

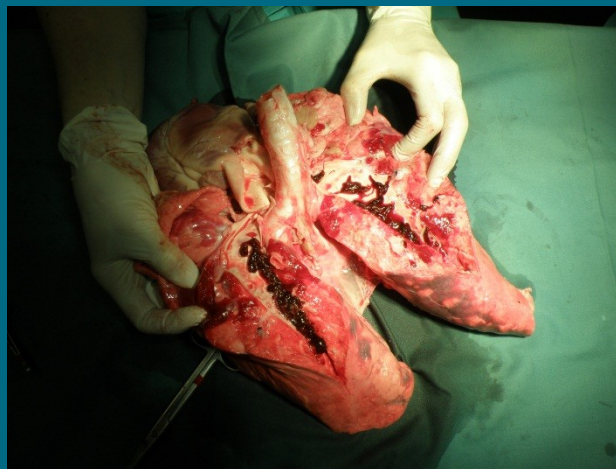
Extracorporeal Cardiopulmonary Support may be an efficient rescue of patients with massive pulmonary embolism. A porcine study.

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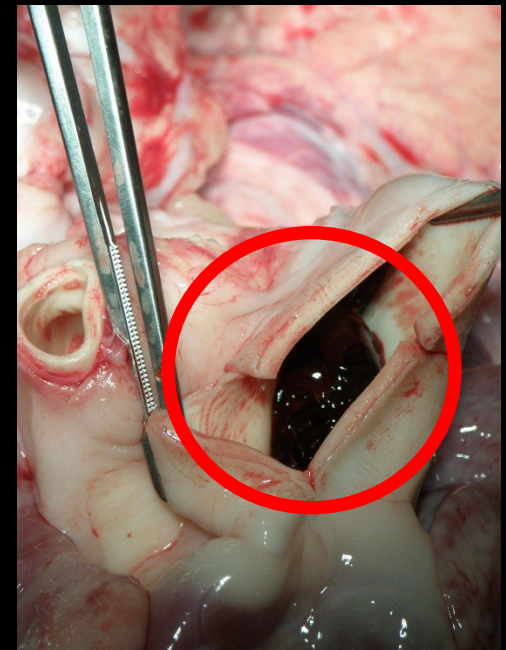


Introduction

Cardiac arrest (CA) with massive pulmonary embolism (PE)

➤ Several treatment modalities

BUT no evidence of the best treatment¹



¹Dong BR et al. Thrombolytic therapy for pulmonary embolism. Cochrane Database Syst Rev 2009(3):CD004437

Study Objectives

Aims of this study:

1. To establish a porcine model of massive PE to test different treatment modalities
2. To show that Cardiopulmonary Support (CPS) can rescue pigs with massive PE
3. Since there are previously pro and con studies for mild hypothermia in correlation with fibrinolysis^{2,3}

To examine whether mild hypothermia increases fibrinolysis

²Yenari MA et al. Thrombolysis with tissue plasminogen activator (tPA) is temperature dependent. *Thromb Res* 1995;77(5):475-81 ³Yoshihara H et al. Changes in coagulation and fibrinolysis occurring in dogs during hypothermia. *Thromb Res* 1985;37(4):503-12

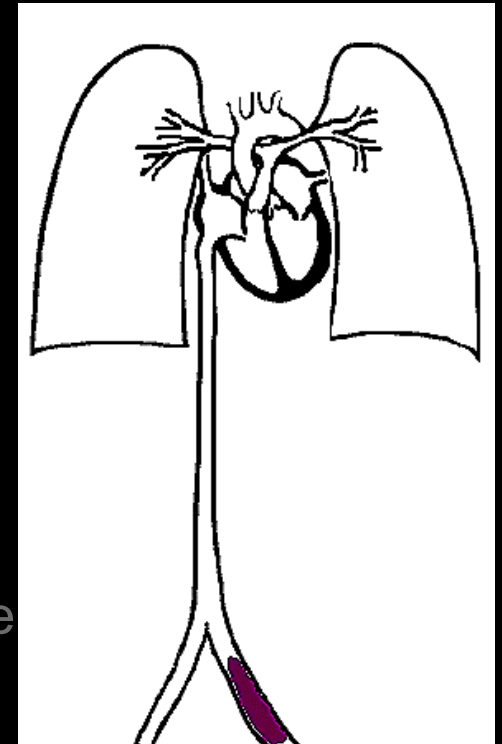
Material & Methods I

➤ Experimental randomised study

- Approval by the Danish Animal Experiments Inspectorate
- 18 pigs (female Danish Landrace ~80 kg)
 - 6 normothermic (38-39 °C)
 - 6 hypothermic (33-34 °C)
 - 6 treated with recombinant tissue plasminogen activator (rt-PA) 100 mg Actilyse® during first 2 hours on CPS; 3 normo-, 3 hypothermic

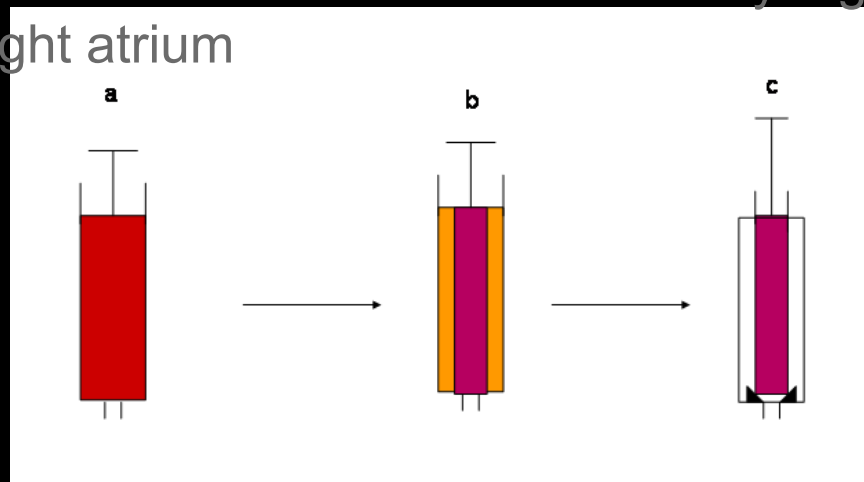
➤ Monitoring

- Arterial, central venous and pulmonary pressure
- Cardiac output and mixed venous saturation
- End Tidal CO₂ (ET-CO₂), bloodgas analysis, D-dimer



Material & Methods II - Preparation of Thrombus

- Placed an endotracheal tube with removed cuff
 - Via right jugular vein into cranial caval vein with end at right atrium
- *In vitro* preparation of thrombus
 - 6 syringes with 50 mL blood from the pigs
 - 150 U bovine thrombin added to each syringe, left for 1 hour
 - Thrombus without serum moved to 20 mL syringe and ready to inject into right atrium



Material & Methods III - Injection of Thrombus

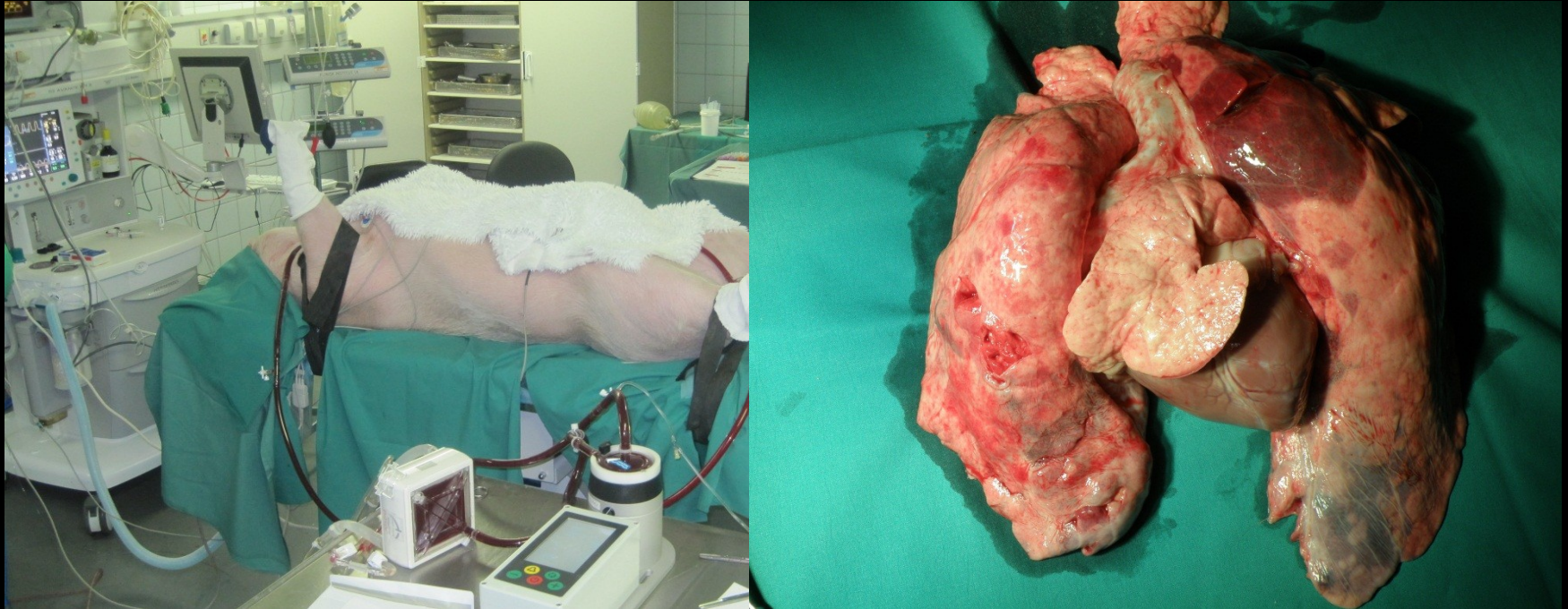
➤ *In vivo* formation of the pulmonary embolism



➤ One thrombus every 5 min until circulatory collapse defined as systolic arterial pressure < 25 mmHg

Material & Methods IV

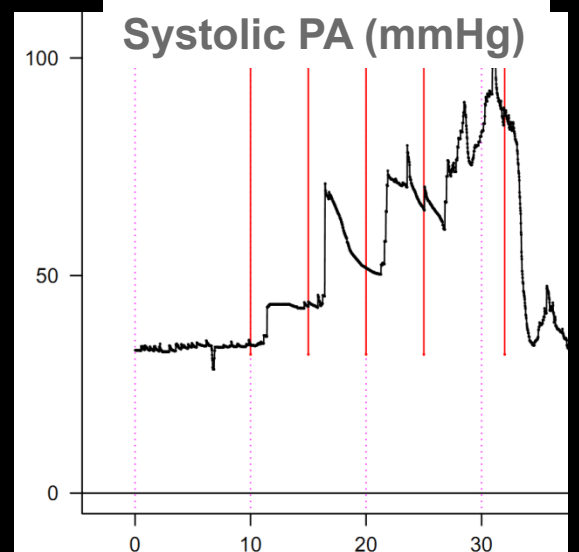
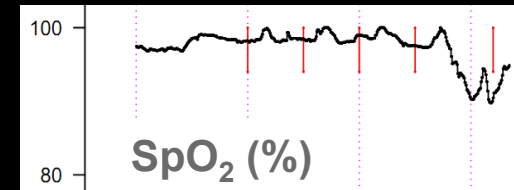
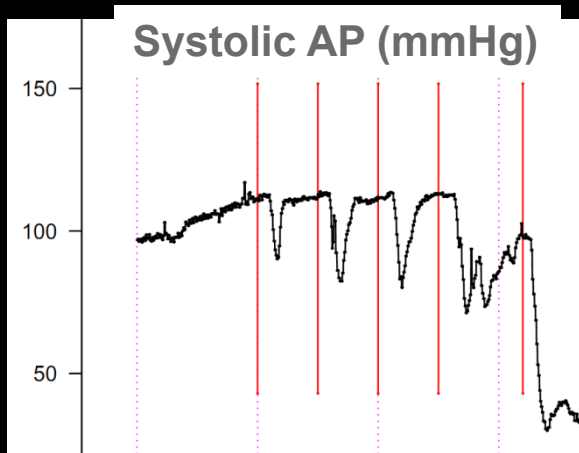
- 10 min after cardiac arrest - CPS for 3 hours



- Killed after 15 min with spontaneous circulation
- Autopsy

Results

Each red line is infusion of a new thrombus. 4-5 thrombi means CA for all 18 animals

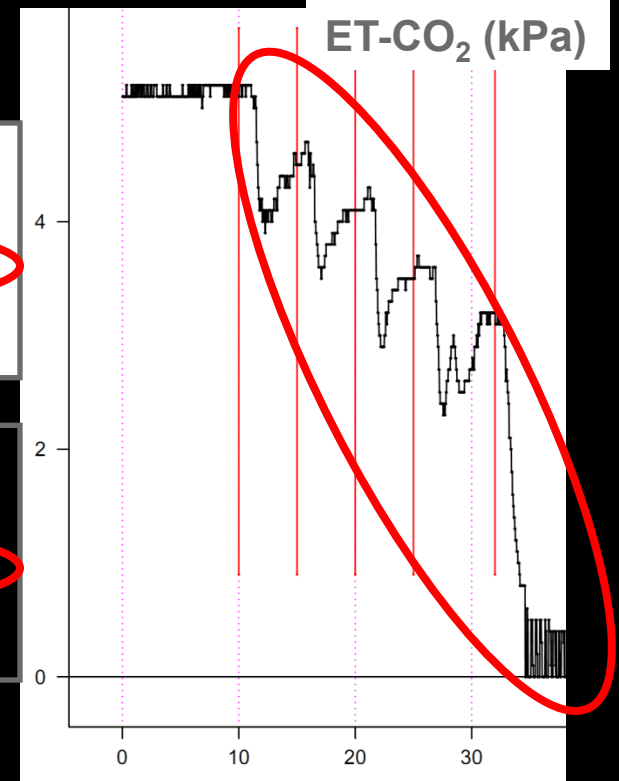


Pre-blood gas analysis

pH	7.33
PaO ₂	11.7 kPa
PaCO₂	6.2 kPa
HCO ₃	23.2 mmol/L
SaO ₂	0.96

Post-Blood gas analysis

pH	7.26
PaO ₂	20.9 kPa
PaCO₂	5.1 kPa
HCO ₃	17.7 mmol/L
SaO ₂	0.98

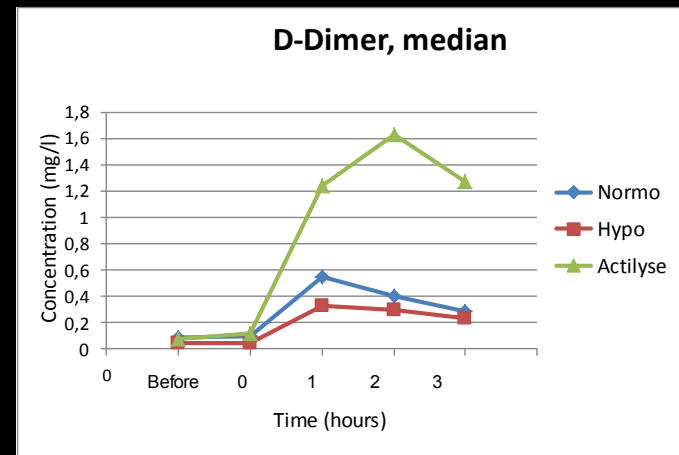


Results

- All 18 pigs re-established circulation after CPS
- No significant differences in remaining emboli in pulmonary arteries

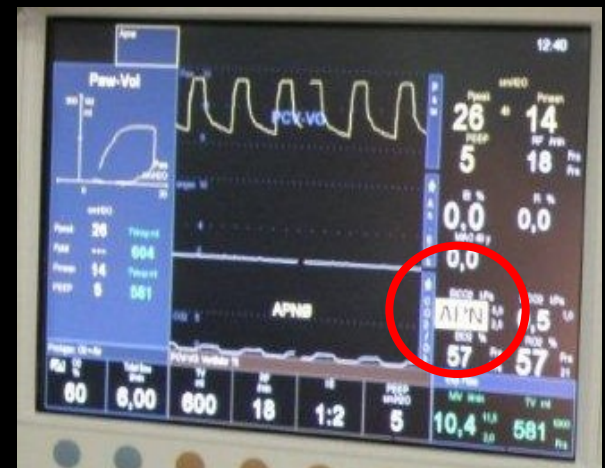
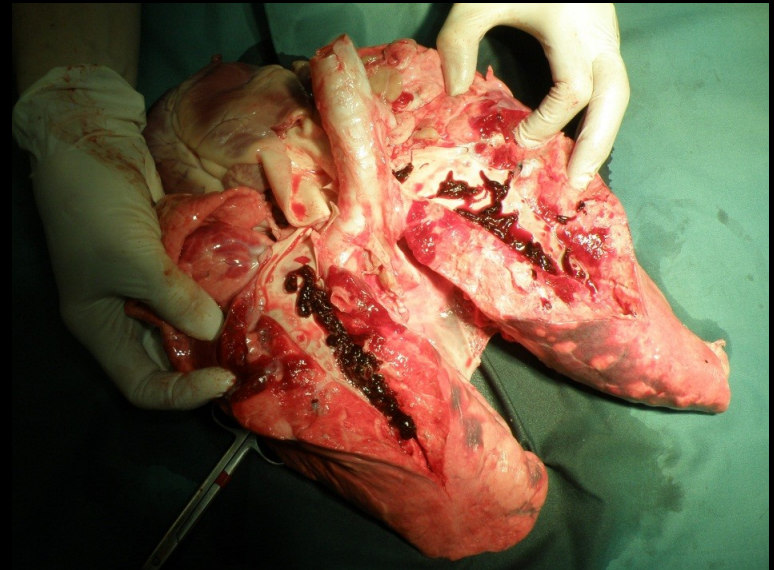
Group – Rest emboli	Mean ± SD
Normothermia	20.0 ± 2.2 g
Hypothermia	17.0 ± 3.7 g
rt-PA	14.3 ± 3.2 g

- No difference in amount between normo-/hypothermic rt-PA pigs



Conclusion

- Established a porcine model of massive PE
- CPS can be a life-saving procedure in PE
- rt-PA increased fibrinolysis but not the remaining emboli
- Mild hypothermia did not reduce the PE significantly
- ET-CO₂ decrease to apnoea - paCO₂ remains the same
- ET-CO₂ is a simple non-invasive parameter and may be reliable in the diagnosis of acute PE



Thank you!

