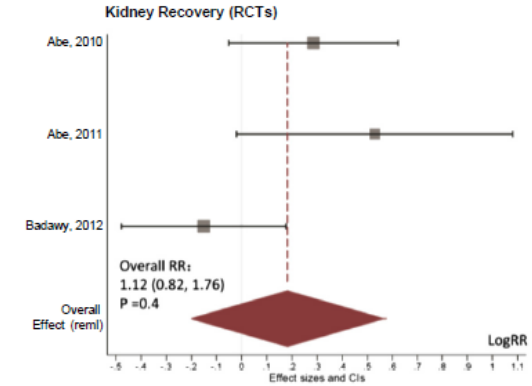
Extended Daily Dialysis Versus Continuous Renal Replacement Therapy for Acute Kidney Injury: A Meta-analysis

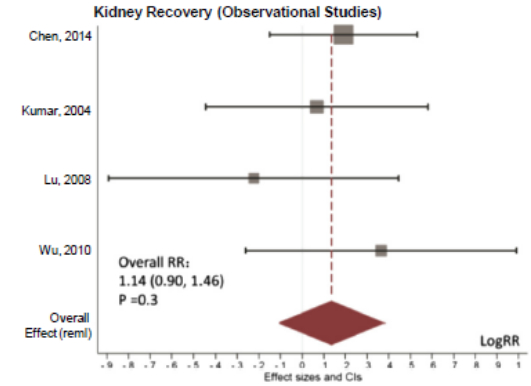
Ling Zhang, MD,[1,2] Jiqiao Yang, MD,[3] Glenn M. Eastwood, MD,[2] Guijun Zhu, MD,[2,4] Aiko Tanaka, MD,[2] and Rinaldo Bellomo, MD, PhD[2]

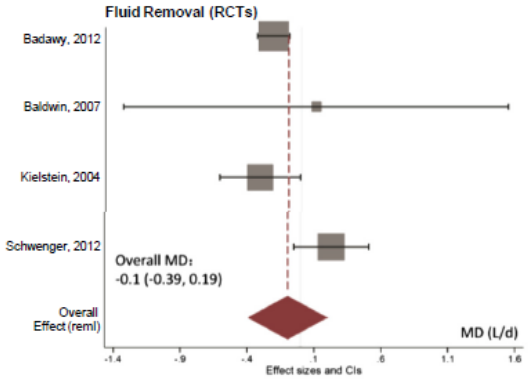
Am J Kidney Dis. 2015;66(2):322-330

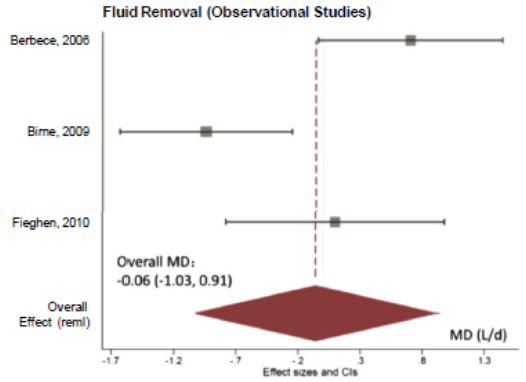












The International Journal of Artificial Organs / Vol. 30 / no. 4, 2007 / pp. 279-280

The monthly thought of the Editor

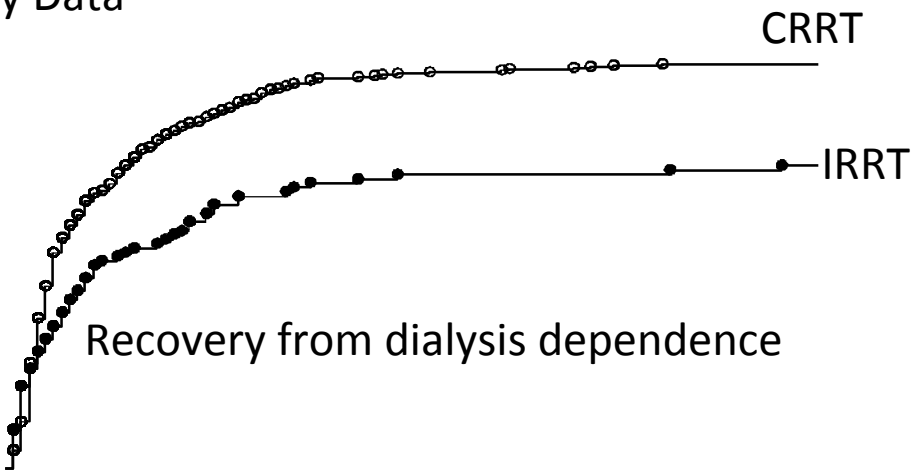
CRRT protects the kidney during acute renal failure

IMPORTANT EDITORIAL FROM RONCO IN THE ISSUE OF INTERNATIONAL JOURNAL OF ARTIFICIAL ORGANS

It suggests the use of CRRT as a "protector" for the kidney in AKI

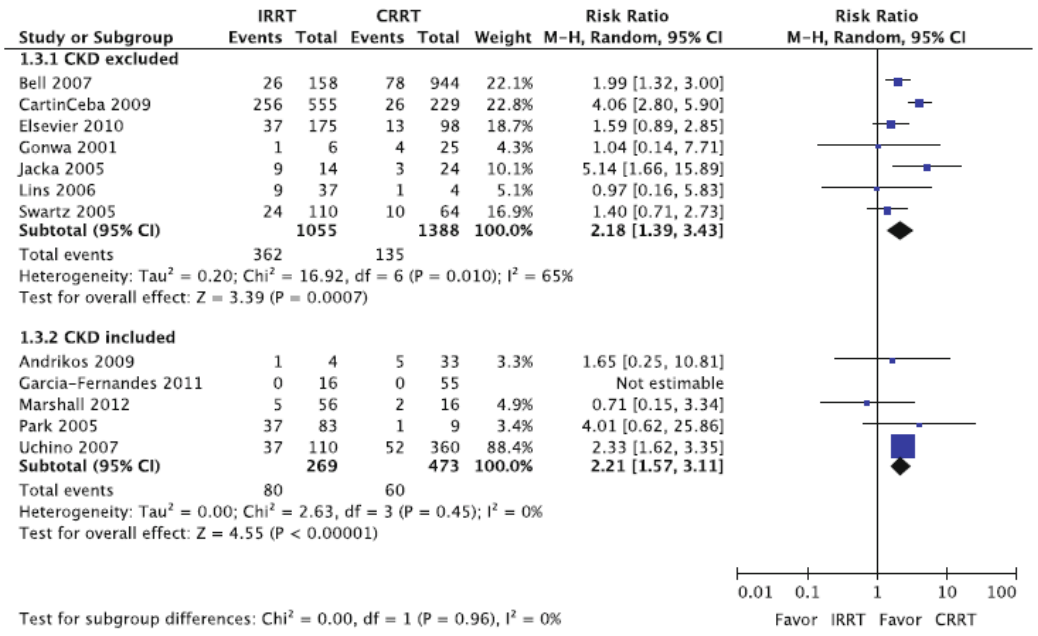
In conclusion, we should not forget to protect the kidney, even during the anuric phase of acute renal failure. We can still protect and preserve the renal parenchyma and its function from further injury by making efforts to achieve and maintain homeostasis. CRRT can be an important tool to achieve this goal.

Recovery from Dialysis Dependence: BEST Kidney Data



Choice of renal replacement therapy modality and dialysis dependence after acute kidney injury: a systematic review and meta-analysis

Intensive Care Med (2013) 39:987–997



Role of Technology for the Management of AKI in Critically Ill Patients: From Adoptive Technology to Precision Continuous Renal Replacement Therapy

J. Cerdá[a] I. Baldwin[c] P.M. Honore[d] G. Villa[e] John A. Kellum[b]
Claudio Ronco[f] on behalf of the ADQI Consensus Group

Blood Purif 2016;42:248–265

W poszukiwaniu precyzji

W jaki sposób i kiedy może pomóc technologia w leczeniu AKI?
Czy rozpoczęcie leczenia powinno wynikać z opracowanego algorytmu?
Jakie są podstawowe składniki technologiczne pomocne w „przepisywaniu dawki” CRRT?
Jakie są podstawowe składniki technologiczne niezbędne w „dostarczeniu dawki” CRRT?
Czy technologia może pomóc w procesie „przepisywania” i dynamicznej kontroli osiąganych celów?
Jak powinna być planowana adekwatność zabiegu i dostarczana dawka?
Kiedy powinny być użyte inne techniki pozaustrojowej eliminacji? (HVHF, MARS, TPE, ECMO, ECCOR?
Jakie powinny być główne kierunki rozwoju technologii pomocnej w CRRT?

Role of Technology for the Management of AKI in Critically Ill Patients: From Adoptive Technology to Precision Continuous Renal Replacement Therapy

J. Cerdá[a] I. Baldwin[c] P.M. Honore[d] G. Villa[e] John A. Kellum[b]
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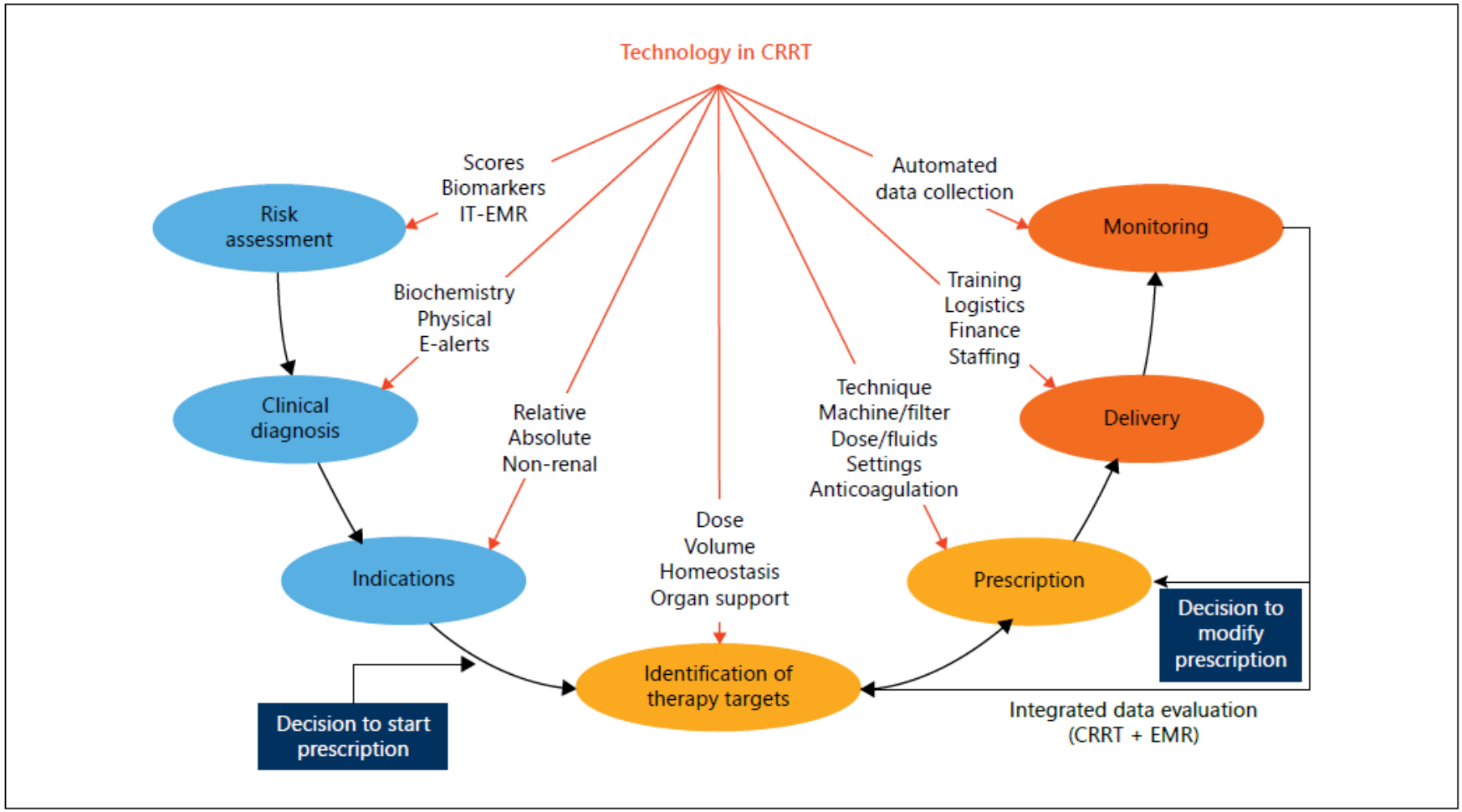
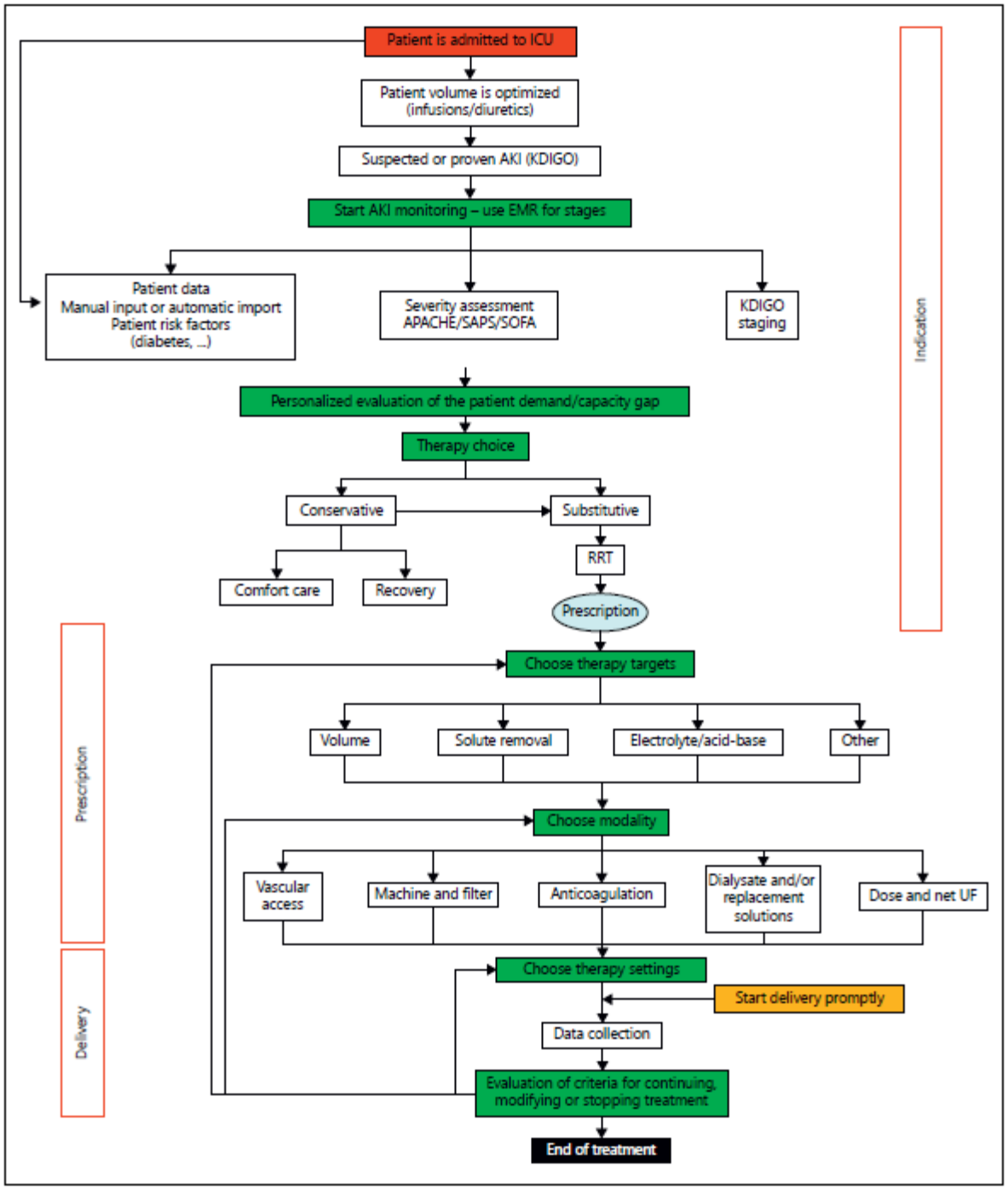
Blood Purif 2016;42:248–265

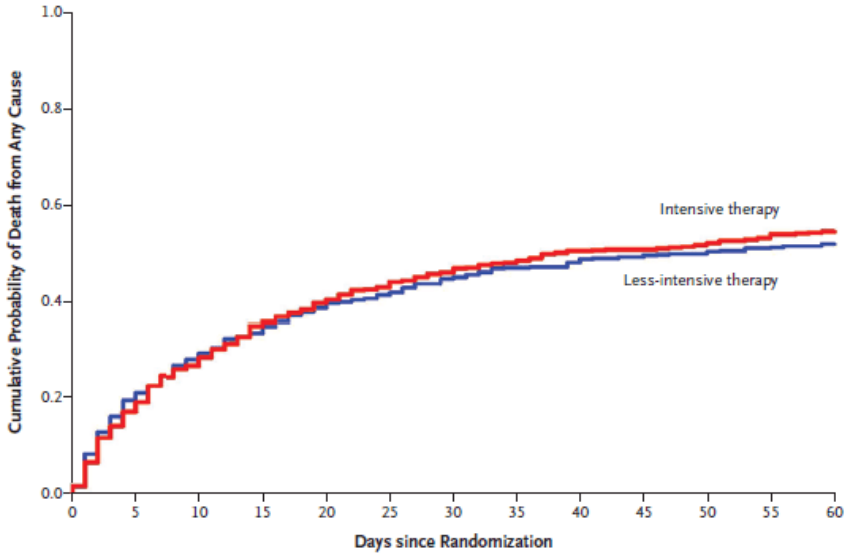


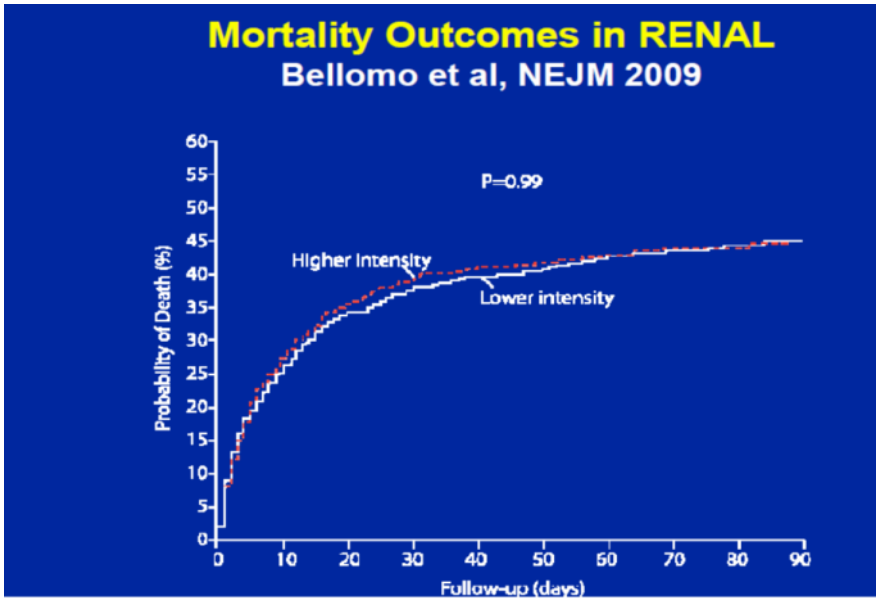

Patient is admitted to ICU
Patient volume is optimized (infusions/diuretics)
Suspected or proven AKI (KDIGO)
Start AKI monitoring – use EMR for stages
Patient data
Manual input or automatic import
Patient risk factors
(diabetes, ...)
Severity assessment
APACHE/SAPS/SOFA
KDIGO staging
Indication
Personalized evaluation of the patient demand/capacity gap
Therapy choice
Conservative
Substitutive
Comfort care
Recovery
RRT
Prescription
Choose therapy targets
Volume
Solute removal
Electrolyte/acid-base
Other
Choose modality
Vascular access
Machine and filter
Anticoagulation
Dialysate and/or replacement solutions
Dose and net UF
Prescription
Choose therapy settings
Start delivery promptly
Data collection
Delivery
Evaluation of criteria for continuing, modifying or stopping treatment
End of treatment

Optymalna dawka RRT?

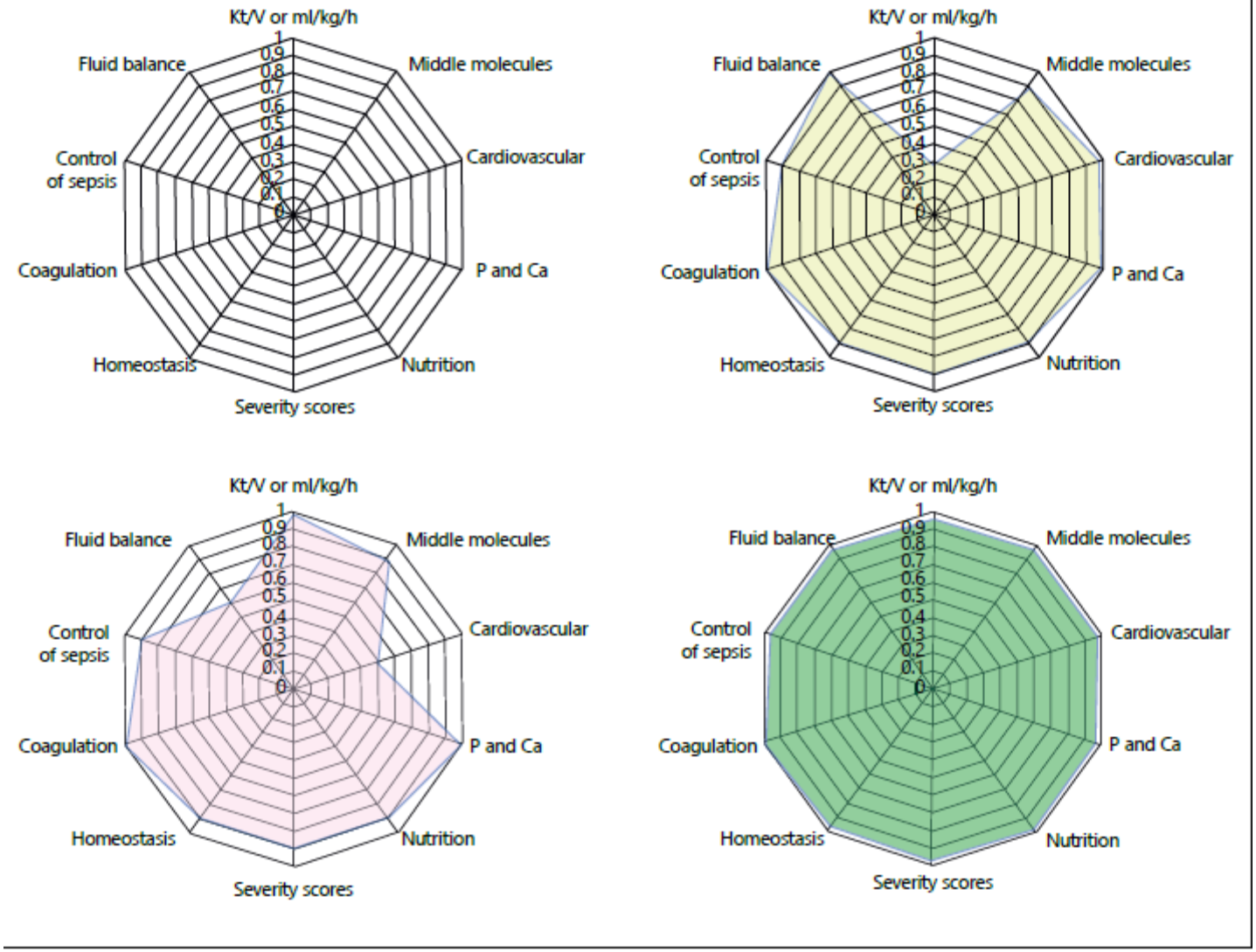
- Optymalna intensywność leczenia nadal pozostaje kontrowersyjna

- VA/NIH Acute Renal Failure Trial Network





Role of Technology for the Management of AKI in Critically Ill Patients: From Adoptive Technology to Precision Continuous Renal Replacement Therapy



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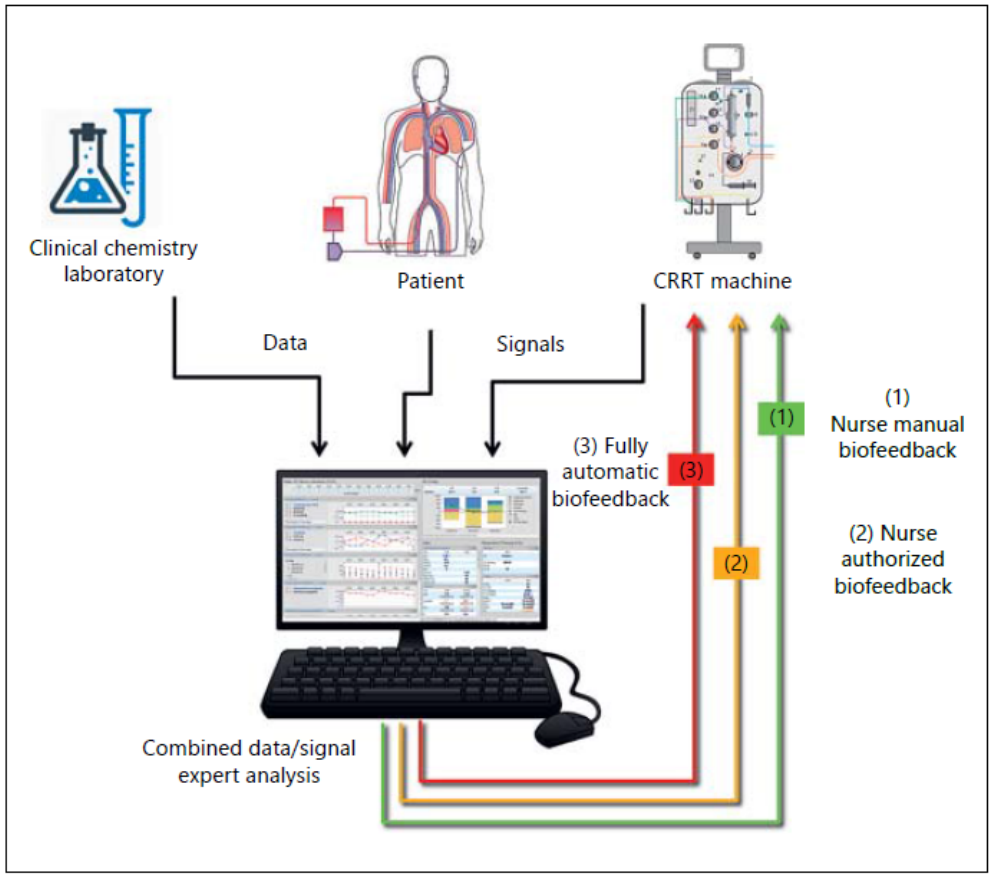
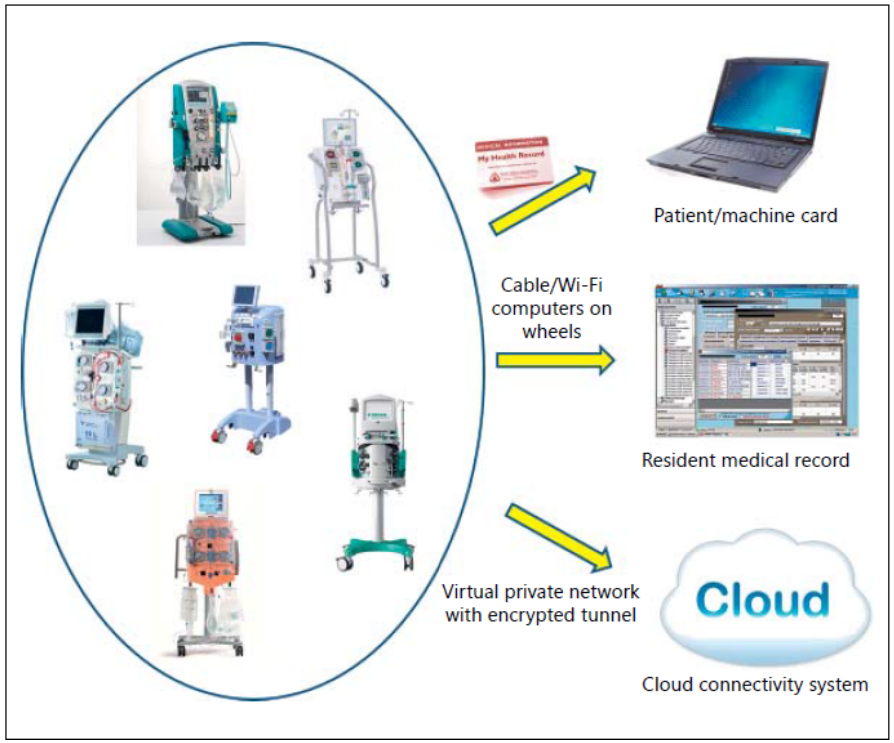




Renal replacement therapy in acute kidney injury: controversy and consensus

CRITICAL CARE
Ronco et al. Critical Care (2015) 19:146

Idealny model przyszłości CRRT

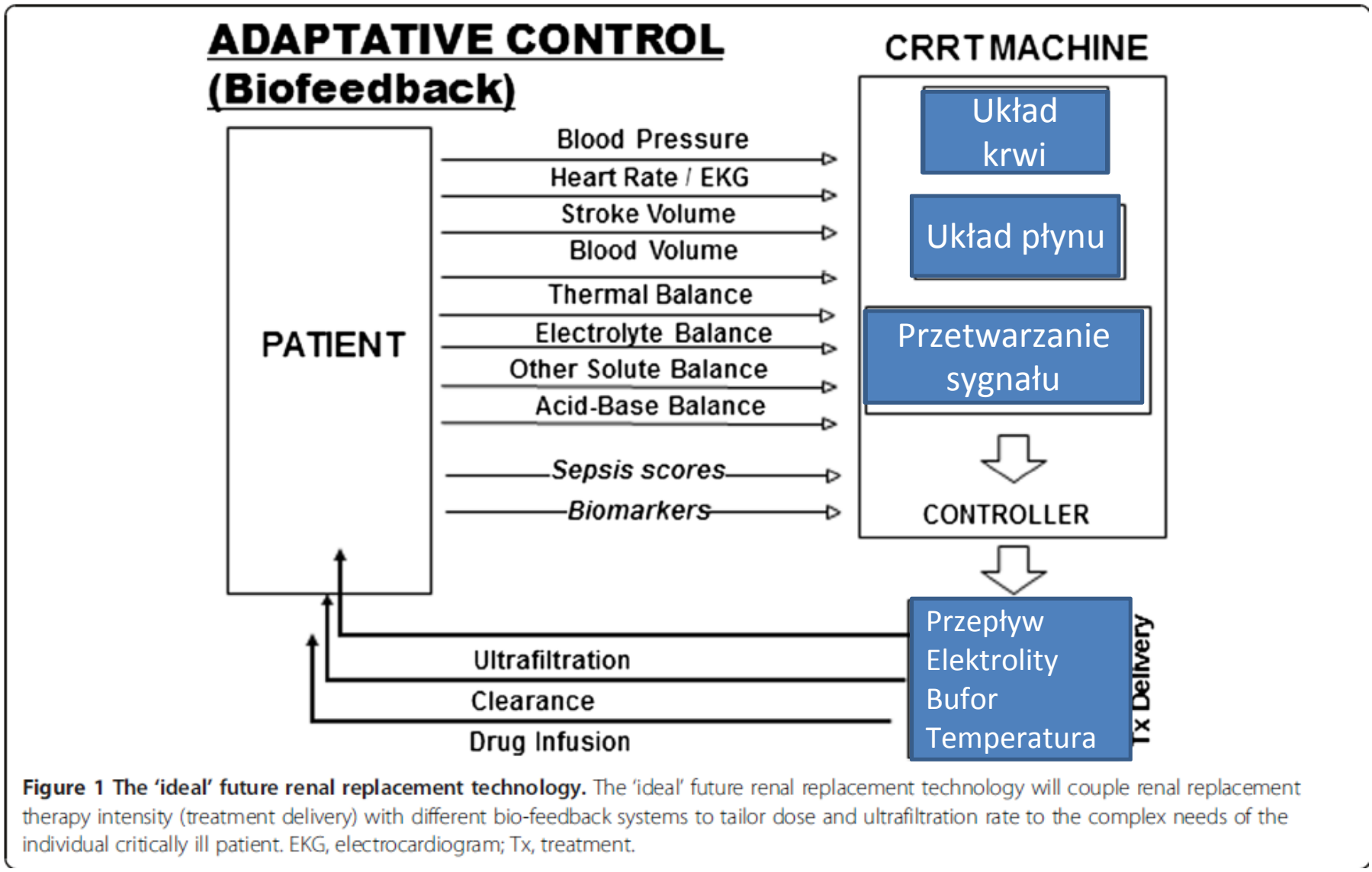


Figure 1 The 'ideal' future renal replacement technology. The 'ideal' future renal replacement technology will couple renal replacement therapy intensity (treatment delivery) with different bio-feedback systems to tailor dose and ultrafiltration rate to the complex needs of the individual critically ill patient. EKG, electrocardiogram; Tx, treatment.

Blood Purification

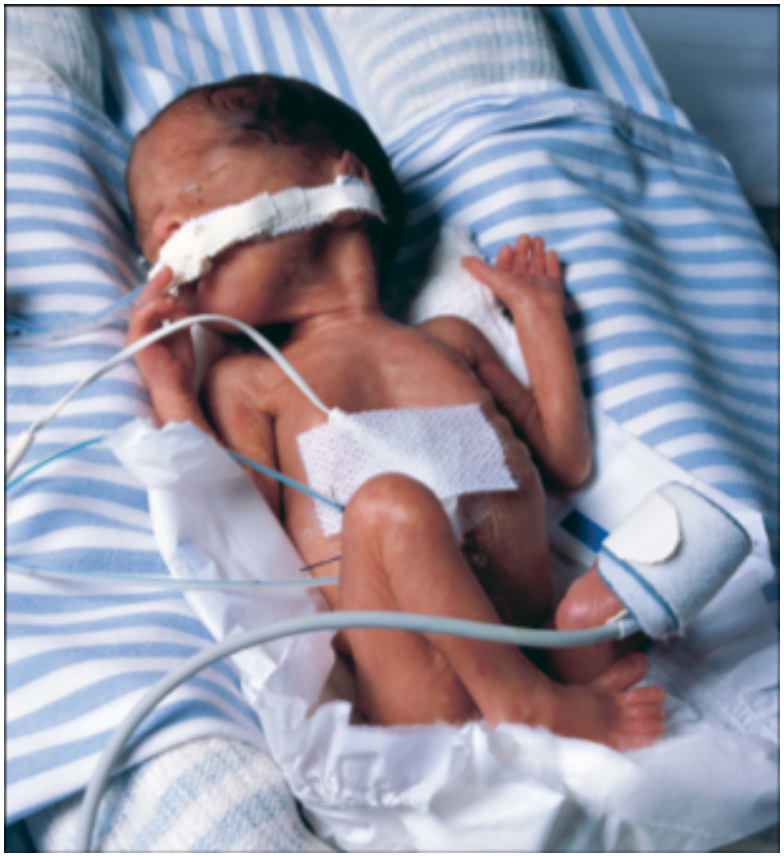
ADQI Consensus

Blood Purif 2016;42:248–265
DOI: 10.1159/000448527

Zgodnie z zaleceniami 17 raportu ADQI (Asiago, czerwiec 2016)

- Rekomenduje się stosowanie nowoczesnych narzędzi informatycznych w celu poprawy praktycznej opieki nad pacjentem (A)
- Proces ten powinien określać jasne etapy i wspólną terminologię jak również dostarczanie precyzyjnej dawki CRRT (A)
- Dostarczona dawka leczenia powinna być jak najbliższa dawce przepisanej z częstą jej modyfikacją (co 6 godz) (A)
- Zalecana jest integracja pacjenta z sygnałami z aparatury CRRT poprzez narzędzia IT i magazynujące dane (B)
- Ocena dawki dostarczonej powinna być mierzona przynajmniej raz na dobę (KT/V) lub w szerszym rozumieniu oceniając inne parametry (Radar plot)
- W przypadku stosowania innych technik nie rekomenduje się HVHF w leczeniu sepsy (A), PF, MARS, CRRT/ECMO, ECCOR powinne być stosowane jedynie z indywidualnych wskazań (D)

Postęp także u najmniejszych

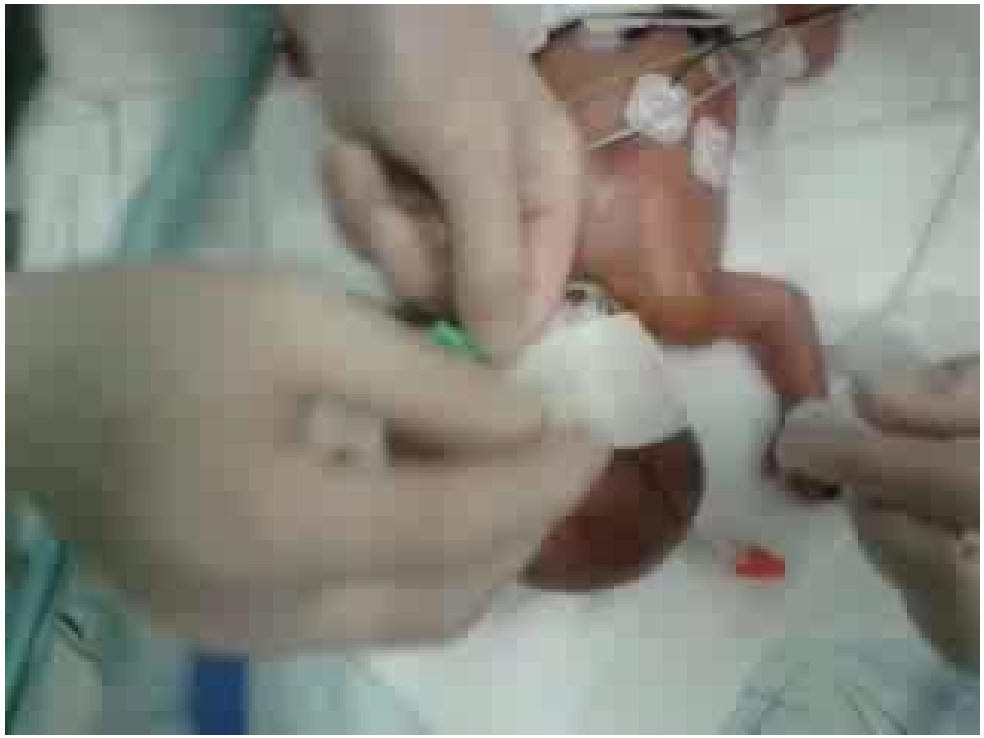


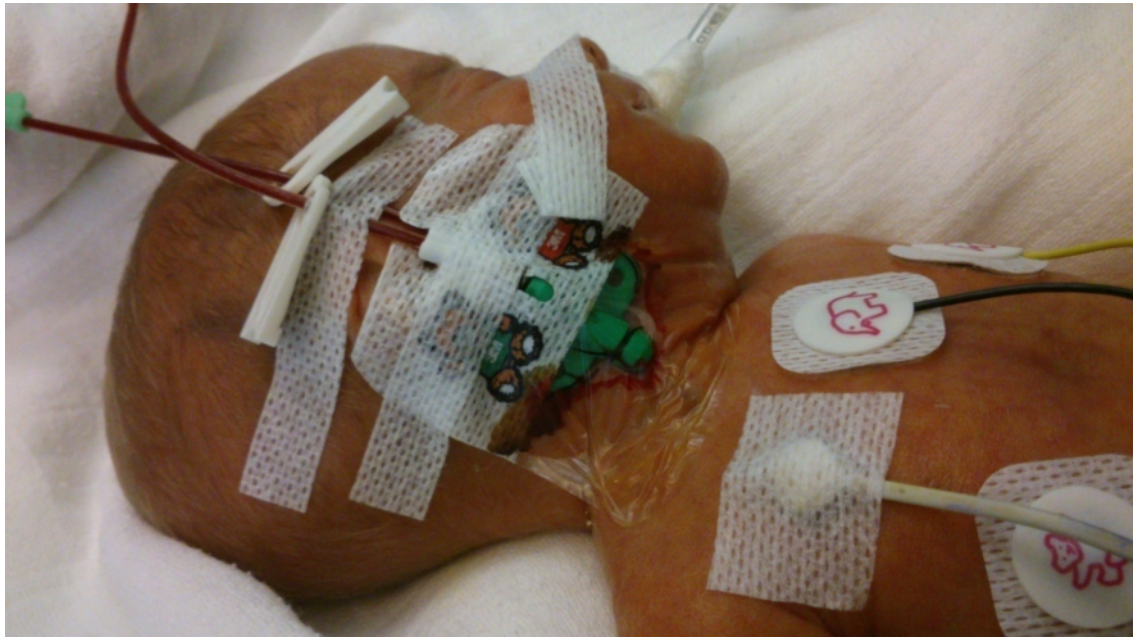
Wojewódzki Szpital Specjalistyczny w Legnicy

Wojciech Kowalik, Krystyna Solawa, Anastasija Sinicka, Magdalena Szmyt, Beata Kowalczyk

Noworodek 25 Hbd,
820 g leczony CRRT

%FO = 35%

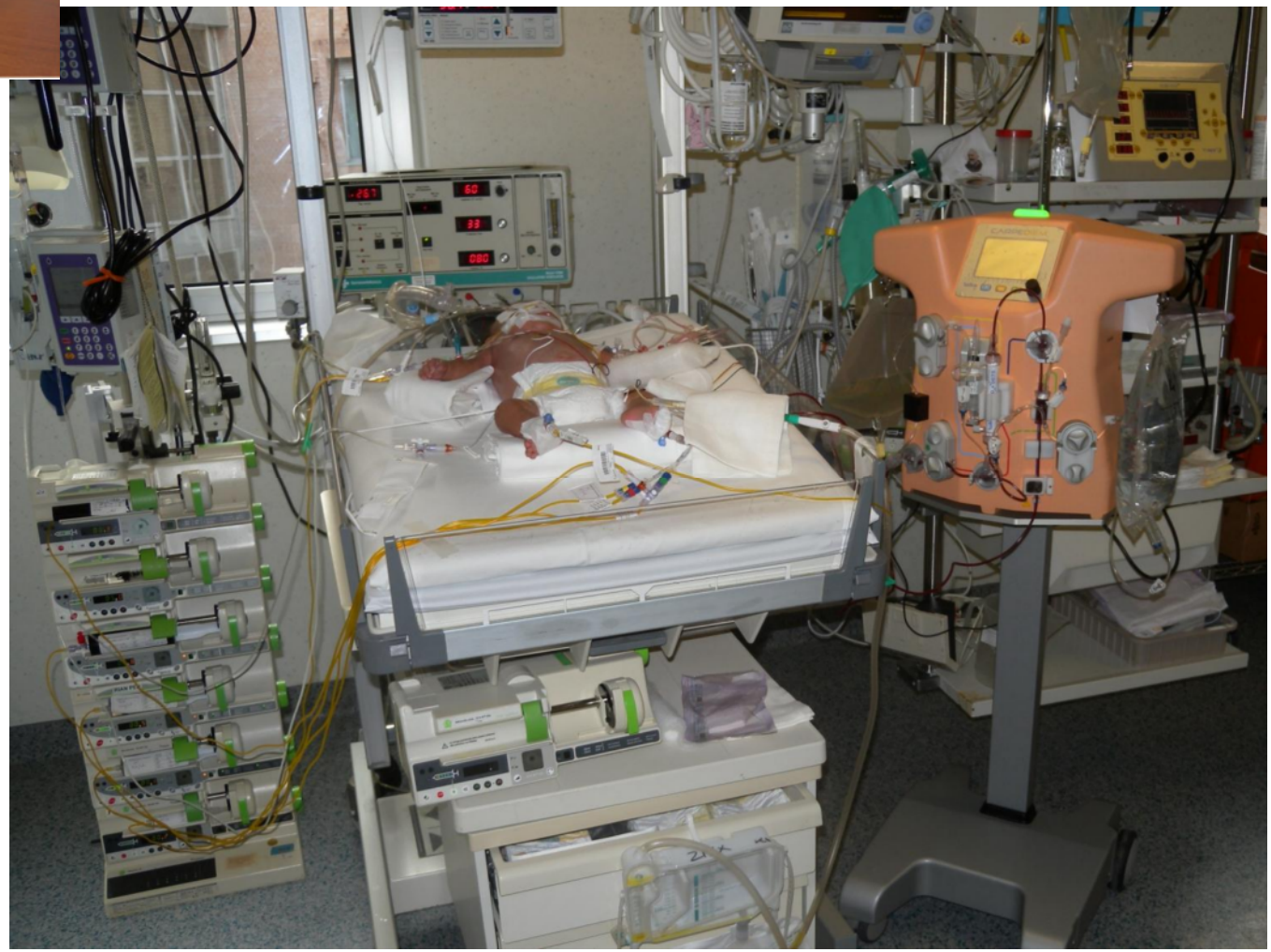




CA.R.PE.DI.E.M. (Cardio–Renal Pediatric Dialysis Emergency Machine): evolution of continuous renal replacement therapies in infants. A personal journey

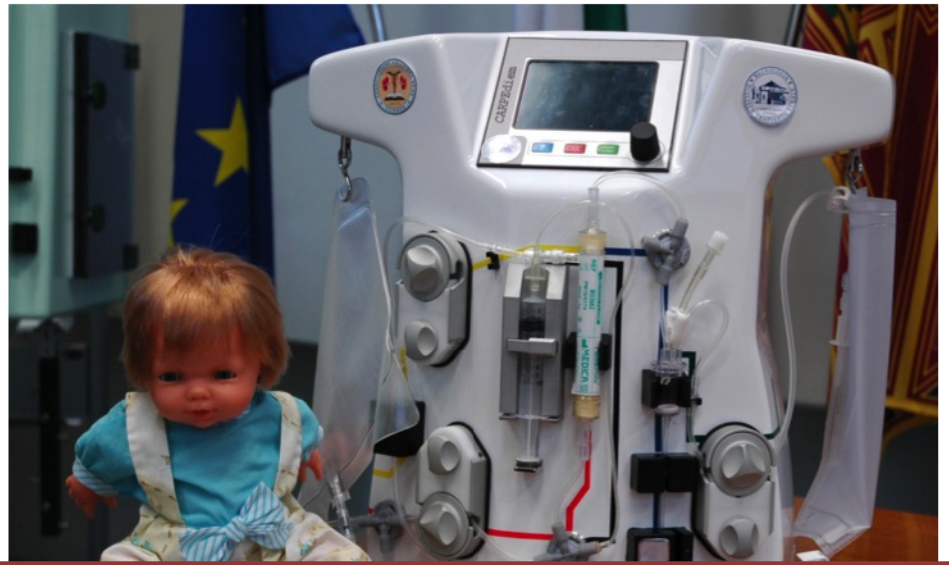
Claudio Ronco · Francesco Garzotto · Zaccaria Ricci

Pediatr Nephrol (2012) 27:1203–1211



CARPEDIEM:
CArdio Renal PEDIatric Emergency Machine

Pediatric patients in the range of 2-10 kgs
(approximate BSA of 0.15–0.5 m^2)



DESIGNED BY THE **INTERNATIONAL RENAL RESEARCH INSTITUTE** OF VICENZA, DIRECTED BY CLAUDIO RONCO (2011)

CARPEDIEM:
CArdio Renal PEDIatric Emergency Machine

- ✓ Low priming volumes (27-41 ml)
- ✓ Operational simplicity
- ✓ Enhanced accuracy
- ✓ Possibility of operating wtih smaller vascular accesses (?)

- Slow Continuos UltraFiltration
- Continuous venovenous hemofiltration (pre or post)

INFANT CRRT CIRCUITS: PRISMAFLEX® vs CARPEDIEM®

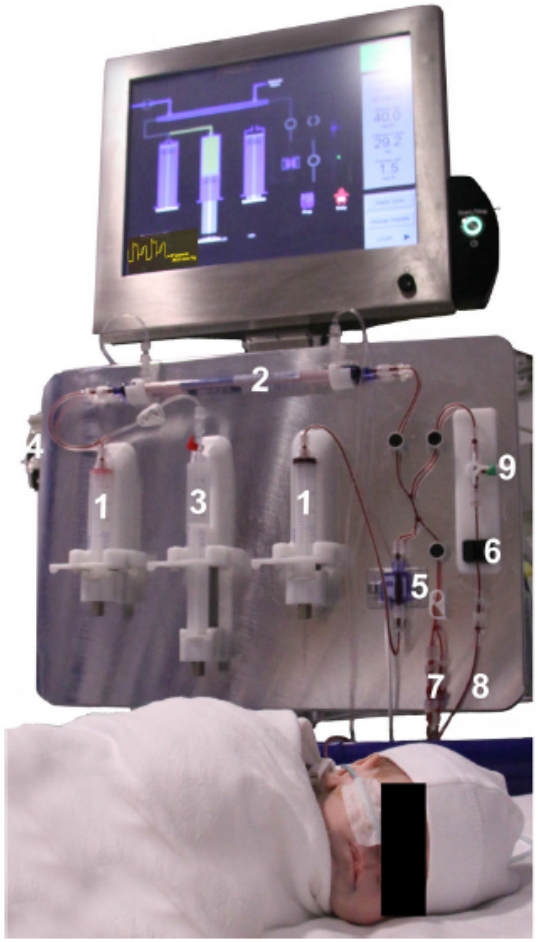
	Priming volume	Qb (ml/min)	Blood pressure range: art/ven	Max net UF	UF rate range (ml/h)	UF rate supervision	weight supervision	Fluid gravimetric control
Prismaflex® HF20 (0,20 m^2)	59 ml	10-100	-250 +450 ± 15 mmHg	none	0-500	TMP alarm	≤ 7 g	±20 g *immediate* Or ±60 ml/*last 3 hrs*
Carpediem® 025 (0,25 m^2)	41 ml	2-50	-400 + 100 mmHg	1000 ml/24 h	0-600	20% of Qb	1 g	Steps from 4 to max 30 g
Carpediem® 015 (0,147 m^2)	33 ml	2-20	-400 + 100 mmHg	1000 ml/24 h	0-240	20% of Qb	1 g	Steps from 4 to max 30 g
Carpediem® 0075 (0,075 m^2)	27 ml	2-15	-400 + 100 mmHg	1000 ml/24 h	0-150	20% of Qb	1 g	Steps from 4 to max 30 g

Courtesy of S. Picca

Haemodialysing babies weighing <8 kg with the Newcastle infant dialysis and ultrafiltration system (Nidus): comparison with peritoneal and conventional haemodialysis

Malcolm G. Coulthard · Jean Crosier · Clive Griffiths · Jon Smith · Michael Drinnan · Mike Whitaker · Robert Beckwith · John N. S. Matthews · Paul Flecknell · Heather J. Lambert

Pediatr Nephrol (2014) 29:1873–1881



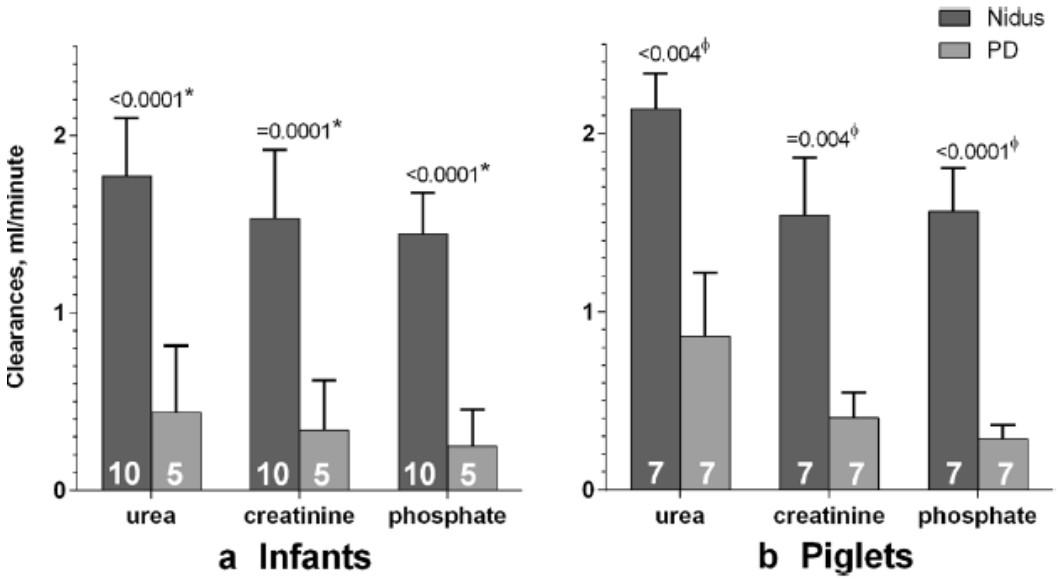
Strzykawki zamiast pomp

Objętość krążenia – 13 ml

Zakres wagi pacjentów 800 g- 3400g

Cewnik jednoświatłowy

Brak konieczności wypełniania układu



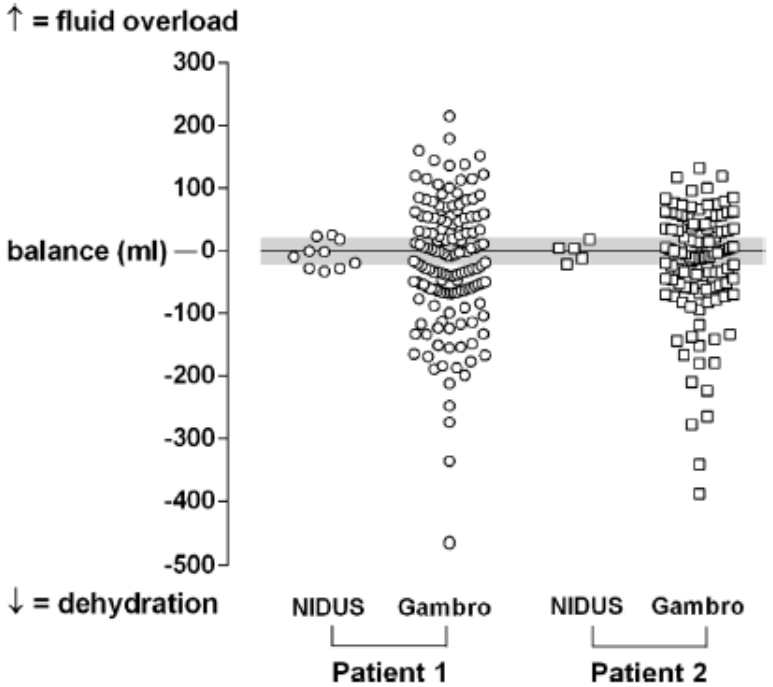


Fig. 6 The estimated fluid balance errors in 2 babies who weighed about

Smaller circuits for smaller patients: improving renal support therapy with Aquadex™

David Askenazi[1] · Daryl Ingram[2] · Suzanne White[2] · Monica Cramer[1] · Santiago Borasino[3] · Carl Coghill[4] · Lynn Dill[1,2] · Frank Tenney[1] · Dan Feig[1] · Sahar Fathallah-Shaykh[1]

Pediatr Nephrol (2016) 31:853–860

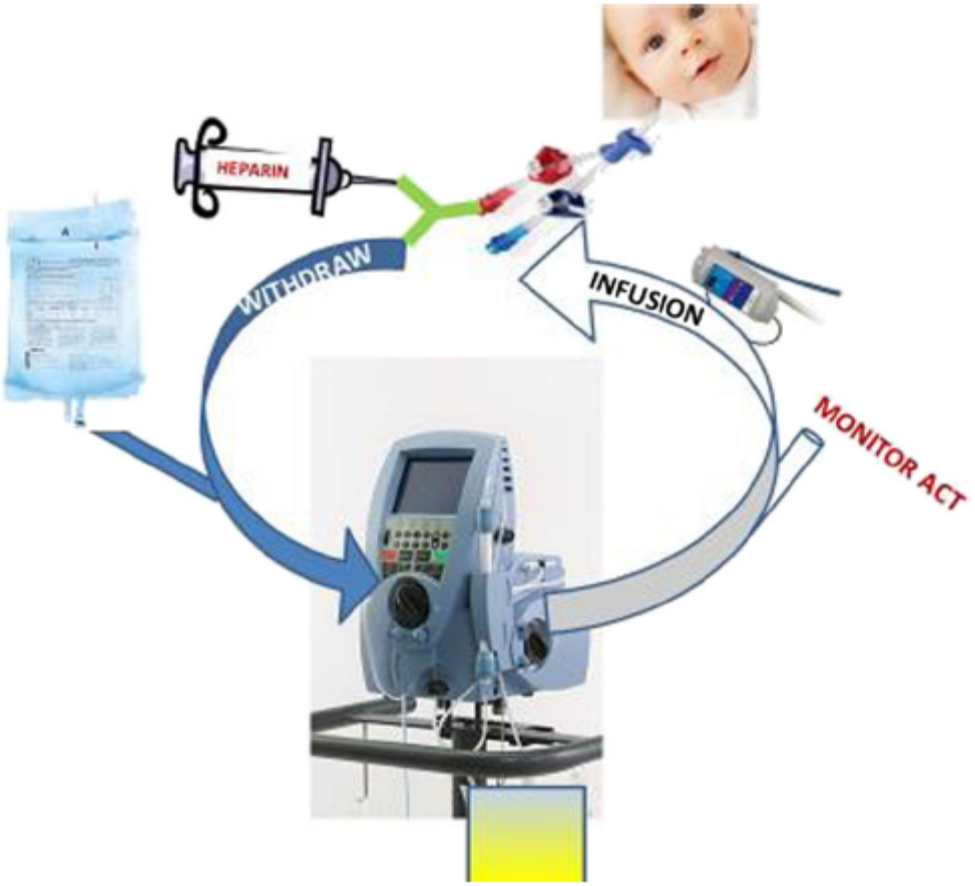
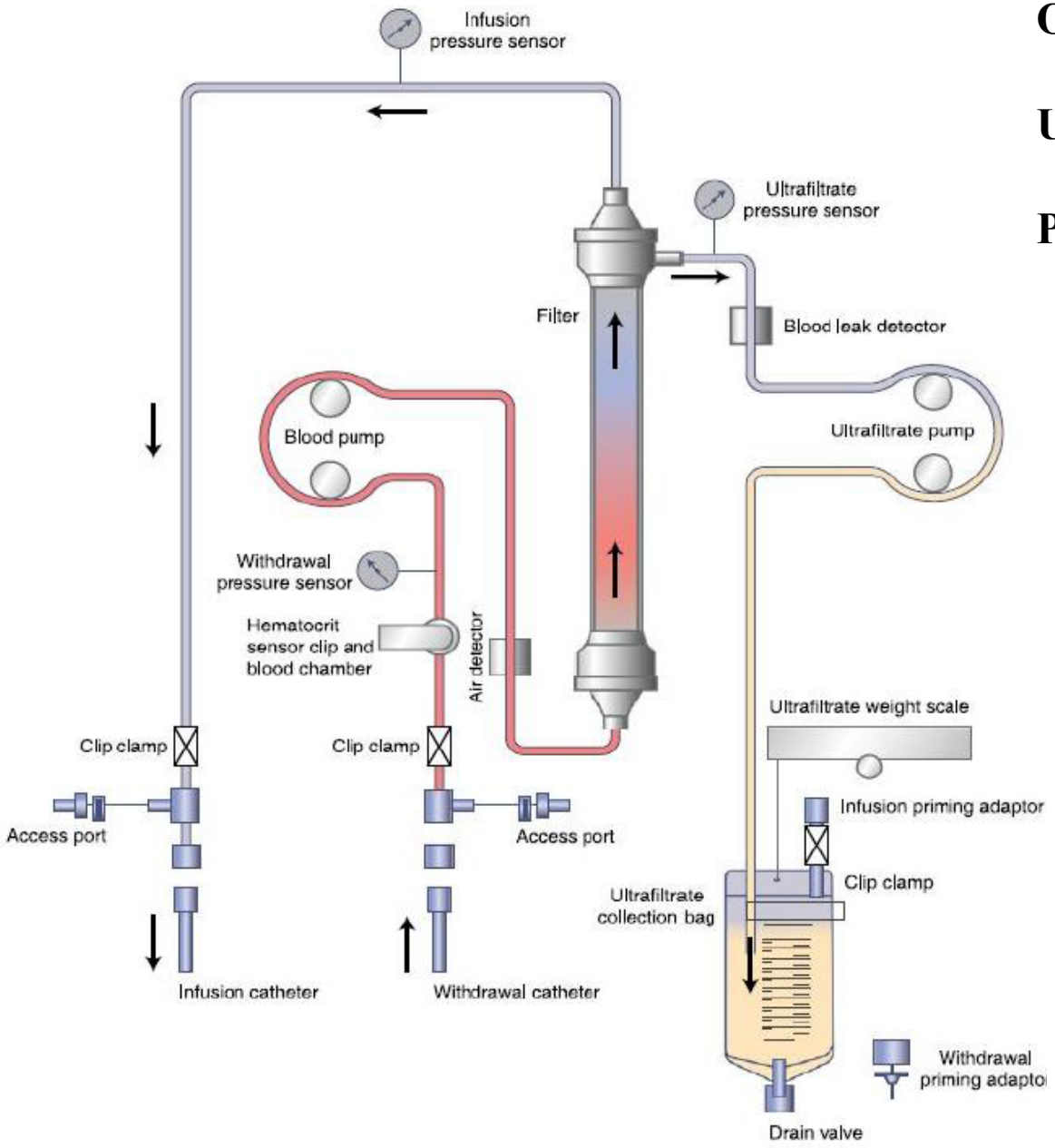


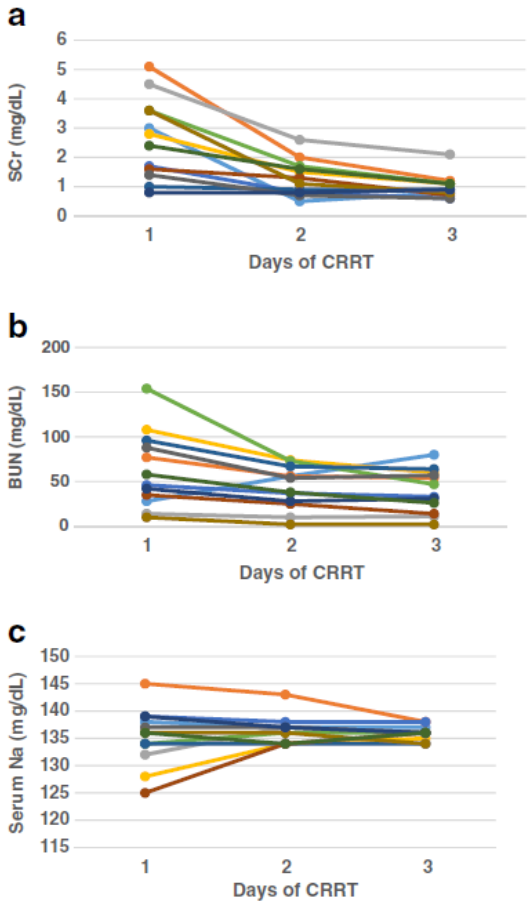
Fig. 1 Continuous veno-venous hemofiltration (CVVH) using the



Objętość krążenia - 35 ml

UF – 10 – 500ml/godz

Przepływ krwi 10 – 40 ml/min



Podsumowanie

- Aktualne użycie metod ciągłych wymaga całkowitego zrozumienia zachodzących procesów oraz znajomości aparatury
- Aktualnie leczenie AKI uważa się za kompleksowe leczenie pacjenta z niewydolnością wielonarządową
- Do realizacji tych celów niezbędne jest wprowadzenie technologii informacyjnych ze zintegrowanym systemem gromadzenia i przetwarzania danych
- Dla dzieci o wadze poniżej 15 kg powinny być (w miarę dostępności) stosowane aparaty dedykowane tej grupie pacjentów