Kardialer Risikopatient

I. gasteiger

ANÄSTHESIE FORUM

ALPBACH

REPETITORIUM

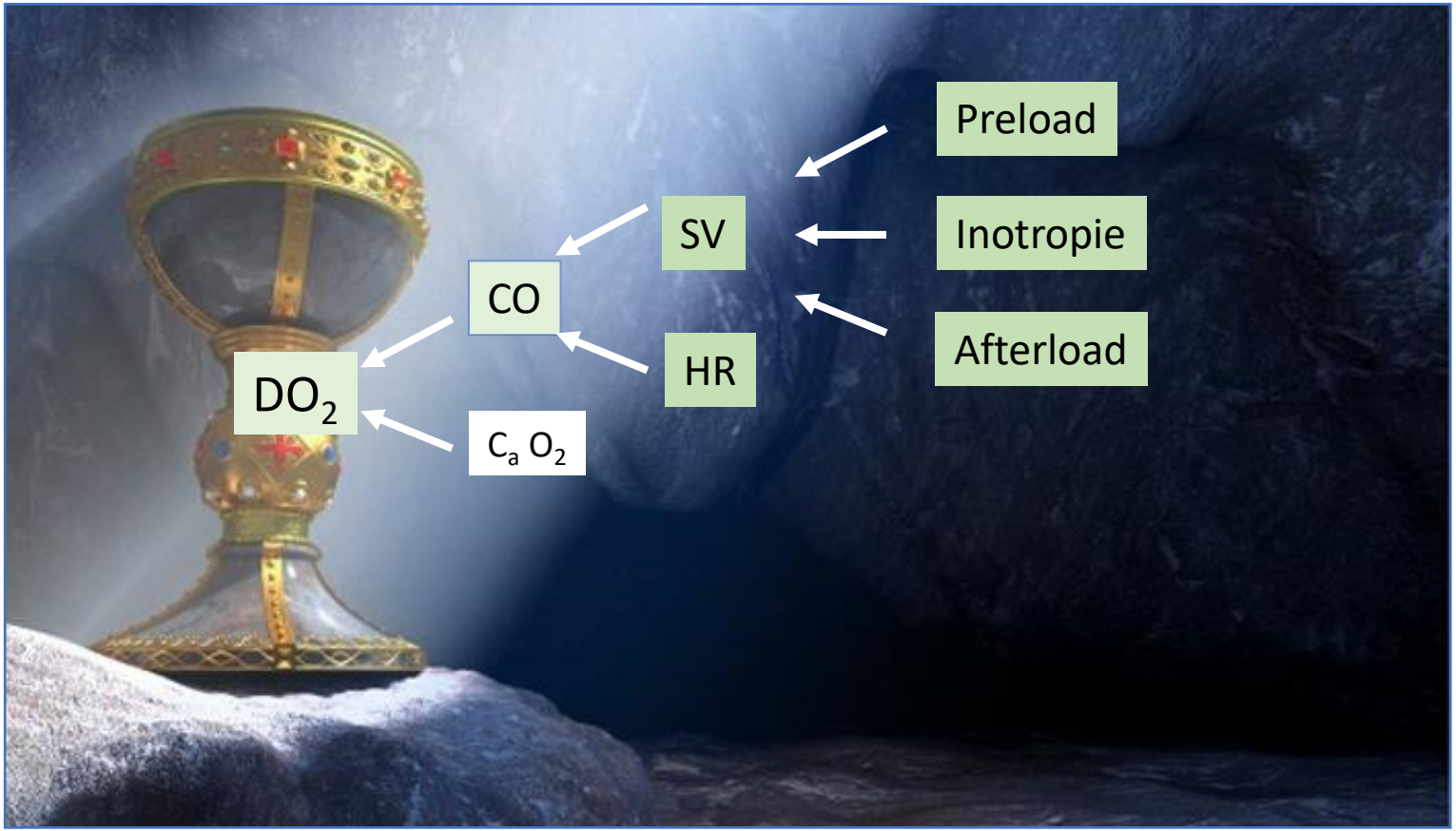
Durchführung Anaesthesie

Ziel:

DO_2  VO_2

- „The importance of skilled anaestheological managment in keeping adequat circulation is often underlined.“

- **Koordination, praeoperativen Abklärung und Freigabe** durch den **Anästhesisten**, da dieser über das Expertenwissen („experts on the specific demands of the procedure“) verfügt.


Preload
SV
Inotropie
CO
Afterload
HR
DO_2
$C_a O_2$

Tatort Orthopädie 15:30 Uhr

- 67 Jahre männlich
- Septische Knieprothese
- Temp 37,8 C°, CRP 37 mg/dl

Koordination, praeoperativen Abklärung und Freigabe durch den **Anästhesisten**, da dieser über das Expertenwissen („experts on the specific demands of the procedure“) verfügt.

- AS I-II, MI II-III
- Pulm Hypertonus (sPAP 50 mmHg)
- TAPSE 14mm
- Kreatinin Anstieg

Problemfeld

- Planung (Zeitpunkt, Personal, Equipment, ICU)
- Planung hämodynamische Ziele
- Stressreduktion (Patient, Team-mitglieder)
- Durchführung

Wie machen wir es ?

- Anxiolyse
- Guter venöser Zugang
- Arterielle Kanüle wach (ev. ZVK?)

Arterie wach?

BJA

British Journal of Anaesthesia, 129 (4): 478–486 (2022)

doi: 10.1016/j.bja.2022.06.027
Advance Access Publication Date: 23 August 2022
Cardiovascular

CARDIOVASCULAR

Continuous intra-arterial *versus* intermittent oscillometric arterial pressure monitoring and hypotension during induction of anaesthesia: the AWAKE randomised trial

Karim Kouz[1,†], Mirja Wegge[1,†], Moritz Flick[1], Alina Bergholz[1], Parisa Moll-Khosrawi[1], Rainer Nitzschke[1], Constantin J. C. Trepte[1], Linda Krause[2], Daniel I. Sessler[3,4], Christian Zöllner[1] and Bernd Saugel[1,4,*]

Methods: In this single-centre randomised trial, 242 noncardiac surgery patients in whom intra-arterial arterial pressure monitoring was planned were randomised to unblinded continuous intra-arterial or to intermittent oscillometric arterial pressure monitoring (with blinded intra-arterial arterial pressure monitoring) during induction of anaesthesia. The primary endpoint was the area under a mean arterial pressure (MAP) of 65 mm Hg within the first 15 min of induction of anaesthesia. Secondary endpoints included areas under MAP values of 60, 50, and 40 mm Hg and durations of MAP values <65, <60, <50, and <40 mm Hg.

Outcome	Continuous intra-arterial monitoring (n=112)	Intermittent oscillometric monitoring (n=112)	P-value
AUC MAP <65 mm Hg (mm Hg • min)			<0.001*
Mean	27 (34)	70 (80)	
Median	15 (2–36)	46 (7–111)	
Range	0–157	0–464	
AUC MAP <60 mm Hg (mm Hg • min)			<0.001*
Mean	14 (22)	46 (63)	
Median	5 (0–15)	24 (1–74)	
Range	0–112	0–390	
AUC MAP <50 mm Hg (mm Hg • min)			<0.001*
Mean	2 (7)	15 (34)	
Median	0 (0–1)	0 (0–15)	
Range	0–38	0–247	
AUC MAP <40 mm Hg (mm Hg • min)			0.007*
Mean	0 (1)	4 (14)	
Median	0 (0–0)	0 (0–0)	
Range	0–8	0–119	
Duration of MAP <65 mm Hg (min)			<0.001*
Mean	3.2 (2.8)	5.6 (4.1)	
Median	2.6 (0.7–5.0)	5.4 (2.1–9.5)	
Range	0.0–11.7	0.0–15.0	
Duration of MAP <60 mm Hg (min)			<0.001*
Mean	2.0 (2.3)	4.3 (3.9)	
Median	1.3 (0.0–3.0)	3.3 (0.6–7.7)	
Range	0.0–9.3	0.0–14.5	
Duration of MAP <50 mm Hg (min)			<0.001*
Mean	0.5 (1.1)	1.9 (2.8)	
Median	0.0 (0.0–0.3)	0.2 (0.0–3.5)	
Range	0.0–6.0	0.0–13.8	
Duration of MAP <40 mm Hg (min)			0.005*
Mean	0.1 (0.2)	0.6 (1.6)	
Median	0.0 (0.0–0.0)	0.0 (0.0–0.0)	
Range	0.0–1.2	0.0–11.7	
Cumulative norepinephrine dose (μg kg^{-1})			<0.001*
Mean	0.75 (0.54)	0.49 (0.47)	
Median	0.62 (0.33–1.01)	0.29 (0.12–0.72)	
Range	0.00–2.34	0.00–1.91	

Association of Intraoperative Hypotension with Acute Kidney Injury after Elective Noncardiac Surgery

Louise Y. Sun, M.D., S.M., Duminda N. Wijeysundera, M.D., Ph.D., Gordon A. Tait, Ph.D., W. Scott Beattie, M.D., Ph.D.

Anesthesiology 2015; 123:515-23

	MAP < 55 mmHg		MAP < 60 mmHg		MAP < 65 mmHg	
IOH Duration (min)	N	AKI	N	AKI	N	AKI
1–5	2,807	189 (6.7%)	2,490	137 (5.5%)	1,474	64 (4.3%)
6–10	637	63 (9.9%)	1,030	64 (6.2%)	1,252	79 (6.3%)
11–20	63	7 (11.1%)	579	67 (11.6%)	1,182	80 (6.8%)
>20	23	4 (17.4%)	274	30 (11.0%)	903	92 (10.2%)

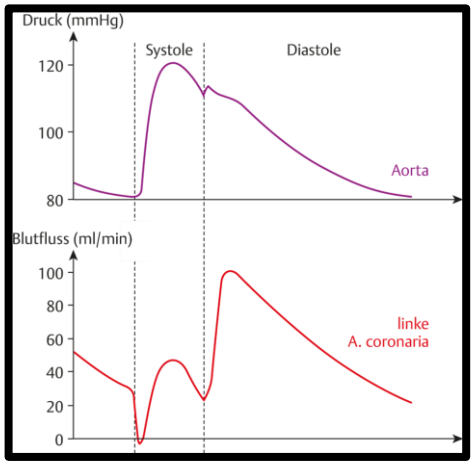
AKI = acute kidney injury; IOH = intraoperative hypotension; MAP = mean arterial pressure.

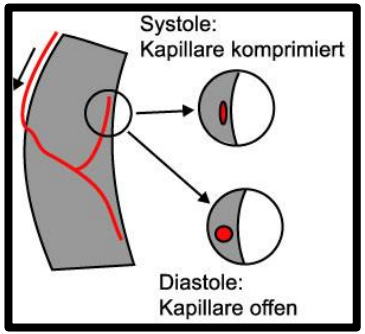
Wie machen wir es ?

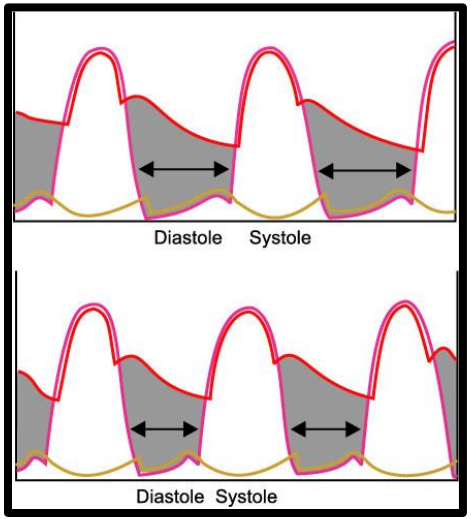
- Anxiolyse
- Guter venöser Zugang
- Arterielle Kanüle wach (ev. ZVK?)
- Kombinierte AN-Einleitung
  - (Midazolam), Fentanyl, Ketanest, Propofol, Esmeron
  - Noradrenalin frühzeitig (keine indirekten Sympathomimetika)
- Großzügige Indikation zu invasivem Monitoring
  - Flussmessung
  - TEE
  - PAK ?
  - Inotropie ?? (Milrinon, Levosimendan)

KHK

- Koronarperfusion abhängig von DAP
- Diastolenverkürzung durch Tachykardie





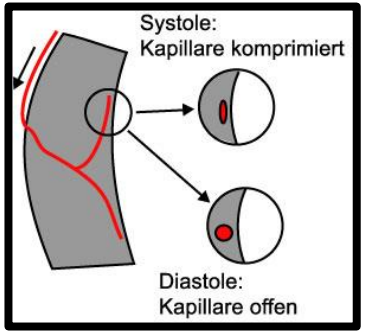


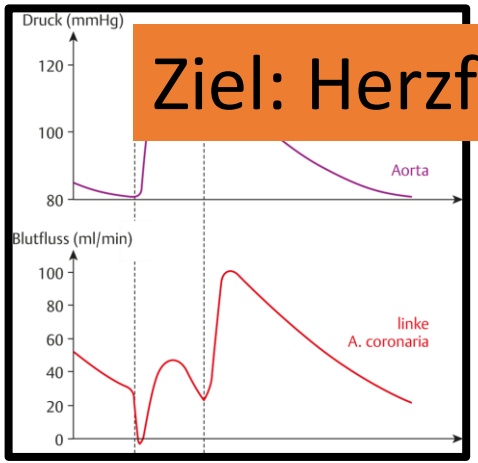
www.rudolf-deiml.homepage.t-online.de

KHK

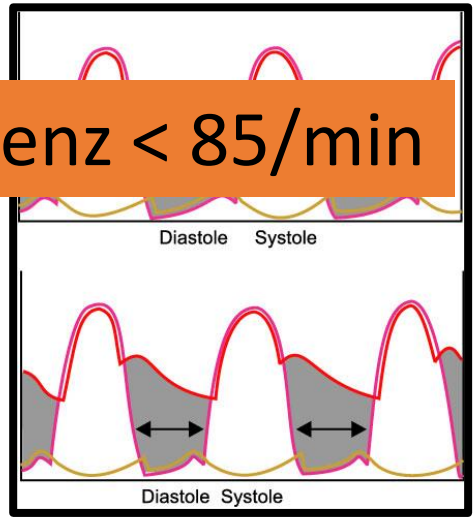
- Koronarperfusion abhängig von DAP

- Diastolenverkürzung durch Tachykardie





Ziel: Herzfrequenz < 85/min



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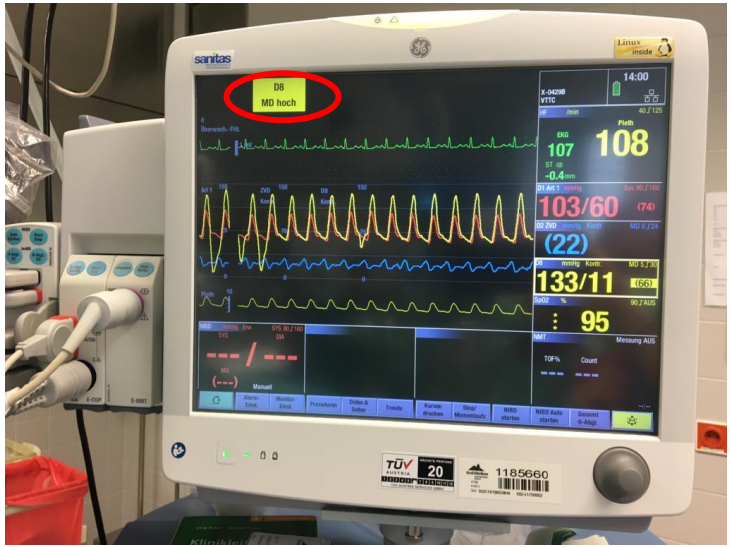
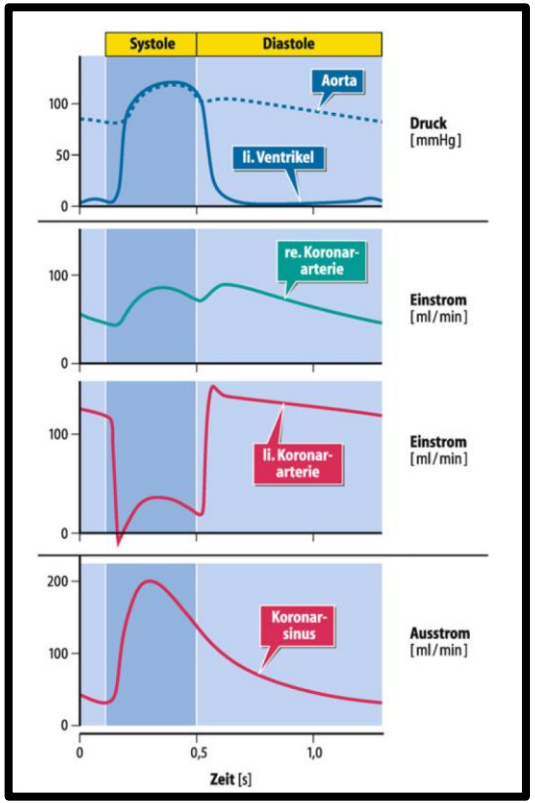
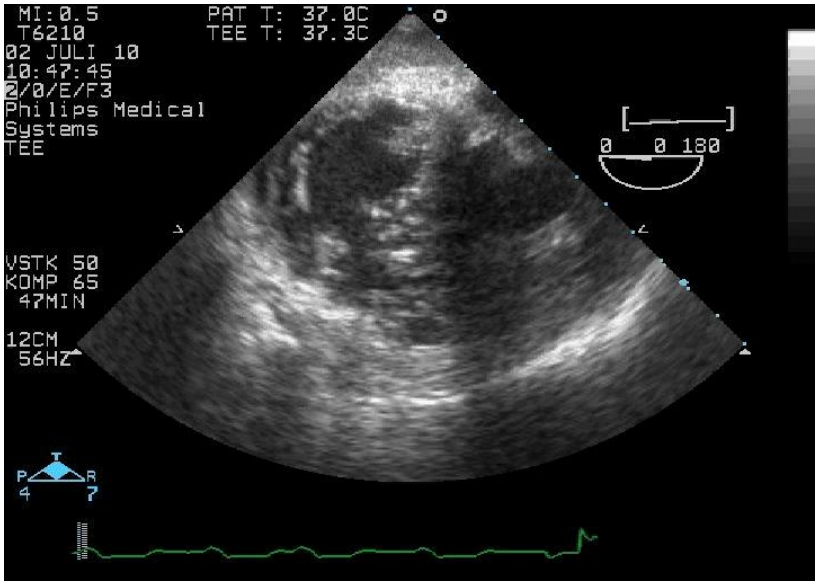
Rechter Ventrikel

- RCA MAP dependent





Schmidt_Physiologie des Menschen mit Pathophysiologie_2010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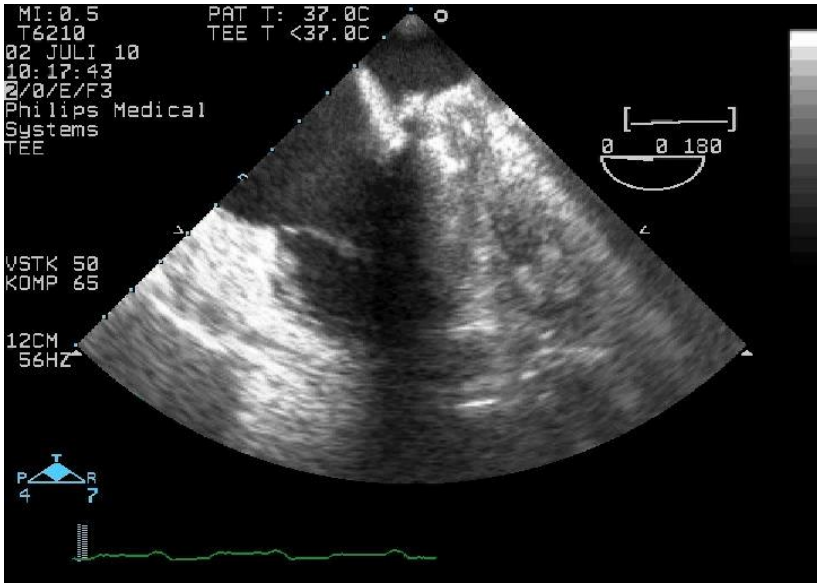
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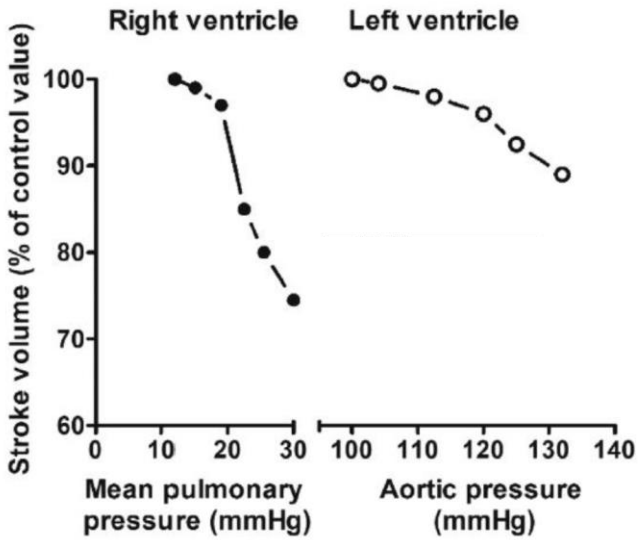
Spezielle Pharmakotherapie RVF

- PVR
  - Vasodilatatoren iv
    - Nicht selektiv PVR ↓ SVR ↓ (Cave: coronare Minderperfusion)
    - Ventilation/Perfusions - Missmatch ↑
  - Inhalative Vasodilatatoren
    - NO und Prostacykline
    - Selektiv und HPV <->
- Optimierung Vorlast
  - Wenn RV Kontraktilität (Echo) <-> und PVR nur gering ↑
  - Volume Response testen



JAMA | Original Investigation | CARING FOR THE CRITICALLY ILL PATIENT

Effect of Individualized vs Standard Blood Pressure Management Strategies on Postoperative Organ Dysfunction Among High-Risk Patients Undergoing Major Surgery

A Randomized Clinical Trial

Emmanuel Futier, MD, PhD; Jean-Yves Lefrant, MD, PhD; Pierre-Gregoire Guinot, MD, PhD; Thomas Godet, MD, PhD; Emmanuel Lorne, MD; Philippe Cuvillon, MD, PhD; Sebastien Bertran, MD; Marc Leone, MD, PhD; Bruno Pastene, MD; Vincent Piriou, MD, PhD; Serge Molliex, MD, PhD; Jacques Albanese, MD, PhD; Jean-Michel Julia, MD; Benoit Tavernier, MD, PhD; Etienne Imhoff, MD; Jean-Etienne Bazin, MD, PhD; Jean-Michel Constantin, MD, PhD; Bruno Pereira, PhD; Samir Jaber, MD, PhD; for the INPRESS Study Group

INTERVENTIONS Individualized management strategy aimed at achieving a systolic blood pressure (SBP) within 10% of the reference value (ie, patient's resting SBP) or standard management strategy of treating SBP less than 80 mm Hg or lower than 40% from the reference value during and for 4 hours following surgery.

MAIN OUTCOMES AND MEASURES The primary outcome was a composite of systemic inflammatory response syndrome and dysfunction of at least 1 organ system of the renal, respiratory, cardiovascular, coagulation, and neurologic systems by day 7 after surgery. Secondary outcomes included the individual components of the primary outcome, durations of ICU and hospital stay, adverse events, and all-cause mortality at 30 days after surgery.

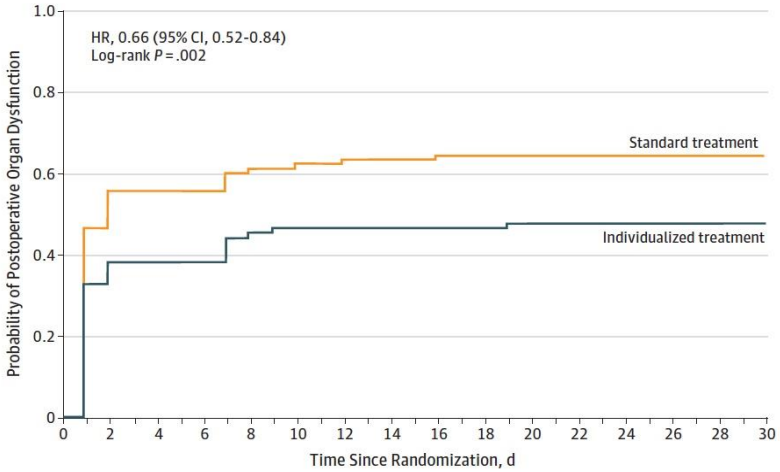
JAMA. 2017;318(14):1346-1357.

JAMA | Original Investigation | CARING FOR THE CRITICALLY ILL PATIENT

Effect of Individualized vs Standard Blood Pressure Management Strategies on Postoperative Organ Dysfunction Among High-Risk Patients Undergoing Major Surgery

A Randomized Clinical Trial

Figure 3. Kaplan-Meier Estimates of the Probability of Postoperative Organ Dysfunction by Day 30 After Surgery



No. at risk

Standard treatment	145	78	65	58	54	53
Individualized treatment	147	99	91	82	80	79

Organ dysfunction was assessed for renal (risk, injury, failure, loss, and end-stage kidney injury [RIFLE] stage of risk or higher), respiratory (need for invasive or noninvasive ventilation), cardiovascular (acute cardiac failure or myocardial ischemia or infarction), neurologic (stroke or altered consciousness), and coagulation (Sequential Organ Failure Assessment subscore ≥2 points in the coagulation component) systems. Data for patients who did not develop organ dysfunction were censored at 30 days after surgery. The adjusted hazard ratio (HR) for postoperative organ dysfunction in the individualized treatment group, as compared with the standard treatment group, was 0.66 (95% CI, 0.52-0.84; P = .001). The median follow-up duration was 30 days (interquartile range, 30-30 days) in the 2 treatment groups.

JAMA. 2017;318(14):1346-1357.

Intraoperative Hypotension and Myocardial Infarction Development Among High-Risk Patients Undergoing Noncardiac Surgery: A Nested Case-Control Study

Linn Hallqvist, MD, PhD Student, DESA,*† Fredrik Granath, PhD,‡ Michael Fored, MD, PhD,‡ and Max Bell, MD, PhD*†

6 www.anesthesia-analgesia.org July 2021 • Volume 133 • Number 1

ANÄSTHESIE FORUM ALPBACH REPETITORIUM

Table 2. ORs of MI in Relation to Intraoperative Hypotension

Risk factor	Cases n (%)	Controls n (%)	OR (unadjusted) (95% CI)	OR (adjusted[a]) (95% CI)	OR (adjusted[b]) (95% CI)
Hypotensive event[c] (mm Hg)					
≤20	13 (4)	84 (26)	Ref	Ref	Ref
21–40	22 (7)	105 (32)	1.53 (0.60-3.94)	1.37 (0.50-3.73)	1.37 (0.48-3.92)
41–50	31 (10)	64 (19)	5.30 (1.87-15.1)	4.58 (1.60-13.1)	3.42 (1.13-10.3)
>50	260 (80)	73 (22)	38.8 (14.5-104)	27.0 (9.82-74.1)	22.6 (7.69-66.2)

- **Findings:** In this nested case-control study of high-risk surgical patients, intraoperative hypotensive events >50 mm Hg, decrease from individual baseline, was associated with a 20-fold relative—and a 6% absolute—risk increase of clinically significant perioperative MI.

Anaesthesia 2022, 77, 153–163 doi:10.1111/anae.15535

Original Article

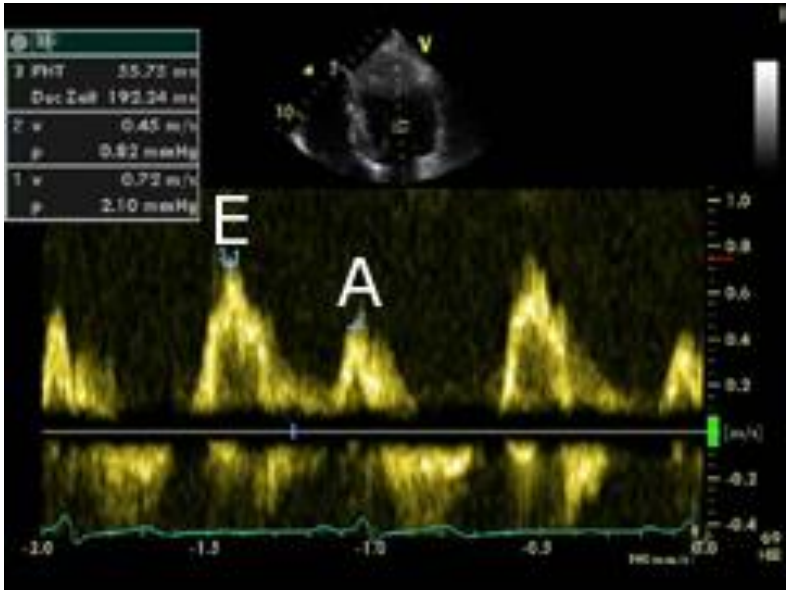
Treatment threshold for intra-operative hypotension in clinical practice—a prospective cohort study in older patients in the UK

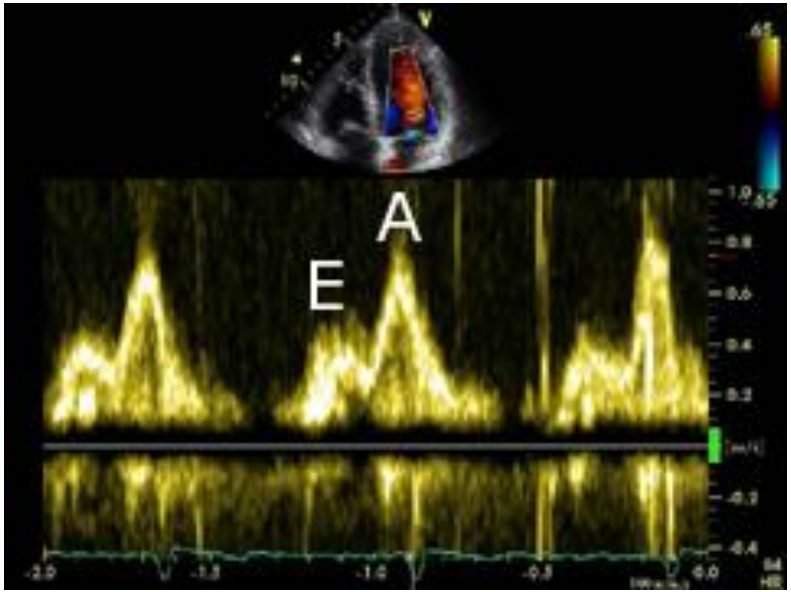
A. J. Wickham,[1] D. T. Highton,[2] S. Clark,[3] D. Fallaha,[4] D. J. N. Wong[5]
and **D. S. Martin[6,7,8] on behalf of the Research and Audit Federation of Trainees***

hypotension and its treatment thresholds in UK practice. Patients aged ≥ 65 years were studied prospectively from 196 UK hospitals within a 48-hour timeframe. The primary outcome was the incidence of hypotension (mean arterial pressure <65 mmHg; systolic blood pressure reduction >20%; systolic blood pressure <100 mmHg). Secondary outcomes included the treatment blood pressure threshold for vasopressors; incidence of acute kidney injury; myocardial injury; stroke; and in-hospital mortality. Additionally, anaesthetists

thresholds for hypotension. Data were collected from 4750 patients. Hypotension affected 61.0% of patients when defined as mean arterial pressure <65 mmHg, 91.3% of patients had >20% reduction in systolic blood pressure from baseline and 77.5% systolic blood pressure <100 mmHg. The mean (SD) blood pressure triggering vasopressor therapy was mean arterial pressure 64.2 (11.6) mmHg and the mean (SD) stated intended treatment threshold from the survey was mean arterial pressure 60.6 (9.7) mmHg. A composite adverse outcome of myocardial injury, kidney injury, stroke or death affected 345 patients (7.3%). In this

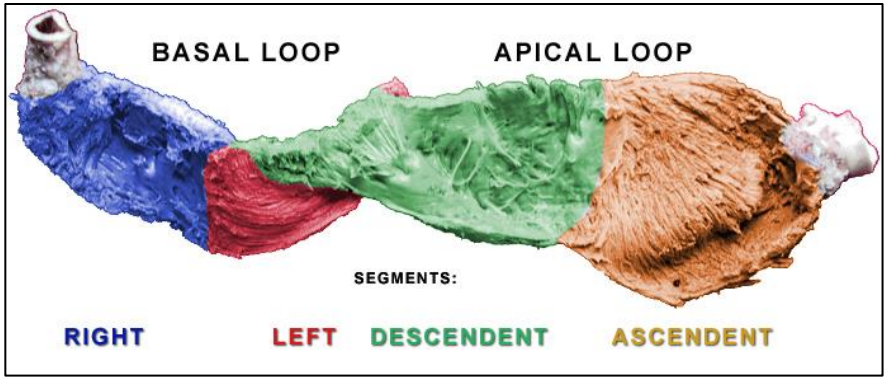
LV - Füllung





Vorhof: 30 %

Torrent Guasp
ventricular myocardial band



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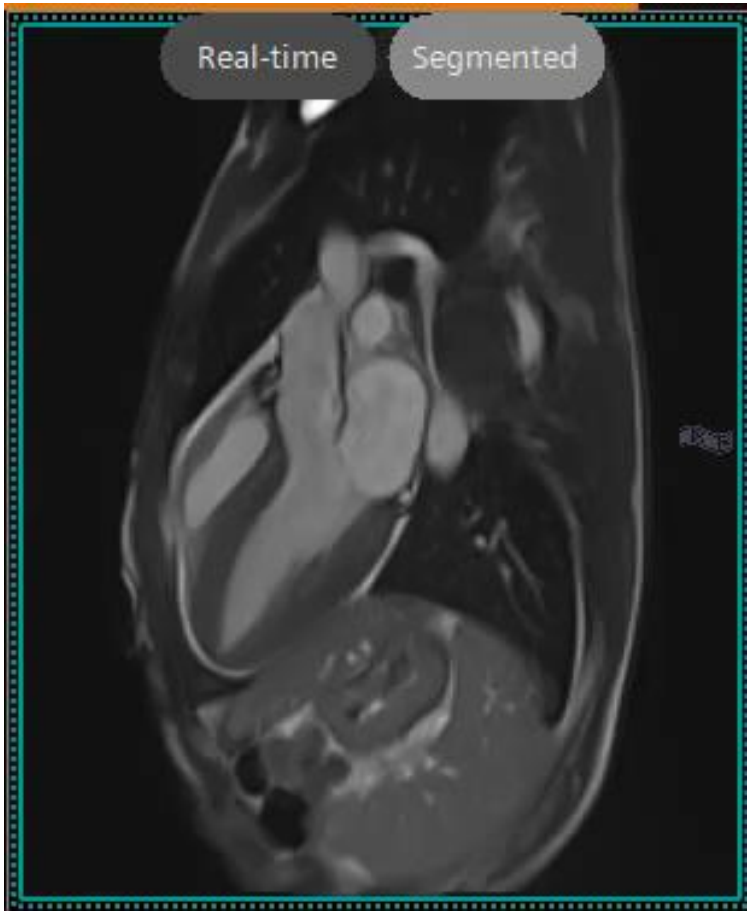
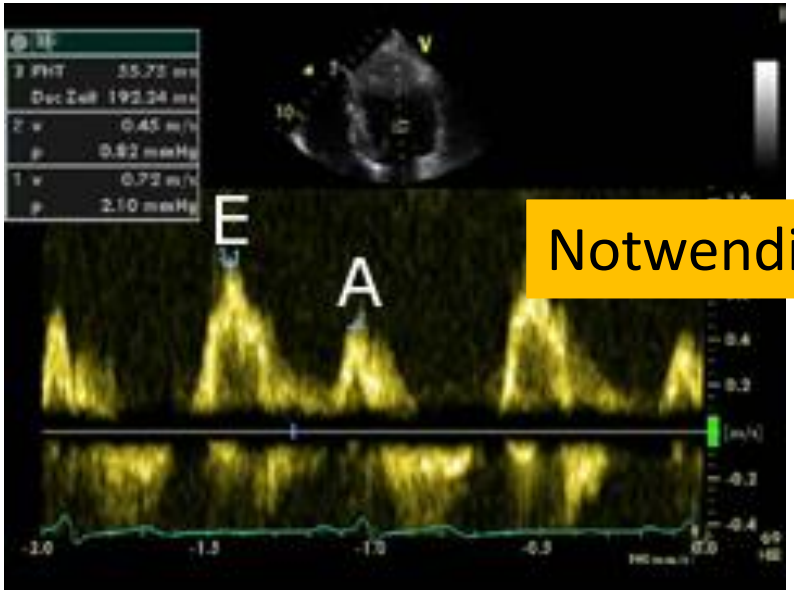
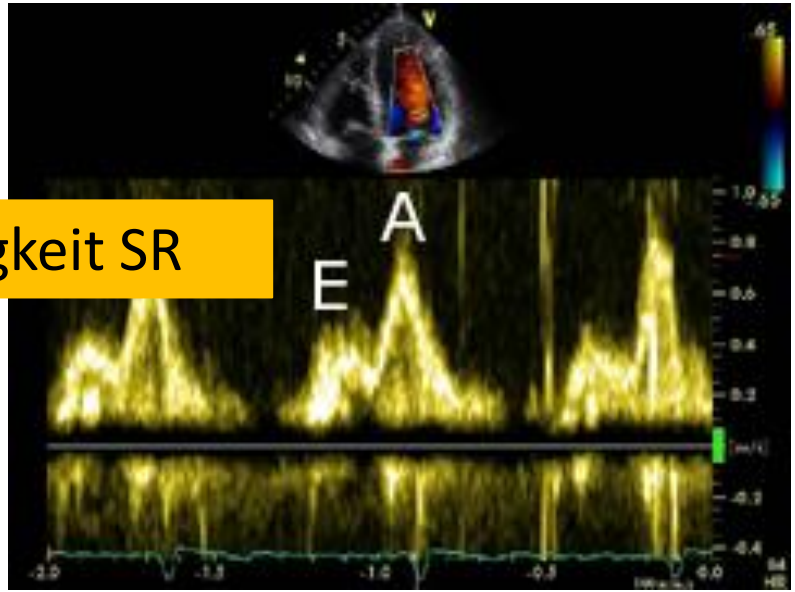


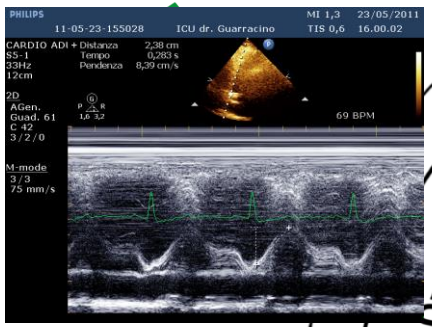
LV - Füllung

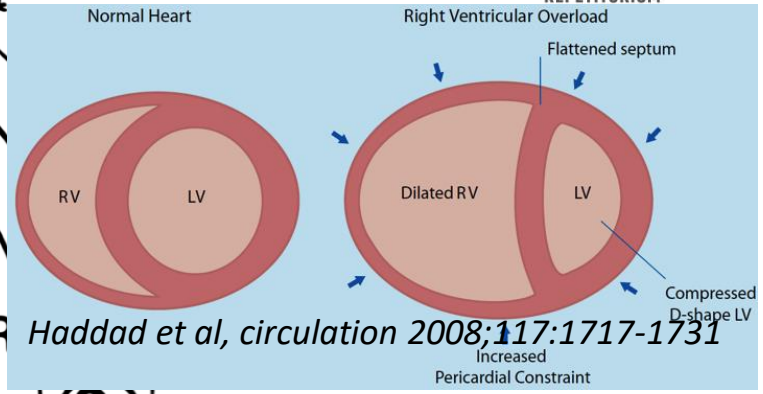


Notwendigkeit SR

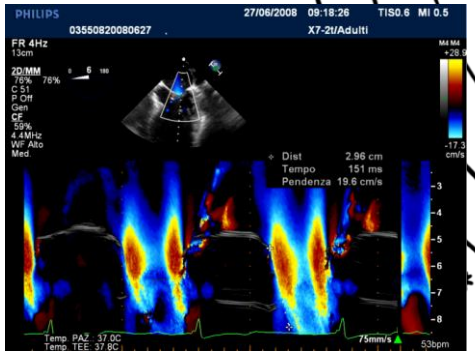


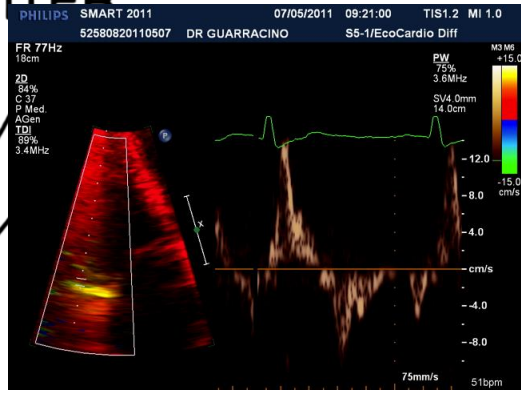
Das geozentrische Bild der Hämodynamik





Haddad et al, circulation 2008;117:1717-1731





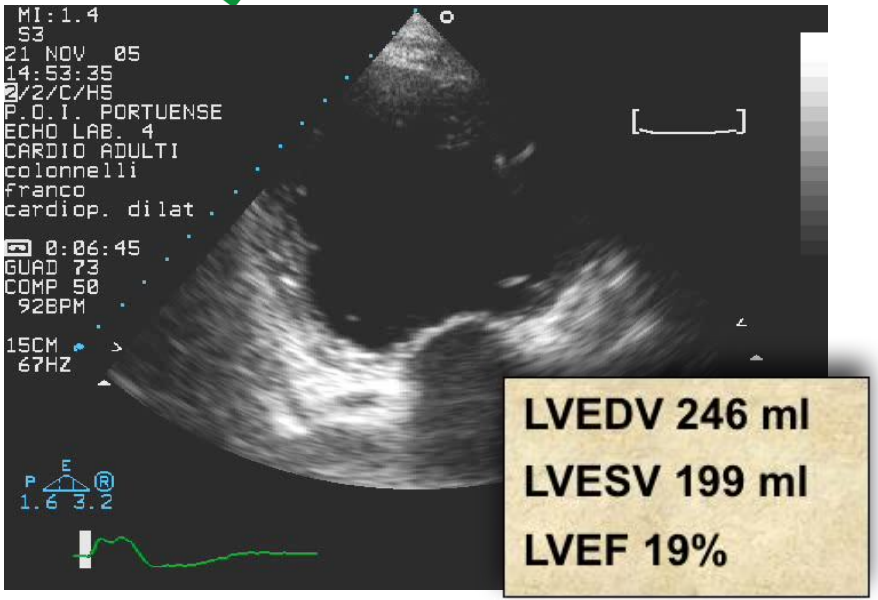
Ejection Fraction

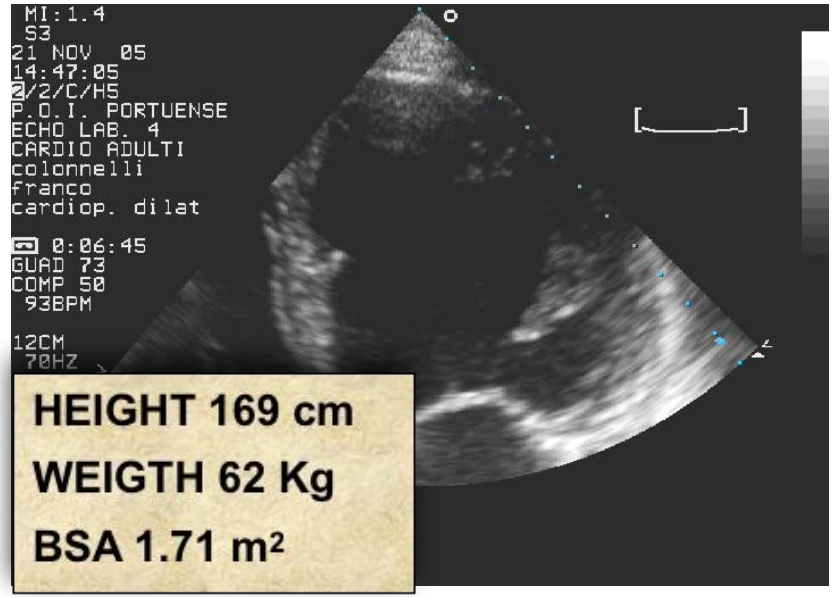
- EF 60%

- EF 40%

- EF 20%

Ejection Fraction vs Stroke volume





EF 19% ➡ SV 47 ml x 92 bpm= 4.3 l/min / 1.7 m²= 2.5 l/min/m²

Hämodynamische Ziele bei Klappenvitien

Vitium	Hf	Kontraktilität	Preload	SVR	PVR
- Aortenstenose	↓	⇋	↑	↑	
- Mitralstenose	↓	⇋	↑	↑	
- Aorteninsuffizienz	↑	⇋ ↑	↑	↓	⇋
- Mitralinsuffizienz	↑	⇋ ↑	⇋	↓	↓
- Trikuspidalinsufienz	↑	⇋ ↑	↑	⇋	↓

Mutlak H.. Anaesthesist: 2011 60:799-813

- Invasive Druckmessung vor Einleitung !!!
- Hämodynamisches Monitoring !!!

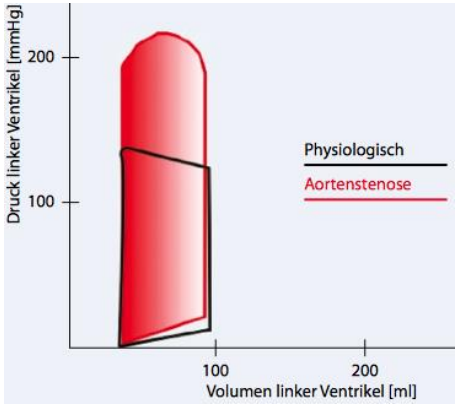
Management - Aortenstenose

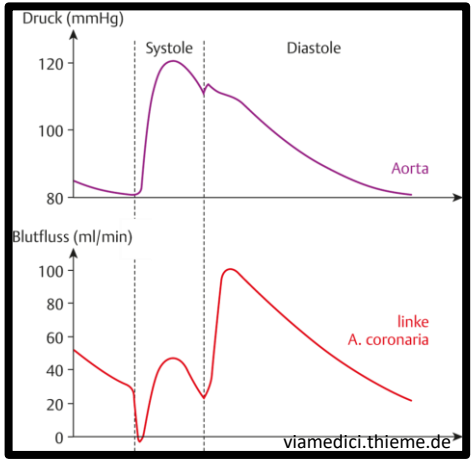
- Häufigstes Klappenvitium!!!
- Hypetropher Ventrikel

- Vorlastabhängig
  - Reduzierte Compliance (diastolische Dysfunktion)
  - Cave: SAM bei Hypovolämie

- Normo-(Brady)-kardie
  - Für suffizienten Auswurf
  - Ausreichende Coronarperfusion

- Subendokardiale Ischämieneigung bei
  Tachykardie und HZV-Abfall
- Nachlastabhängige Coronarperfusion!!





Mutlak H.. Anaesthesist: 2011 60:799-813

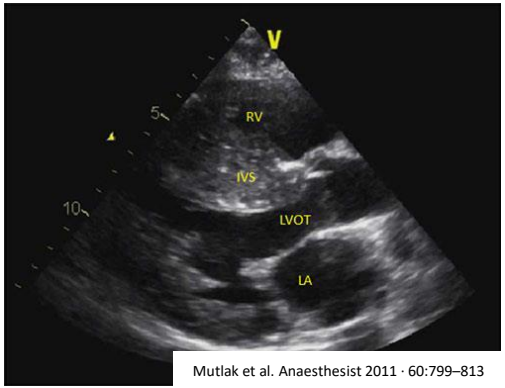
Management - Aortenstenose

Vitium	Hf	Kontraktilität	Preload	SVR	PVR
Aortenstenose	⬇	⇋	⬆	⬆	⇋

- Erhalt des Sinusrhythmus!!!

- Vasopressoren (Phenylephrin, Noradrenalin)
- Cave: Inotropie (SAM-Neigung)
- Cave : Nachlastreduktion

- Regionalanästhesie:
  - Cave Spinalanästhesie (Sympathikolyse) relativ kontraindiziert!!!
- „Je kranker desto eher AN oder periphere Blockade“ *L.Gasteiger*



Mutlak et al. Anaesthesist 2011 · 60:799–813

Mutlak H. Anaesthesist: 2011

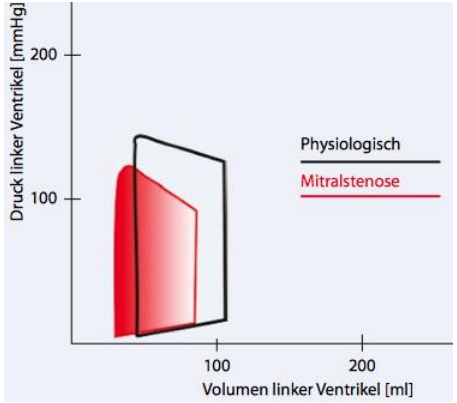
Management - Mitrastenose

- Ursache: Rheumatisches Fieber (60%)
  - seltener SLE, Endocarditis, rheumatoide Arthritis

- Erhöhung des LAP um ausreichenden Gradienten zu generieren
  - **Pulmonal Arterieller Hypertonus**
  - **Lungödemneigung**
  - **Rechtsherzbelastung**

- Reduktion der Vorlastreserve
- Abnahme des SV (Breite der Kurve)

- Vorhofdilatation (VHF und Thrombenbildung)



Mutlak H.. Anaesthesist: 2011 60:799-813

Management - Mitrastenose

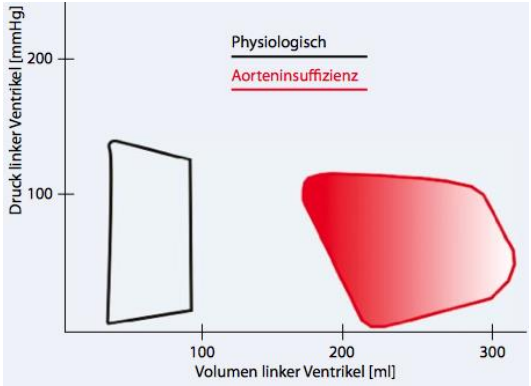
Vitium	Hf	Kontraktilität	Preload	SVR	PVR
Mitralstenose	⬇	⇋	↑	↑	⬇

- Erhalt des Sinusrhythmus!!!!
  - Aggressive Therapie von neuaufgetretenem VHF
- Dämpfung sympathischer Reize (Einleitung)

- Volumenverlust ausgleichen (Cave Hypervolämie)
- Cave Wiederstandsabfall (Schlagvolumen „fixiert“)
- Vermeidung Hypoxie und Hyperkapnie (da - > PVR ↑)
- PVR Senkung eventuell mittels inh Vasodilatatoren
- ZVD-Messung obligat (PAK großzügig)

Management - Aorteninsuffizienz

- Ursache:
  - Bikuspide Aortenklappe, Marfan Syndrom
  - Endokarditis, Rheumatisches Fieber
  - Aortendissektion (Akute AI)



- Erhöhung enddiastolisches und endsystolisches Volumen
  - Sekundäre exzentrische Dilatation und MI
  - Reduktion Wandspannung und O_2-Verbrauch (Gesetz von Laplace)
- EF-Verminderung (?)
- Schlechte Toleranz bei akutem Auftreten

Mutlak H.. Anaesthesist: 2011 60:799-813

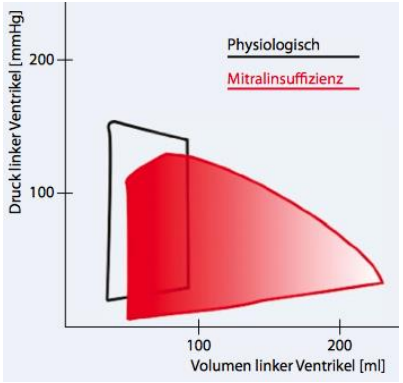
Management - Aorteninsuffizienz

Vitium	Hf	Kontraktilität	Preload	SVR	PVR
Aorteninsuffizienz	⬆	⇋ ↑	⬆	⬇	⇋

- Reduktion des Regurgitationsvolumen
  - Kurze Diastolendauer
  - Hohe Herzfrequenz
  - Vasodilatation
- Optimierung Schlagvolumen:
  - Volumengabe
- Praeoperative Anlage invasives Monitoring und ev. ZVK
  - Kleine Eingriffe bei asymptomatischen Patienten auch ohne invasives Monitoring möglich
- Alle Anästhesieverfahren möglich!

Management - Mitralinsuffizienz

- Funktionelle (dila CMP) und organische MI (myxomatöse, Sehnenfadenausriss)
- Volumenbelastung linker Vorhof und Ventrikel
- Ventrikeldilatation um SV aufrecht zu erhalten
- Asymptomatik ab 40% Backflow
- Sekundäre VHF
  - > massive Symptomenverstärkung
- Sehr häufiges Vitium
  - Prävalenz bis 9%
- **Hohe Morbidität!!**
  - 10-Jahresmorbidität Herzversagen 60%
  - 5-Jahresmortalität für asymptomatische Patienten 33%
    - Bei NYHA I-II



Mutlak H.. Anaesthesist: 2011 60:799-813

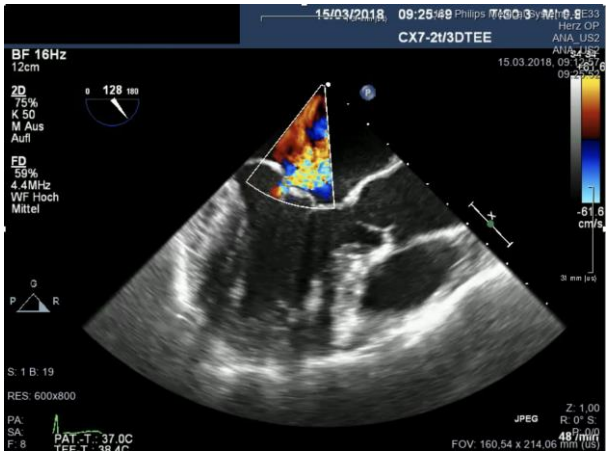
- Ling LH et al. Clinical outcome of mitral regurgitation due to flail leaflat. N Engl J Med, 1996

Management - Mitralinsuffizienz

Vitium	Hf	Kontraktilität	Preload	SVR	PVR
Mitralinsuffizienz	↑	⇋ ↑	⇋	↓	↓

- **Cave: EF wird überschätzt!!** (EF 60% bereits pathologisch)
- **Cave: MI wird generell unterschätzt!!**
- **Cave: Ischämieneigung bei zusätzlicher KHK**

- Vermeidung von SVR-Anstieg
- Vermeidung Hypoxie und Hyperkapnie
- Vorlastoptimierung
  - **Cave: Lungenödem** (ZVD-Dynamik)



Management - Mitralinsuffizienz

Vitium	Hf	Kontraktilität	Preload	SVR	PVR
Mitralinsuffizienz	⬆	⇋ ↑	⇋	⬇	⬇

- **ZVD - Messung bei höhergradiger MI (fast) obligat (PAK oder TEE)**
- Aggressive The

Full - Fast - Forward

- Bei KHK und SVR-Abfall bevorzugt reine α-Agonisten / bzw IABP
- Vermeidung von Inotropieabfall (Dobutamin, Milrinon, Levosimendan)
- Vorsichtige Volumengabe
- Diffiziles Handling - > großzügige Indikation zu Verlegung in Zentrum
- **Hohe postoperative Morbidität und Mortalität**
  - Bei hochgradigen Vitien großzügige ICU- Indikation auch bei kleineren Eingriffen!!

Durchführung Anaesthesie

- 67 Jahre männlich
- Septische Knieprothese
- Temp 37,8 C°, CRP 37 mg/dl

- KHK (Z.n. CABG vor 12 Jahren)
- Isch. CMP (EF 30%)
- AS I-II, MI II-III
- Pulm Hypertonus (sPAP 50 mmHg)
- TAPSE 14mm
- Kreatinin Anstieg

- Zeitpunkt
- Personal
- Equipment / ICU

- Ziele:
  - DAP > 60 mmHg
  - SAP > 100 mmHg
  - HF <-> 80/min

- Narkosemanagement

- Inotropie

Take home

- Evaluierung des Patienten und der individuellen Pathologie
- Klärung der hämodynamischen Ziele
- Physiologische Überlegungen
- Planung des anästheologischen Procedere
- Zweitmeinung einholen