BREAKTHROUGH IN MULTI ORGAN SUPPORT!

One single device for liver, lung and kidney support

ADVOS
ADVanced Organ Support
Mortality in correlation with the number of organ failures

The mortality rate of patients with multi organ failure is still very high (up to 90%) – despite current improvements of intensive-care medicine. Beside the cardiovascular system, the detoxification organs like liver, lungs, and kidney loom large here.

Although the dysfunctions are clearly separated, the failure of an organ affects the function of other organs, such as the hepato-renal, reno-cardial, or cardio-pulmonary syndrome, where the degree of severity of disorder correlates directly with the number of organ dysfunctions. The restricted function of the main detoxification organs leads to an aggregation of toxins, that fires up the vicious circle. A progressive multi organ failure can cause death within few days.

Conventional extracorporeal treatments only support the functions of one or two organs. More promising is the new technology of ADVOS that treats multi organ failure with a combined support of the three main detoxification organs.

ADVOS: First treatment worldwide for individualized multi organ support
• Liver: Removal of hepatic toxins
• Lung: Extracorporeal CO₂ removal without large bore catheters
• Kidney: Removal of water-soluble as well as protein-bound nephrotoxins
• Acid-Base balance: Correction of metabolic and respiratory acidosis
• Body temperature: Controlled cooling and warming
• Continuous and intermittent treatment possible

ADVOS multi – Simultaneous support of all detoxification organs
The ADVOS procedure is based on the principle of the albumin dialysis with following advantages: high dialysate flow, low albumin consumption and enhanced toxin removal.

The core invention is the recycling of the toxin loaded albumin dialysate by pH and temperature changes taking place in the purification circuit (ADVOS multi Circuit).

**Acid cycle**
Reducing the pH eliminates positively charged substances (e.g. copper and CO₂) from the albumin dialysate

**Base cycle**
Increasing the pH and the temperature eliminates negatively charged substances (e.g. bilirubin and bile acid) from the albumin dialysate

- Albumin dialysate flow up to 60L/h due to rapid recycling in both purification cycles
- Comprehensive detoxification due to simultaneous removal of positively and negatively charged substances
- $\text{H}^+$ and $\text{CO}_2$ removal for treatment of metabolic and respiratory acidosis through individualized pH adjustment of the albumin dialysate
- Regulating the patient’s body temperature by individualized temperature adjustment of the albumin dialysate
Dialyzers

Extracorporeal Circuit

Toxin-loaded albumin dialysate

Dialysate Circuit

Purified albumin dialysate

ADVOS multi Circuit

Filtrate/Waste

Acid pH↓

Base pH↑

Filtrate/Waste
Clinical results of the ADVOS treatment

Liver
Progression of bilirubin levels in a patient with multiorgan failure until discharge (maximal SOFA-Score 22)

Lung
Typical pCO₂ reduction curve in patients with respiratory failure:
Reduction of pre- to post-dialyzer CO₂ up to 10 × higher compared to lung
Kidney
Creatinine reduction in anuric patients

Acid–Base balance
Rapid pH and pCO₂ correction in respiratory acidosis

Rapid improvement of pH and bicarbonate during severe metabolic acidosis
ADVOS products and accessories

Product portfolio for the ICU suitable use of the ADVOS system

- **ADVOS multi**
- **Integrated container for flexible fluid management**
- **User-friendly information panel with integrated instructions for use**
- **Space saving holder for treatment fluids**

**Intermittent to continuous treatment duration**
Treatment duration up to 24h/set-up

**Independence**
Flexible fluid management without necessity of connection to reverse osmosis

**Usability**
Brisk set-up and easy operation supported by video based instructions
Indications of ADVOS

The combined support of three detoxification organs allows the application of ADVOS for many ICU indications

<table>
<thead>
<tr>
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<th>Liver support</th>
<th>Kidney support</th>
<th>Lung support / acid-base balance</th>
<th>Temperature regulation</th>
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<tbody>
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<td><strong>Multi organ failure</strong></td>
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<td>• Postoperative (e.g. after liver surgery)</td>
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<tr>
<td>• Postoperative (e.g. after cardiac surgery)</td>
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<td>• Cardiogenic shock</td>
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<td>• Septic shock</td>
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<td>• Hypoxic liver failure</td>
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<td>Liver transplantation (waiting list &amp; postoperative)</td>
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<td>Acute liver failure</td>
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<td>Acute-on-chronic liver failure</td>
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<td>Respiratory failure</td>
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Level of organ support needed in different patient indications

+ important
++ very important
+++ highest priority
List of publications regarding multi organ support

First clinical experience in 14 patients treated with ADVOS: a study on feasibility, safety and efficacy of a new type of albumin dialysis
Huber W, Henschel B, Schmid R, Al-Chalabi A
https://www.ncbi.nlm.nih.gov/pmc/articles/PMC5312588/

Das Advanced Organ Support (ADVOS) Verfahren in der Therapie des Multiorganversagens
D. Sollinger, M. Dörken, J. Lutz
http://online-divi.de/img/DIVI/content/abstracts2016.pdf?v=1

Erste Erfahrungen mit einem neuen erweiterten Dialyseverfahren bei kritisch kranken Patienten mit Multiorganversagen
http://online-divi.de/img/DIVI/content/abstracts2016.pdf?v=1

Erfolgreiche Therapie einer schwerwiegenden Rhabdomyolyse nach Einnahme von Risperidon durch den Einsatz verschiedener Dialyse- und Adsorptionsverfahren (ADVOS®, CVVHD, CytoSorb®)
http://online-divi.de/img/DIVI/content/abstracts2016.pdf?v=1

Erste Erfahrungen mit dem ADVOS®-Verfahren (Advanced Organ Support) bei Patienten mit alkoholischer Steatohepatitis (ASH)
W. Huber, B. Henschel, T. Lahmer, M. Braun, U. Mayr, R. Schmid, A. Al-Chalabi
http://online-divi.de/img/DIVI/content/abstracts2016.pdf?v=1

Anwendung eines neuartigen Hämodialyseverfahrens bei einem septischen Patienten mit hyperkapnischm Lungenversagen
http://online-divi.de/img/DIVI/content/abstracts2016.pdf?v=1

First clinical experience with a new type of albumin dialysis: the HepaWash® system;
B. Henschel, R. Schmid, W. Huber
http://www.ncbi.nlm.nih.gov/pmc/articles/PMC4471673/
Evaluation of the Hepa Wash® treatment in pigs with acute liver failure
Al-Chalabi, A., Matevossian, E., v Thaden, A.-K., Luppa, P., Neiss, A.,
Schuster, T., Yang, Z., Schreiber, C., Schimmel, P., Nairz, E., Perren, A.,
Radermacher, P., Huber, W., Schmid, R.M., and Kreymann, B.

Improvement of survival in a swine model of acute liver failure
by a new liver support system (Hepa Wash®)
Journal of Hepatology. 2010; 52: 319-S320
Al-Chalabi, A., Matevossian, E., Preißel, A.K., Yang, Z., Schreiber, C.,
Schimmel, P., Nairz, E., Yan, H., Geiger, A., and Kreymann, B.
http://www.journal-of-hepatology.eu/article/S0168-8278(10)60820-3/abstract

Survival improvement in pigs with liver failure and superimposed
sepsis by a new liver support system (Hepa Wash®)
Critical Care. 2010; 14: 508
Al-Chalabi, A., Matevossian, E., Preißel, A.K., Yan, H., Geiger, A.,
Nairz, E., Schimmel, P., Schreiber, C., Yang, Z., and Kreymann, B.
http://ccforum.com/content/14/S1/P508

A model of ischemic isolated acute liver failure in pigs: standardizing
monitoring and treatment
European Surgical Research. 2010; 45: 86-97
Al-Chalabi, A., Matevossian, E., Preißel, A., Perren, A., Yang, Z.,
http://www.karger.com/Article/Pdf/319878

Acute renal failure and multiple organ dysfunction in the ICU: from
renal replacement therapy (RRT) to multiple organ support
therapy (MOST).
Ronco C., Bellomo R.

Extracorporeal CO2 removal--a way to achieve ultraprotective
mechanical ventilation and lung support: the missing piece of
multiple organ support therapy.
Contrib Nephrol. 2010;165:174
Gramaticopolo S, Chronopoulos A, Piccinni P, Nalessa F,
Brendolan A, Zanella M, Cruz DN, Ronco C.
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