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Allianz Herzchirurgie Zürich

Stadt Zürich Stadtspital Triemli

# To bridge or not to bridge: V-A ECMO bei Aspirationsthrombektomie

Martin Oliver Schmiady, MD

Universität Zürich[UZH]

## Conflict of Interest

- none

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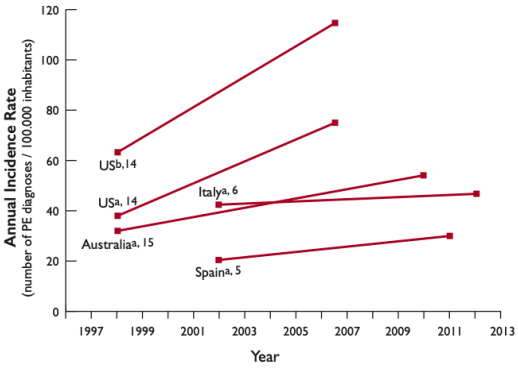
# Epidemiologie der LE





Von den Todesfällen versterben rund 34% der Patienten innerhalb weniger Stunden nach Symptombeginn, ohne das eine zielgerichtete Therapie begonnen werden konnte.

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# Klassifikation der Lungenembolie

| Category | Features |
|---|---|
| Low risk | No RV strain<br>Hemodynamically stable |
| Intermediate risk | RV strain<br>Hemodynamically stable |
| High risk, fulminate | RV strain<br>Hemodynamically unstable<br>≥1 of the following:<br>SBP <90 mm Hg for 15 min<br>Drop of >40 mm Hg from baseline SBP<br>Vasopressor support<br>MCS<br>Cardiac arrest<br>Severe (refractory) hemodynamic instability |

MCS indicates mechanical circulatory support; PE, pulmonary embolism; RV, right ventricular; and SBP, systolic blood pressure.

RV strain is defined as an RV:left ventricle ratio on computed tomography or transthoracic echocardiography >0.9 or elevated cardiac biomarkers (troponin or BNP [brain natriuretic peptide]).

Goldberg JB, Giri J, Kobayashi T, Ruel M, Mittnacht AJC, Rivera-Lebron B, DeAnda A Jr, Moriarty JM, MacGillivray TE. Surgical Management and Mechanical Circulatory Support in High-Risk Pulmonary Embolisms: Historical Context, Current Status, and Future Directions: A Scientific Statement From the American Heart Association. Circulation. 2023 Feb 28;147(9):e628-e647. doi: 10.1161/CIR.0000000000001117. Epub 2023 Jan 23. PMID: 36688837.

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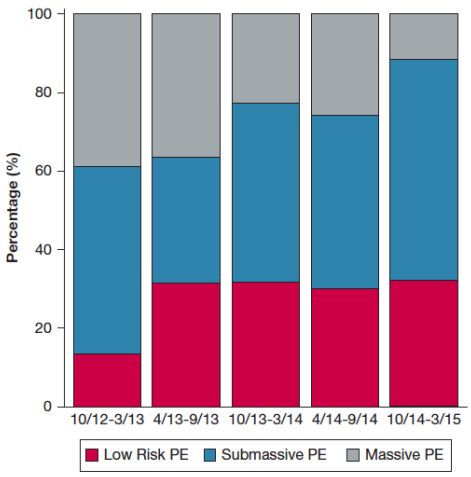
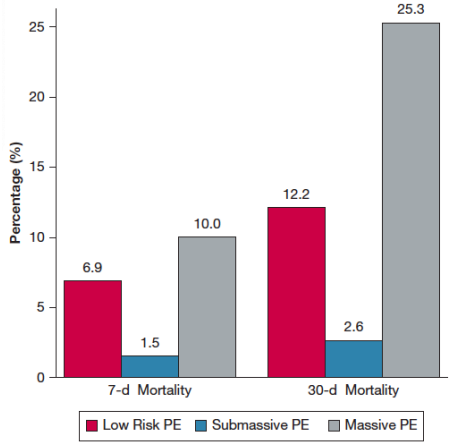
# Verteilung und Outcome




Kabrhel C, Rosovsky R, Channick R, Jaff MR, Weinberg I, Sundt T, Dudzinski DM, Rodriguez-Lopez J, Parry BA, Harshbarger S, Chang Y, Rosenfield K. A Multidisciplinary Pulmonary Embolism Response Team: Initial 30-Month Experience With a Novel Approach to Delivery of Care to Patients With Submassive and Massive Pulmonary Embolism. Chest. 2016 Aug;150(2):384-93. doi: 10.1016/j.chest.2016.03.011. Epub 2016 Mar 19. PMID: 27006156.

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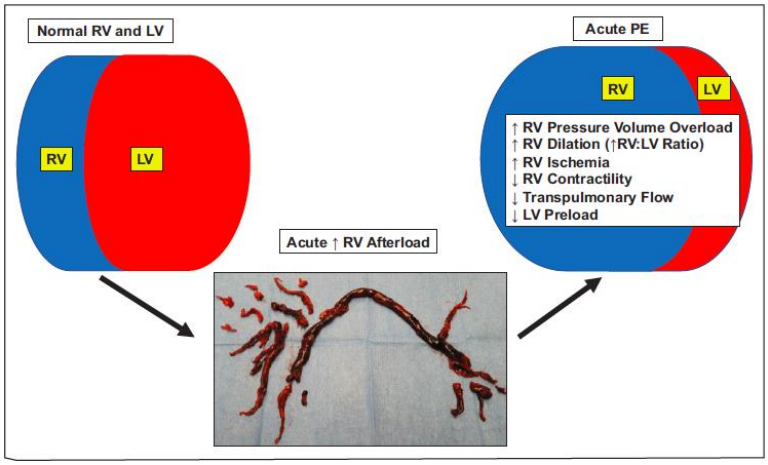
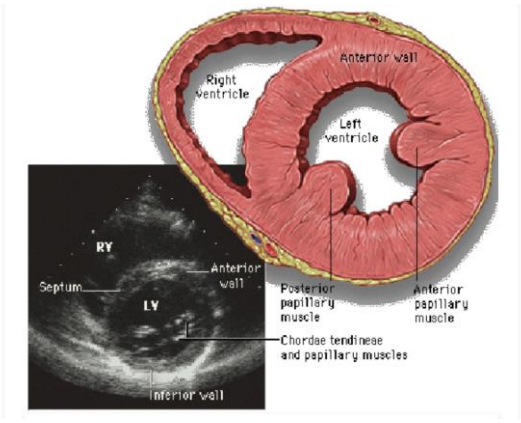
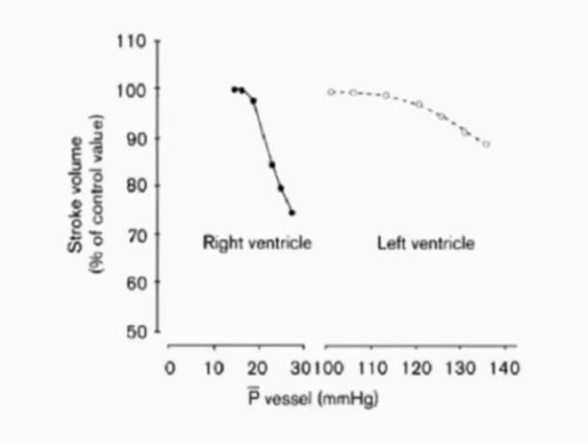
# Hämodynamischer Effekt



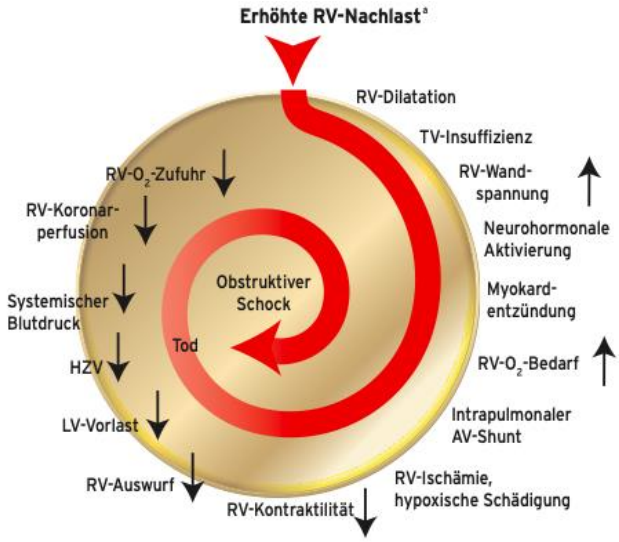

Goldberg JB, Giri J, Kobayashi T, Ruel M, Mittnacht AJC, Rivera-Lebron B, DeAnda A Jr, Moriarty JM, MacGillivray TE. Surgical Management and Mechanical Circulatory Support in High-Risk Pulmonary Embolisms: Historical Context, Current Status, and Future Directions: A Scientific Statement From the American Heart Association. Circulation. 2023 Feb 28;147(9):e628-e647. doi: 10.1161/CIR.0000000000001117. Epub 2023 Jan 23. PMID: 36688837.

# Besonderheiten des RV



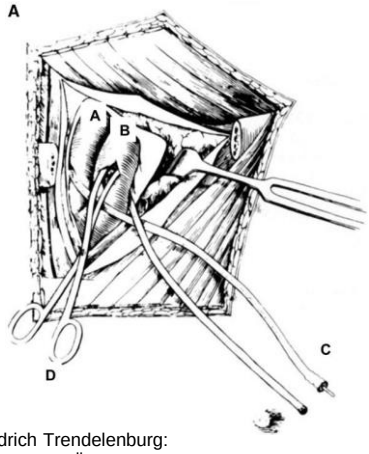



# Der Circulus vitiosus der LE

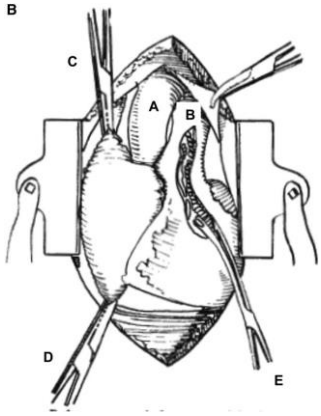



AV = arteriovenös; $O_2$ = Sauerstoff; TV = Trikuspidalklappe (tricuspid valve)

# Chirurgische Therapieansätze




Friedrich Trendelenburg:
21.04.1908: Über die operative Behandlung der Embolie der Lungenarterien (37. Tagung der Deutschen Gesellschaft für Chirurgie).



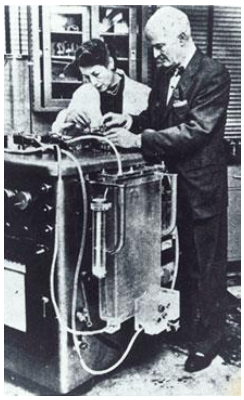

„Inflow Occlusion“ Technik

# Chirurgische Therapieansätze

**„By far the most dramatic of all surgical interventions“**

Dalen JE. Pulmonary embolism: what have we learned since Virchow? Natural history, pathophysiology, and diagnosis. Chest. 2002 Oct;122(4):1440-56. doi: 10.1378/chest.122.4.1440. PMID: 12377877.

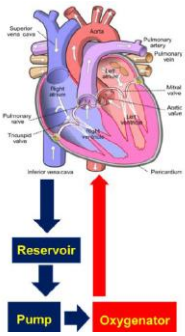
- **87% Mortalität**
- **Zwischen 1908 und 1954 nur 12 dokumentieret Überlebende**



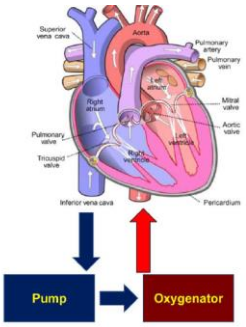
John Gibbon Jr.1903 – 1973

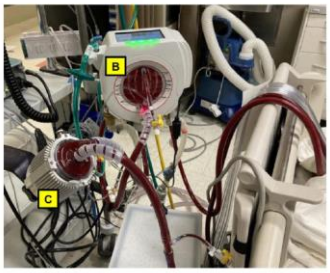
- 06.05.1953 erster erfolgreicher Einsatz der HLM
- 1961: Denton Cooley/ erste erfolgreiche chir. Thrombektomie an HLM

# HLM und V-A ECMO








- Offen v.s. geschlossenes System
- > ACT
- Mobilität/Verfügbarkeit

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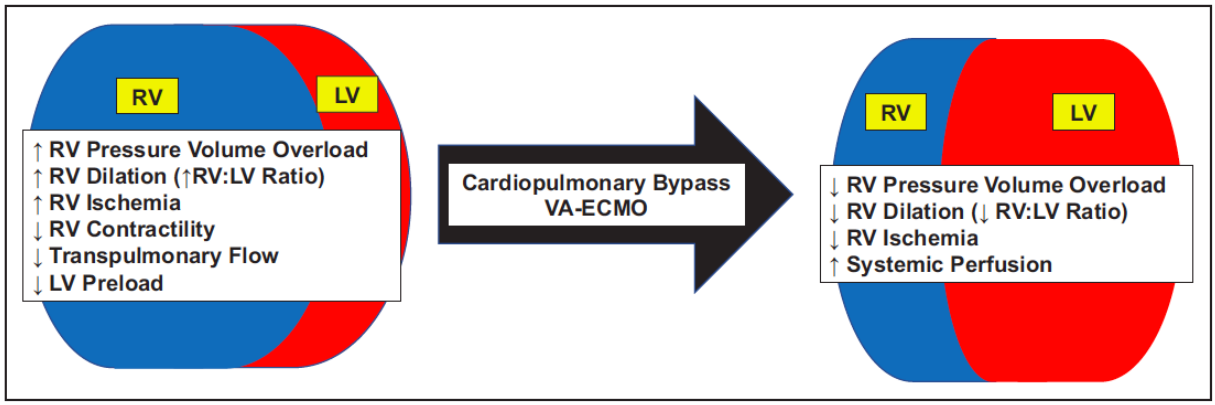
# Hämodynamischer Effekt der ECC




Goldberg JB, Giri J, Kobayashi T, Ruel M, Mittnacht AJC, Rivera-Lebron B, DeAnda A Jr, Moriarty JM, MacGillivray TE. Surgical Management and Mechanical Circulatory Support in High-Risk Pulmonary Embolisms: Historical Context, Current Status, and Future Directions: A Scientific Statement From the American Heart Association. Circulation. 2023 Feb 28;147(9):e628-e647. doi: 10.1161/CIR.0000000000001117. Epub 2023 Jan 23. PMID: 36688837.

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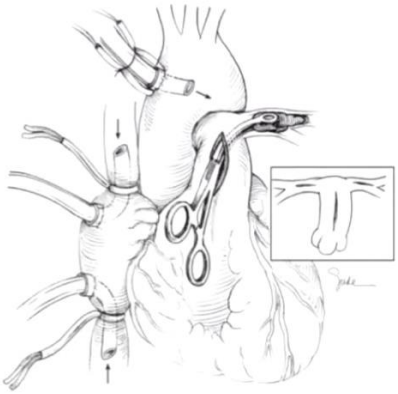
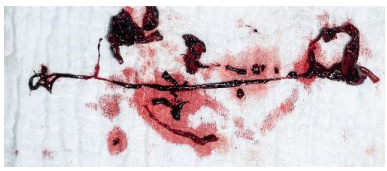
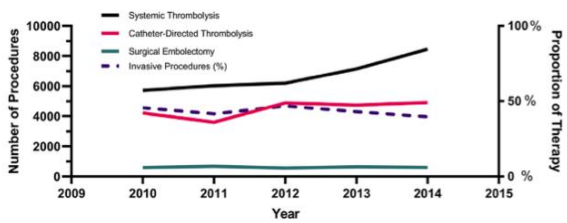
# HLM








| Variable | All patients (n = 2709) | Survivors (n = 1972) | Operative mortality (n = 737) | *P* value* |
|---|---|---|---|---|
| Teaching hospital | 1992/2709 (73.5) | 1468/1972 (74.4) | 523/737 (71.0) | .43 |
| Urban location | 2630/2709 (97.1) | 1932/1972 (98.0) | 698/737 (94.7) | .08 |
| Hospital size | | | | .42 |
| Small | 77/2709 (2.8) | 59/1972 (3.0) | 18/737 (2.4) | |
| Medium | 449/2709 (16.6) | 347/1972 (17.6) | 102/737 (13.8) | |
| Hospital annual volume | 2.3 ± 1.6 | 2.4 ± 1.7 | 2.1 ± 1.3 | |
| Surgeon annual volume | 0.7 ± 0.7 | 0.8 ± 0.7 | 0.6 ± 0.6 | |

Continuous data are presented as mean ± standard deviation and frequency data as n (%). *P value for comparison between survivors to discharge and patients with operative mortality.

Percy ED, Shah R, Hirji S, Tartarini RJ, Yazdchi F, Harloff M, Kaneko T, Pelletier MP. National Outcomes of Surgical Embolectomy for Acute Pulmonary Embolism. Ann Thorac Surg. 2020 Aug;110(2):441-447. doi: 10.1016/j.athoracsur.2020.02.024. Epub 2020 Mar 19. PMID: 32199827.

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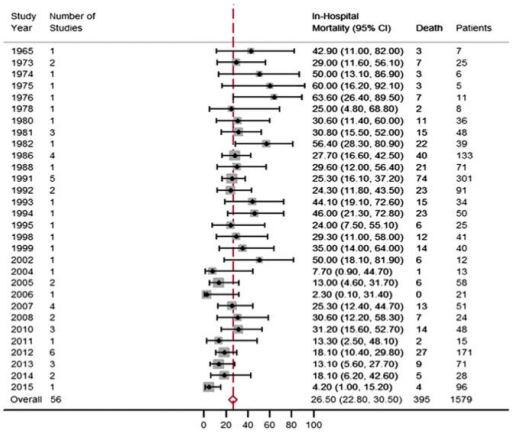
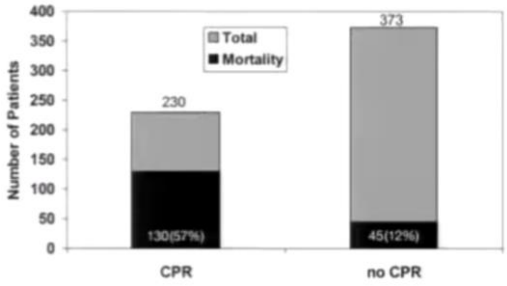
# Outcomes der chirurgische Thrombektomie




Mortalität zwischen 6 und 55%




Kalra R, Bajaj NS, Arora P, Arora G, Crosland WA, McGiffin DC, Ahmed MI. Surgical Embolectomy for Acute Pulmonary Embolism: Systematic Review and Comprehensive Meta-Analyses. Ann Thorac Surg. 2017 Mar;103(3):982-990. doi: 10.1016/j.athoracsur.2016.11.016. Epub 2017 Jan 31. PMID: 28159170

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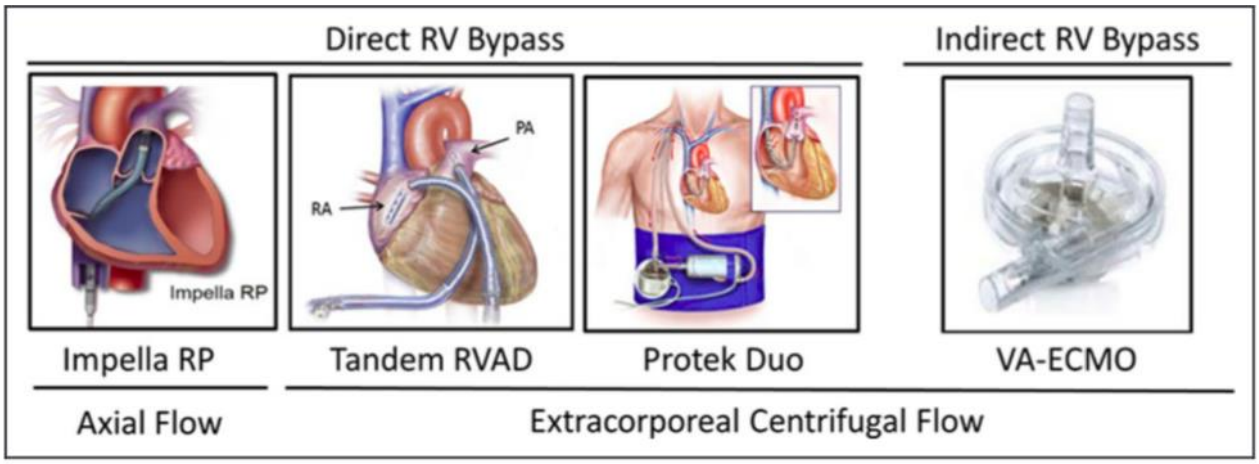
# MCS in PE

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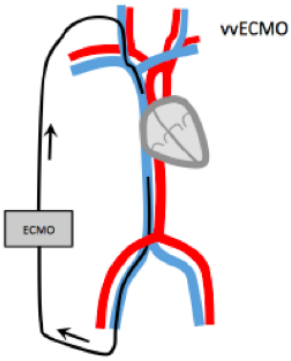
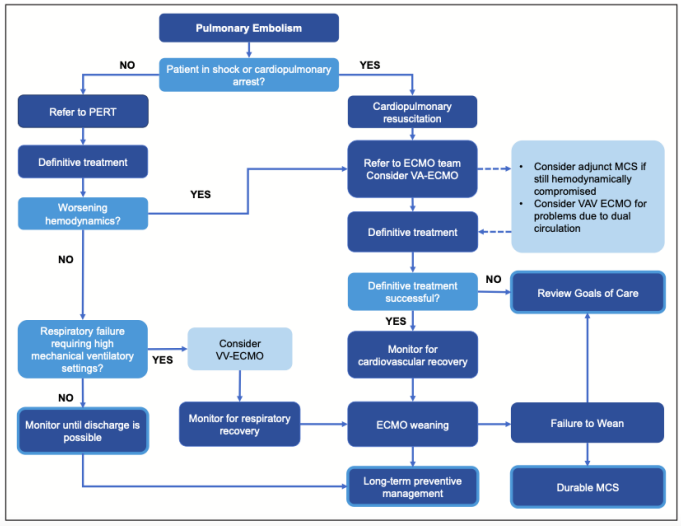
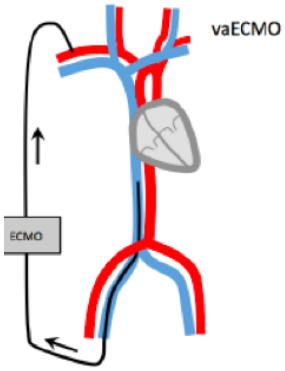
# ECMO

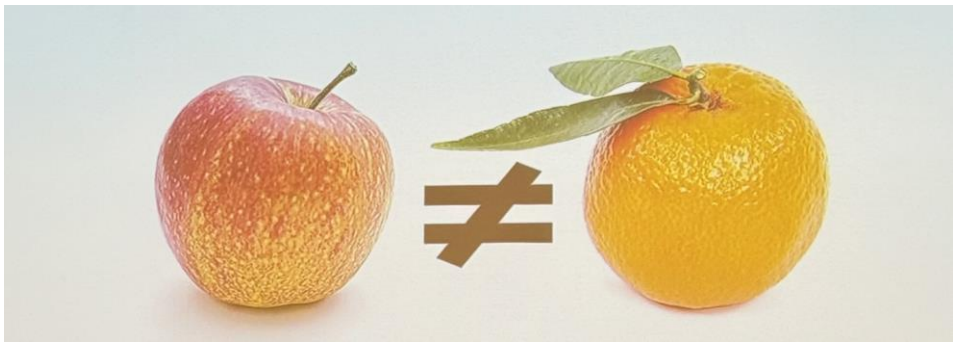



Abdulaziz S MBBS, Kakar V, Kumar PG, Hassan IF, Combes A, Brodie D, Barrett NA, Tan J, Al Ali SF. Mechanical Circulatory Support for Massive Pulmonary Embolism. J Am Heart Assoc. 2025 Jan 7;14(1):e036101. doi: 10.1161/JAHA.124.036101. Epub 2024 Dec 24. PMID:

# Patientencharakteristika



High risk PE
mit
ECMO

High risk PE
ohne
ECMO

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# Patientencharakteristik V-A ECMO

- ✓ St.n. Herzkreislaufstillstand
- ✓ ECPR
- ✓ Schwerste hämodynamische Instabilität
- ✓ Frustraner Lyseversuch
- ✓ Kontraindikation für Antikoagulation/ Lysetherapie
- ✓ Frustranes Weaning von HLM nach chirurgischer Thrombektomie
- ✓ < Alter (±48 Jahre)

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ESC European Society of Cardiology

European Heart Journal (2018) 39, 4196–4204
doi:10.1093/eurheartj/ehy464

CLINICAL RESEARCH
*Pulmonary circulation*

## Outcomes after extracorporeal membrane oxygenation for the treatment of high-risk pulmonary embolism: a multicentre series of 52 cases

**Nicolas Meneveau[1,2]*, Benoit Guillon[1,2], Benjamin Planquette[3], Gaël Piton[2,4], Antoine Kimmoun[5,6], Lucie Gaide-Chevronnay[7], Nadia Aissaoui[8,9], Arthur Neuschwander[10], Elie Zogheib[11,12], Hervé Dupont[11,12], Sebastien Pili-Floury[2,13], Fiona Ecarnot[1,2], François Schiele[1,2], Nicolas Deye[14,15], Nicolas de Prost[16], Raphaël Favory[17], Philippe Girard[18], Mircea Cristinar[19], Alexis Ferré[20], Guy Meyer[3], Gilles Capellier[2,4], and Olivier Sanchez[3]**

**Aims** The role of extracorporeal membrane oxygenation (ECMO) remains ill defined in pulmonary embolism (PE). We investigated outcomes in patients with high-risk PE undergoing ECMO according to initial therapeutic strategy.

**Methods and results** From 01 January 2014 to 31 December 2015, 180 patients from 13 Departments in nine centres with high-risk PE were retrospectively included. Among those undergoing ECMO, we compared characteristics and outcomes according to adjunctive treatment strategy (systemic thrombolysis, surgical embolectomy, or no reperfusion therapy). Primary outcome was all-cause 30-day mortality. Secondary outcome was 90-day major bleeding. One hundred and twenty-eight patients were treated without ECMO; 52 (mean age 47.6 years) underwent ECMO. Overall 30-day mortality was 48.3% [95% confidence interval (CI) 41–56] (87/180); 43% (95% CI 34–52) (55/128) in those treated without ECMO vs. 61.5% (95% CI 52–78) (32/52) in those with ECMO ($P = 0.008$). In patients undergoing ECMO, 30-day mortality was 76.5% (95% CI 57–97) (13/17) for ECMO + fibrinolysis, 29.4% (95% CI 51–89) (5/17) for ECMO + surgical embolectomy, and 77.7% (95% CI 59–97) (14/18) for ECMO alone ($P = 0.004$). Among patients with ECMO, 20 (38.5%, 95% CI 25–52) had a major bleeding event in-hospital; without significant difference across groups.

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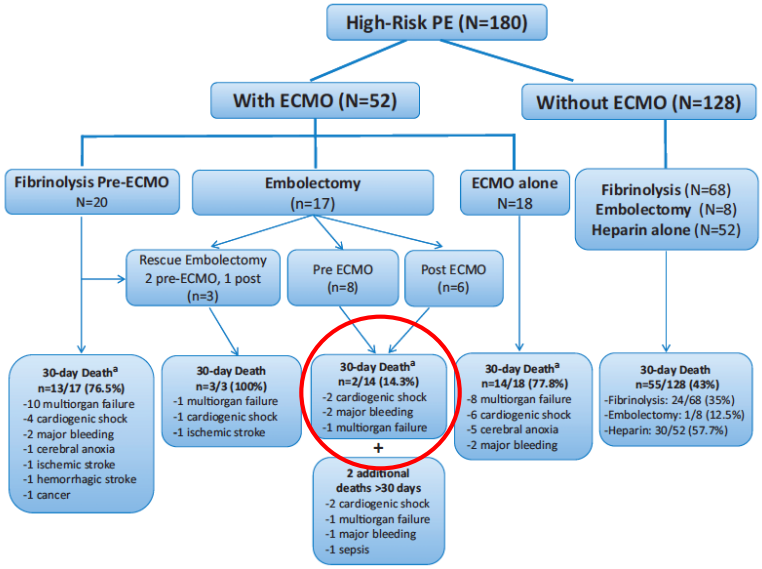
| Variables | All (N = 52) |
|---|---|
| Age (years) | 47.6 ± 15 |
| Males/females | 27/25 (52%/48%) |
| BMI (kg/m$^2$) | 28.5 ± 7.4 |
| Hypertension | 14 (27%) |
| Cardiovascular disease | 3 (5.7%) |
| Smoking | 12 (23%) |
| COPD | 1 (1.9%) |
| Renal failure | 1 (1.9%) |
| History of stroke | 3 (5.7%) |
| Cirrhosis | 1 (1.9%) |
| Predisposing factors for VTE | |
| Hormonal/oral contraceptives | 6 (11.6%) |
| Surgery | 10 (19.2%) |
| Prolonged bed rest | 15 (28.9%) |
| Immobilization of the lower limbs | 10 (19.2%) |
| Pregnancy | 2 (3.9%) |
| Active cancer | 4 (7.7%) |
| History of VTE | 17 (32.7%) |
| Thrombophilia | 4 (7.7%) |
| Time from admission to PE diagnosis (days) | 0 (0–2) |
| Time from PE diagnosis to ECMO | 0 (0–1) |
| Heart rate (b.p.m.) | 94 ± 51.5 |
| Cardiogenic shock | 13 (25%) |
| Cardiac arrest | 39 (75%) |
| Syncope | 15 (28.8%) |
| Dyspnoea | 34 (65.4%) |
| Chest pain | 18 (34.6%) |
| Clinical signs of DVT | 10 (19.2%) |
| Glasgow score | 15 (3–15) |




Meneveau N, Guillon B, Planquette B, Piton G, Kimmoun A, Gaide-Chevronnay L, Aissaoui N, Neuschwander A, Zogheib E, Dupont H, Pili-Floury S, Ecarnot F, Schiele F, Deye N, de Prost N, Favory R, Girard P, Cristinar M, Ferré A, Meyer G, Capellier G, Sanchez O. Outcomes after extracorporeal membrane oxygenation for the treatment of high-risk pulmonary embolism: a multicentre series of 52 cases. Eur Heart J. 2018 Dec 14;39(47):4196-4204. doi: 10.1093/eurheartj/ehy464. PMID:

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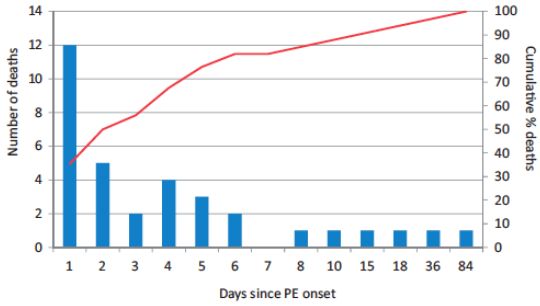
# Outcome




ECMO als alleinige Therapie: Laktat ↑, nach frustraner first Line Therapie im protrahierten Schock

Chirurgische Kandidaten: Selection Bias?

| Outcomes | ECMO alone (A) (N = 18, 95% CI) | ECMO + thrombolysis (B) (N = 17, 95% CI) | ECMO + surgical (C) embolectomy (N = 17, 95% CI) | RR A vs. B (95% CI) | RR A vs. C (95% CI) |
|---|---|---|---|---|---|
| 30-Day all-cause death | 14 (77.7%, 59–97) | 13 (76.5%, 57–97) | 5 (29.4%, 51–89) | 1.02 (0.71–1.46) | 2.64 (1.22–5.75) |
| 90-Day all-cause death | 14 (77.7%, 59–97) | 13 (76.5%, 57–97) | 7 (41.2%, 18–65) | 1.02 (0.71–1.46) | 1.89 (1.02–3.51) |
| 90-Day major bleeding | 4 (22.2%, 4–42) | 7 (41.2%, 18–65) | 9 (52.9%, 30–77) | 0.54 (0.19–1.52) | 0.42 (0.16–1.11) |
| 90-Day non-major bleeding | 5 (27.7%, 11–53) | 9 (52.9%, 30–77) | 9 (52.9%, 30–77) | 0.52 (0.22–1.25) | 0.52 (0.22–1.25) |
| Successful weaning from ECMO | 3 (16.7%, 57–97) | 5 (29.4%, 57–97) | 11 (64.7%, 57–97) | 0.57 (0.16–2.02) | 0.26 (0.09–0.77) |

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# Peripheral Extracorporeal Membrane Oxygenation: Comprehensive Therapy for High-Risk Massive Pulmonary Embolism

Ramin Malekan, MD, Paul C. Saunders, MD, Cindy J. Yu, ANP, Kathy A. Brown, ANP, Alan L. Gass, MD, David Spielvogel, MD, and Steven L. Lansman, MD, PhD

Section of Cardiothoracic Surgery, Department of Surgery, and Division of Cardiology, Department of Medicine, Westchester Medical Center, New York Medical College, Valhalla, New York

*Background.* Although commonly reserved as a last line of defense, experienced centers have reported excellent results with pulmonary embolectomy for massive and submassive pulmonary embolism (PE). We present a contemporary surgical series for PE that demonstrates the utility of peripheral extracorporeal membrane oxygenation (pECMO) for high-risk surgical candidates.

*Methods.* Between June 2005 and April 2011, 29 patients were treated for massive or submassive pulmonary embolism, with surgical embolectomy performed in 26. Four high-risk patients were placed on pECMO, established by percutaneously cannulating the right atrium through a femoral vein and perfusing by a Dacron graft anastomosed to the axillary artery. A small, extracorporeal, rotary assist device was used, interposing a compact oxygenator in the circuit, and maintaining anticoagulation with heparin.

*Results.* Extracorporeal membrane oxygenation was weaned in 3 of 4 patients after 5.3 days (5, 5, and 6), with normalization of right ventricular dysfunction and pulmonary artery pressure (44.0 ± 2.0 to 24.5 ± 5.5 mm Hg) by ECHO. Follow-up computed tomographies showed several peripheral, nearly resorbed emboli in 1 case and complete resolution in 2 others. The fourth patient, not improving after 10 days, underwent surgery where an embolic liposarcoma was extracted. For all 29 cases, hospital and 30-day mortality was 0% and all patients were discharged, with average postoperative length of stay of 15 days for embolectomy and 17 days for pECMO.

*Conclusions.* Heparin therapy with pECMO support is a rapid, effective option for patients who might benefit from pulmonary embolectomy but are at high risk for surgery.

(Ann Thorac Surg 2012;94:104–8)


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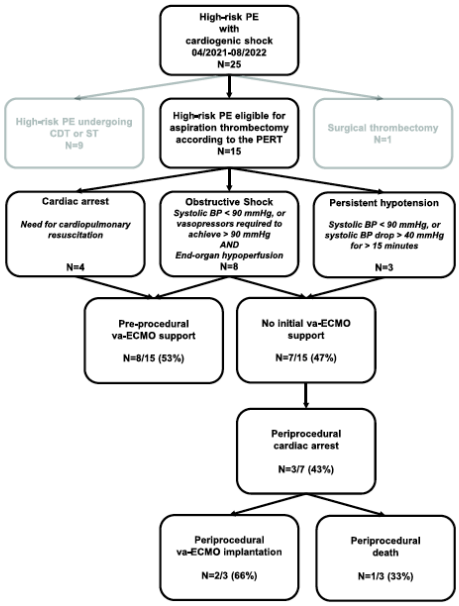
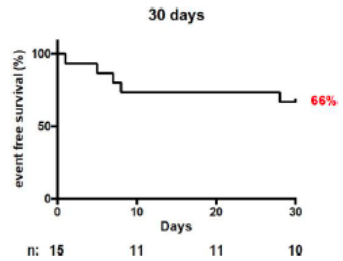
# Initiale Erfahrungen am USZ

**Table 1 Baseline characteristics and clinical medical history**

| | *n* = 15 |
|---|---|
| Age (years), mean (SD) | 63 (12) |
| Male sex, *n* (%) | 14 (93) |
| Body mass index (kg/m²), mean (SD) | 33 (6) |
| ***Risk factors for venous thromboembolism*** | |
| Surgery in the in the prior 30 days, *n* (%) | 6 (40) |
| COVID-19, *n* (%) | 5 (33) |
| Arterial hypertension, *n* (%) | 5 (33) |
| Diabetes mellitus, *n* (%) | 4 (27) |
| Active malignancy, *n* (%) | 4 (27) |
| Previous venous thromboembolism, *n* (%) | 3 (20) |
| Chronic kidney disease (creatine clearance <50 mL/min), *n* (%) | 2 (13) |
| Coronary artery disease, *n* (%) | 1 (7) |
| ***Clinical presentation of acute pulmonary embolism*** | |
| Syncope, *n* (%) | 6 (40) |
| Cardiopulmonary resuscitation, *n* (%) | 4 (27) |
| Mechanical ventilation, *n* (%) | 9 (60) |
| Right ventricular dysfunction, *n* (%) | 15 (100) |
| Right-to-left ventricular ratio by computed tomography scan, mean (SD) | 1.6 (0.4) |
| High-sensitive troponin T positive, *n* (%) | 15 (100) |
| Contraindication to thrombolysis, *n* (%)* | |
| Cardiopulmonary resuscitation | 4 (27) |
| Emergency VA-ECMO implantation without cardiac arrest | 4 (27) |
| Major post-surgical bleeding complication <30 days | 4 (27) |
| Severe thrombocytopenia < 50 G/l. | 3 (20) |
| History or active intracranial bleeding | 2 (13) |
| Persistent instability > 4 h following systemic thrombolysis | 2 (13) |
| Acute ischaemic stroke | 1 (7) |

COVID-19, Coronavirus disease 2019; ESC, European Society of Cardiology; VA-ECMO, veno-arterial extra corporeal membrane oxygenation.
*Some patients had more than one contraindication to thrombolysis.




Kucher N, Ouda A, Voci D, Barco S, Micieli E, Münger M, Pleming W, Grigorean A, Sromicki J, Schmiady MO, Holy EW. Percutaneous large-bore aspiration embolectomy with veno-arterial extracorporal membrane oxygenation support or standby in patients with high-risk pulmonary embolism and contraindications to thrombolysis: a preliminary single centre experience. Eur Heart J Acute Cardiovasc Care. 2023 Apr 17;12(4):232-236. doi: 10.1093/ehjacc/zuad014. PMID:

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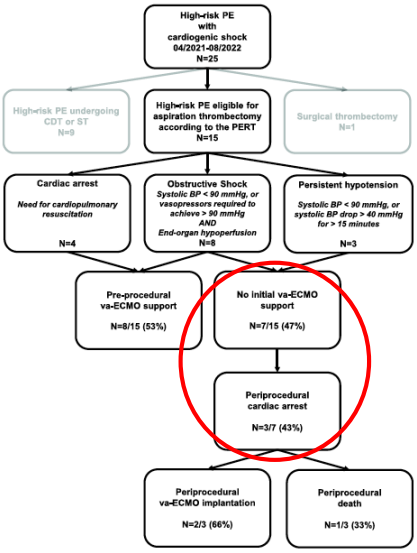
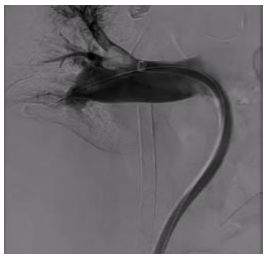
# Initiale Erfahrungen am USZ



- 43% Hämodynamische Verschlechterung während Katheterintervention mit Reanimationspflichtigkeit
- Mortalität 100%
- Large Bore Aspirations-Embolektomie ohne ECMO stand by ist nicht zu empfehlen

# Das Pulmonary Embolism Response Team (PERT)

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# Das PERT Team am USZ

| Fachdisziplin | Rolle |
|---|---|
| Angiologie | Konservative Therapie, Katheterverfahre |
| Herzchirurgie | Offene Thrombektomie an HLM, MCS |
| Anästhesie | Betreuung Schockraum/ OP |
| Kardiologie | Diagnostik, HF Therapie |
| Intensivmedizin | Betreuung IPS, weiterführende Therapien |
| Notfallmedizin | Betreuung Notfallstation |
| Thoraxchirurgie | offene Thrombektomie |
| Pneumologie | Weiterführende Therapien |

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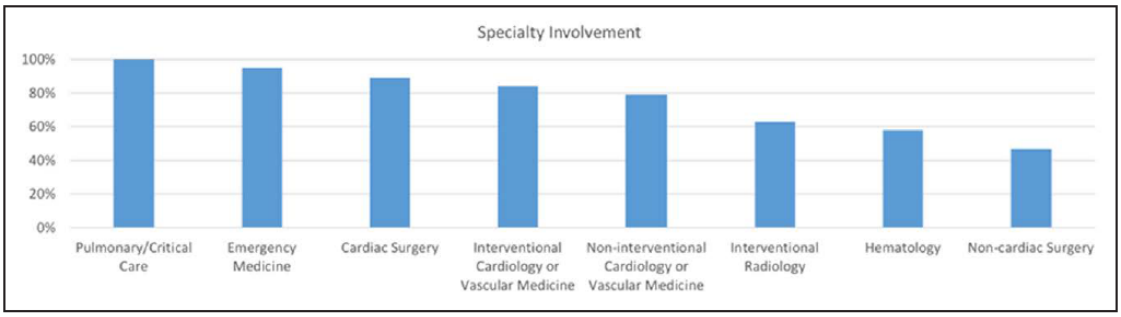
# PERT




Giri J, Sista AK, Weinberg I, Kearon C, Kumbhani DJ, Desai ND, Piazza G, Gladwin MT, Chatterjee S, Kobayashi T, Kabrhel C, Barnes GD. Interventional Therapies for Acute Pulmonary Embolism: Current Status and Principles for the Development of Novel Evidence: A Scientific Statement From the American Heart Association. Circulation. 2019 Nov 12;140(20):e774-e801. doi: 10.1161/CIR.0000000000000707. Epub 2019 Oct 4. PMID: 31585051.

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# Das PERT Team am USZ

| II. Räumliche Voraussetzungen |
|---|
| 1. Aufnahmeeinheit/Schockraum (ER) an 365 Tagen/24 h verfügbar |
| 2. Herzkatheterlabor (HKL) an 365 Tagen/24 h verfügbar |
| 3. Intensiveinheit (ITS) an 365 Tagen/24 h verfügbar |
| 4. Ausfallkonzept für HKL |
| **III. Apparative Voraussetzungen** |
| 1. 12-Kanal-EKG in jeder Aufnahmeeinheit |
| 2. Notfallsonographie an 365 Tagen/24 h innerhalb von 30 min an jedem Aufnahmeort |
| 3. Echokardiographie (inkl. transösophageal) an 365 Tagen/24 h innerhalb von 30 min |
| 4. Schnittbildgebung (CT) an 365 Tagen/24 h verfügbar |
| 5. Hochwertiges Beatmungsgerät |
| 6. Dialysemöglichkeit auf ITS |
| 7. Fachneurologischer Konsildienst innerhalb von 30 min an 365 Tagen/24 h verfügbar |

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# PERT

**DIAGNOSE – Hochrisiko LE**

Patient **instabil** (Schock / CPR / Pressoren / Verschlechterung der Hämodynamik) und V. a. massive Lungenembolie

- **Gabe von UFH-Bolus 80 IU/kg i.v.**
- Sauerstoff-Therapie
- Standard Massnahmen: Labor, *EKG…*
- Ringerfundin / Kristalloide 250-500mL
- Inotropika/Vasopressoren

– Kein Fentanyl/Morphin/Propofol
– Wenn möglich, keine Intubation oder mechanische Beatmung

**PERT-Aktivierung (Schockraum)**
**Anästhesie: 54321**
**PERT (ANG): 076 563 34 44**

→ **ANÄ, ANG,** HER/ECMO, THO, KAR, PNE, IPS

Falls CT nicht sofort möglich, prüfen ob Rechtsherzdilatation in TTE oder Thrombus in Transit (u/o TVT-Screening mit Duplex)

Nein → Keine Rechtsherzdilatation → andere Ursachen der Instabilität wahrscheinlicher als die LE

RHD oder TVT bestätigt

CT-Angio möglich ohne va-ECMO?

Nein → **va-ECMO** durch HER

Ja

**CT-Angio** → **Triage Reperfusion: Folie 12**

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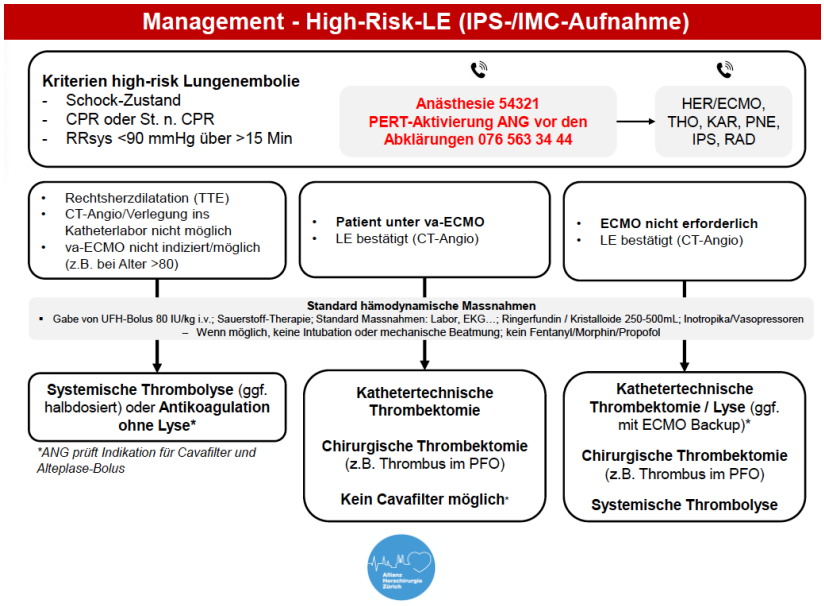
# PERT

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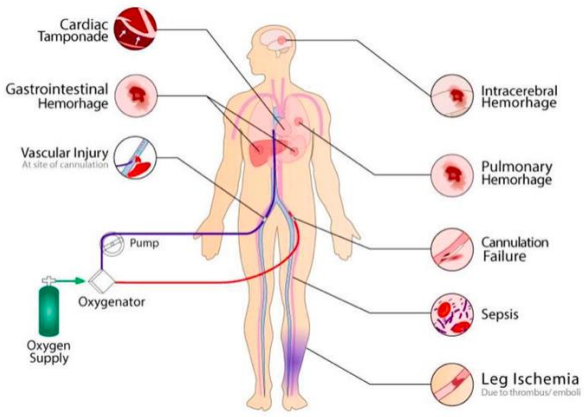
# Komplikationen




Tsangaris A, Alexy T, Kalra R, Kosmopoulos M, Elliott A, Bartos JA, Yannopoulos D. Overview of Veno-Arterial Extracorporeal Membrane Oxygenation (VA-ECMO) Support for the Management of Cardiogenic Shock. Front Cardiovasc Med. 2021 Jul 7;8:686558. doi: 10.3389/fcvm.2021.686558. PMID: 34307500; PMCID: PMC8292640.

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# Komplikationen

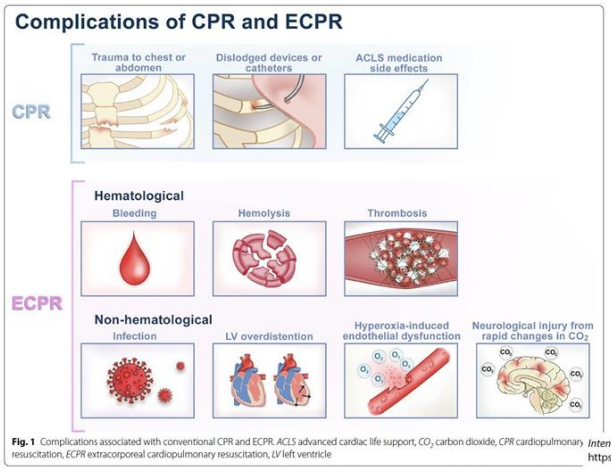


**Fig. 1** Complications associated with conventional CPR and ECPR. *ACLS* advanced cardiac life support, $CO_2$ carbon dioxide, *CPR* cardiopulmonary resuscitation, *ECPR* extracorporeal cardiopulmonary resuscitation, *LV* left ventricle

*Intensive Care Med (2022) 48:1–15*
https://doi.org/10.1007/s00134-021-06514-y

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# Access site vascular complications in MCS

- **Häufig, 8-30%**

✓Hämatom
✓Perforation
✓Dissektion
✓Pseudoaneurysma
✓AV-Fistel
✓Thrombose
✓Thrombembolien
✓Okklusion (Kanüle)
✓Ischämie **20%**

Schrage B et al. Left Ventricular Unloading Is Associated With Lower Mortality in Patients With Cardiogenic Shock Treated With Venoarterial Extracorporeal Membrane Oxygenation: Results From an International, Multicenter Cohort Study. Circulation. 2020 Dec;142(22):2095-2106. doi: 10.1161/CIRCULATIONAHA.120.048792. Epub 2020 Oct 9. PMID: 33032450; PMCID: PMC7688081.

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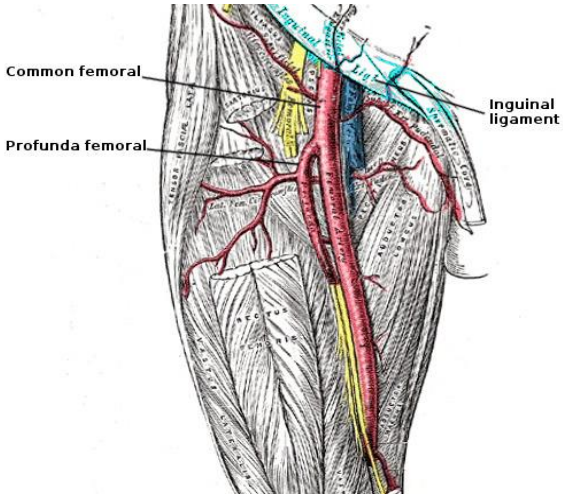
## Wo Kannülieren?

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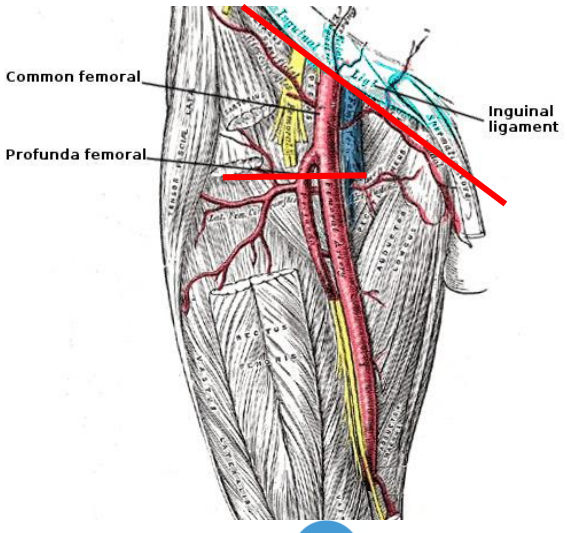
## Sweet Spot of Puncture

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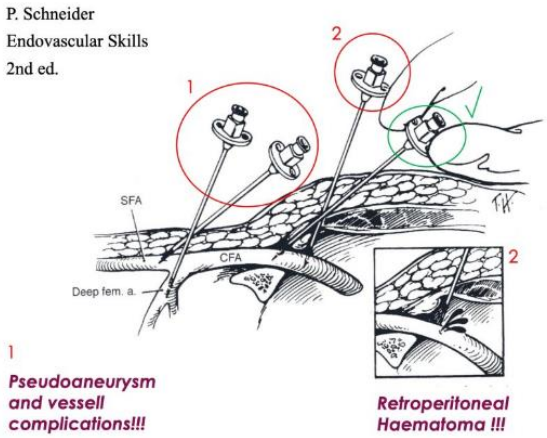
# Warum genau dort?

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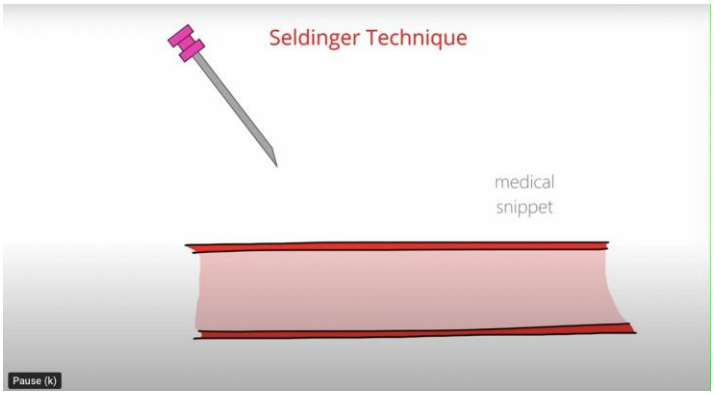
# Wie punktieren?




1. Ultraschallgestützt
2. Kontrolle über Draht
3. Nie gegen Widerstand vorschieben
4. Stets den Draht unter Spannung halten

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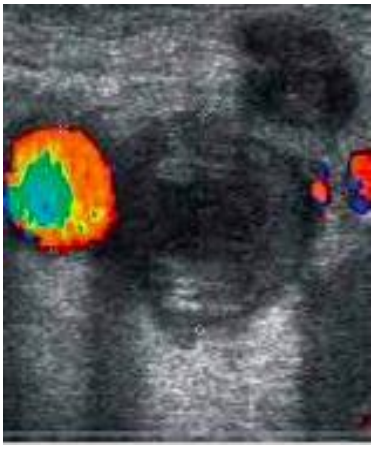
# Ultrasound guided puncture (short axis)

Anatomy

Compression



Doppler ultrasound

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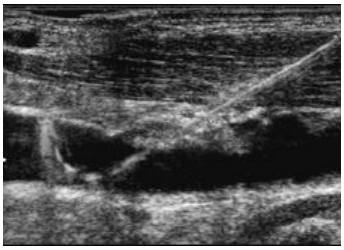
# Ultrasound guided puncture (long axis)



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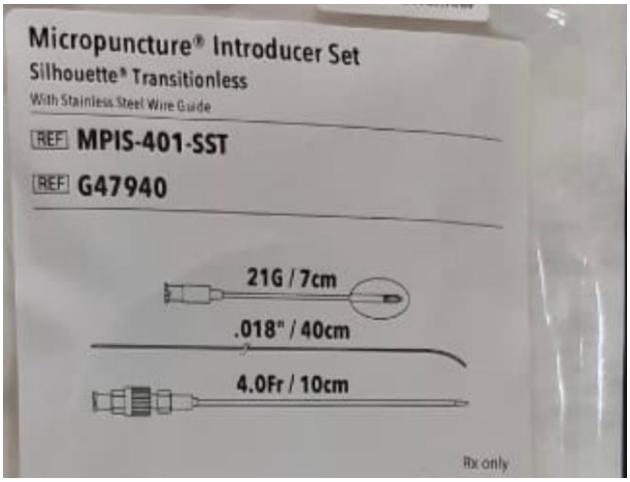
# 4Fr Mikropunktionsset

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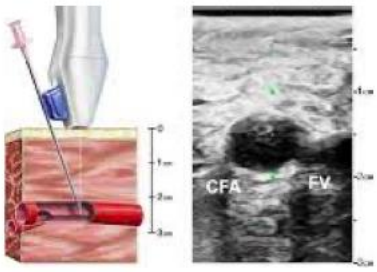
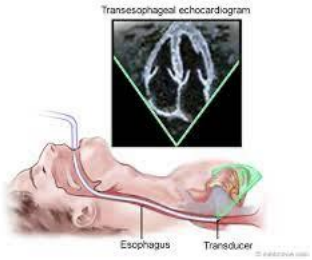
# Safety first




Ultrasound guided puncture




TEE/ TTE

Mobile fluroscopy


Always have controll of the location of the wire

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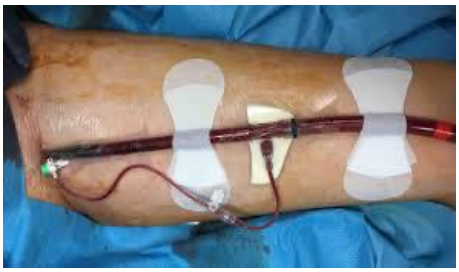
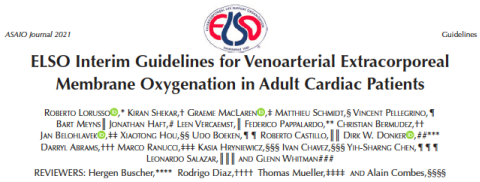
# Distale Beinperfusion



- Target flow 100ml/min
- RR > 50mmHg
- 6-8 Fr
- The use of larger and loger DPCs is not recommenden since these may be associated with vascular trauma + spasm
- Risk Reduction for limb ichemia 16%

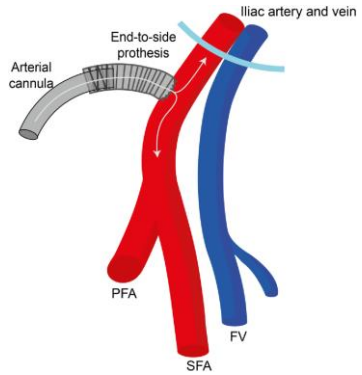


ASAIO Journal 2021 Guidelines

ELSO Interim Guidelines for Venoarterial Extracorporeal Membrane Oxygenation in Adult Cardiac Patients

Roberto Lorusso,* Kiran Shekar,† Graeme MacLaren,‡ Matthieu Schmidt,§ Vincent Pellegrino, ¶ Bart Meyns,‖ Jonathan Haft,# Leen Vercaemst,‖ Federico Pappalardo,** Christian Bermudez,†† Jan Belohlavek,‡‡ Xiaotong Hou,§§ Udo Boeken, ¶ ¶ Roberto Castillo, ‖‖ Dirk W. Donker,##*** Darryl Abrams,††† Marco Ranucci,‡‡‡ Kasia Hryniewicz,§§§ Ivan Chavez,§§§ Yih-Sharng Chen, ¶ ¶ ¶ Leonardo Salazar, ‖‖‖ and Glenn Whitman###

REVIEWERS: Hergen Buscher,**** Rodrigo Diaz,†††† Thomas Mueller,‡‡‡‡ and Alain Combes,§§§§

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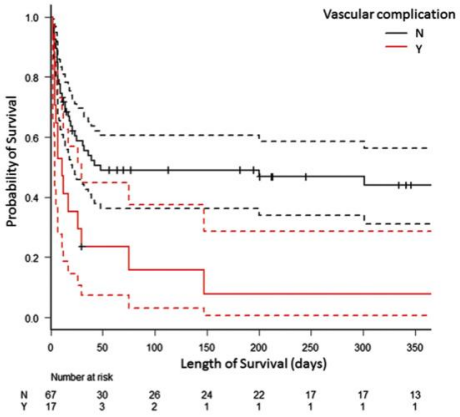
# Access site vascular complications in MCS




Entlassungsrate ohne vaskuläre Komplikationen (49%) versus 18% in Patienten mit Gefässkomplikationen (V-A ECMO, > 18 Jahre)

Tanaka D, Hirose H, Cavarocchi N, Entwistle JW. The Impact of Vascular Complications on Survival of Patients on Venoarterial Extracorporeal Membrane Oxygenation. Ann Thorac Surg. 2016 May;101(5):1729-34. doi: 10.1016/j.athoracsur.2015.10.095. Epub 2016 Feb 10. PMID: 26872734.

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# Räumlichkeiten


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# Der Hybrid ER

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# Timing?


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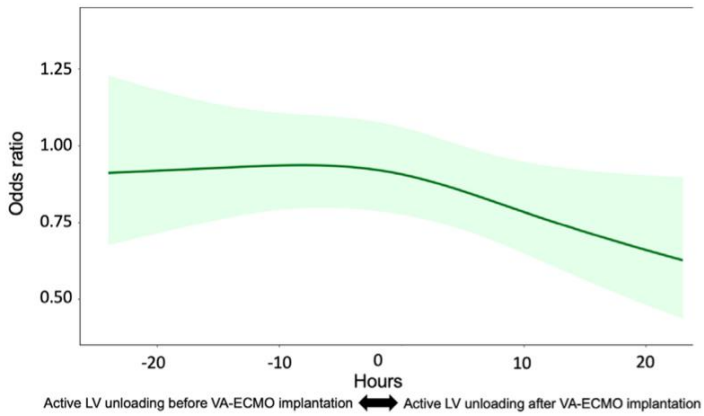
# Association Between Timing of Ventricular Unloading and Successful Weaning From Mechanical Ventilation




Schrage B, Sundermeyer J, Blankenberg S, Colson P, Eckner D, Eden M, Eitel I, Frank D, Frey N, Graf T, Kirchhof P, Kupka D, Landmesser U, Linke A, Majunke N, Mangner N, Maniuc O, Mierke J, Möbius-Winkler S, Morrow DA, Mourad M, Nordbeck P, Orban M, Pappalardo F, Patel SM, Pauschinger M, Pazzanese V, Radakovic D, Schulze PC, Scherer C, Schwinger RHG, Skurk C, Thiele H, Varshney A, Wechsler L, Westermann D. Timing of Active Left Ventricular Unloading in Patients on Venoarterial Extracorporeal Membrane Oxygenation Therapy. JACC Heart Fail. 2023 Mar;11(3):321-330. doi: 10.1016/j.jchf.2022.11.005. Epub 2023 Jan 11. PMID: 36724180.

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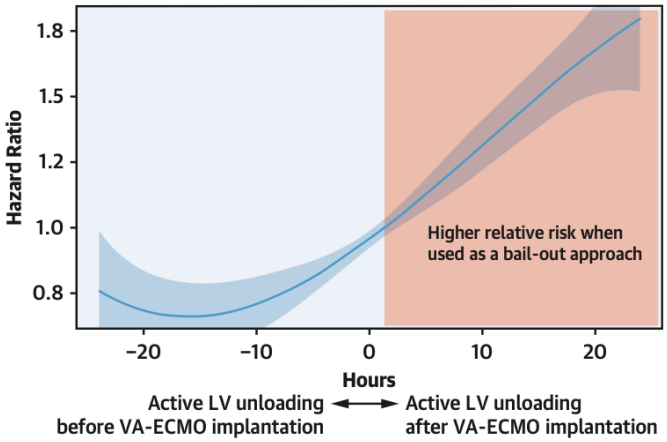
# Association Between Timing of Ventricular Unloading and 30-Day Mortality




Schrage B, Sundermeyer J, Blankenberg S, Colson P, Eckner D, Eden M, Eitel I, Frank D, Frey N, Graf T, Kirchhof P, Kupka D, Landmesser U, Linke A, Majunke N, Mangner N, Maniuc O, Mierke J, Möbius-Winkler S, Morrow DA, Mourad M, Nordbeck P, Orban M, Pappalardo F, Patel SM, Pauschinger M, Pazzanese V, Radakovic D, Schulze PC, Scherer C, Schwinger RHG, Skurk C, Thiele H, Varshney A, Wechsler L, Westermann D. Timing of Active Left Ventricular Unloading in Patients on Venoarterial Extracorporeal Membrane Oxygenation Therapy. JACC Heart Fail. 2023 Mar;11(3):321-330. doi: 10.1016/j.jchf.2022.11.005. Epub 2023 Jan 11. PMID: 36724180.

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# Wrap Up

- ✓ V-A ECMO stellt eine Therapieoption für marginale Patienten mit ansonsten infauster Prognose dar (eCPR, KI für AK/Lyse....)
- ✓ Wenn V-A ECMO dann mit weiterführender Therapie: Thrombektomie/ Reperfusion
- ✓ Schnellstmögliche Implantation bei therapierefraktärem Schock um den circulus vitiosus zu Durchbrechen und Endorganschäden zu vermeiden (Mobile ECMO Teams für Zuweiserspital)
- ✓ Team Approach: PERT
- ✓ Cave: Keine RCT`s, Selection Bias

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# To bridge or not to bridge ?

Individuelles Risiko

Zentrums Erfahrung

Kapazitäten

Lokale ECMO Komplikationen

Weiterführende Therapiemodalitäten

Infrastruktur

## Im Zweifel (in erfahrender Hand): Bridge

# Vielen Dank für die Aufmerksamkeit!

Allianz Herzchirurgie Zürich

**Dr. med. Martin O. Schmiady**
**Oberarzt Herzchirurgie**
**martinoliver.schmiady@usz.ch**