

Dr. med. E. Schindler

Hemodynamic monitoring in critically ill patients



Pulmonary artery thermodilution was the first procedure that was suitable for use in routine clinical determination of cardiac output. In children those procedures are rare and difficult to perform. In recent years, a variety of minimal-invasive cardiac output devices have become available. Of these, the pulse contour based devices (PiCCO, LidCO, Vigileo) in particular, have shown good concordance with cardiac output measurement using the pulmonary artery catheter and can often substitute it perioperatively. Furthermore, they also permit an estimation of the patient's fluid responsiveness.

Perioperative fluid management, in the sense of early goal-directed therapy, has been shown to reduce morbidity and the length of hospital stay. So far, the aortal oesophageal Doppler was the procedure most frequently used method to optimise stroke volume in goal-directed, algorithm-based therapy and is suitable even in children. However, there is some evidence that other minimal-invasive techniques of cardiac output measurement can be used for this purpose. Optimisation of stroke volume under the guidance of a minimal-invasive cardiac output device would appear to be an essential element of perioperative fluid management in high-risk surgical patients.

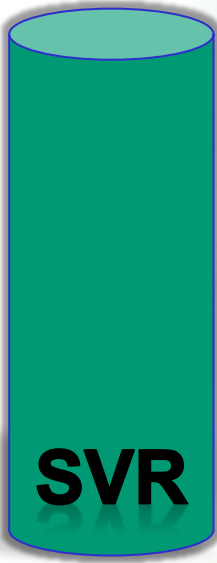
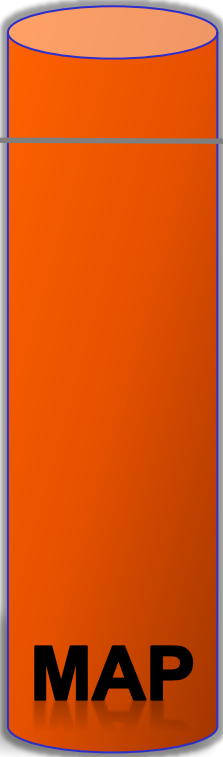
Key words: Haemodynamic, thermodilution, fluid management .

Pressure \neq flow

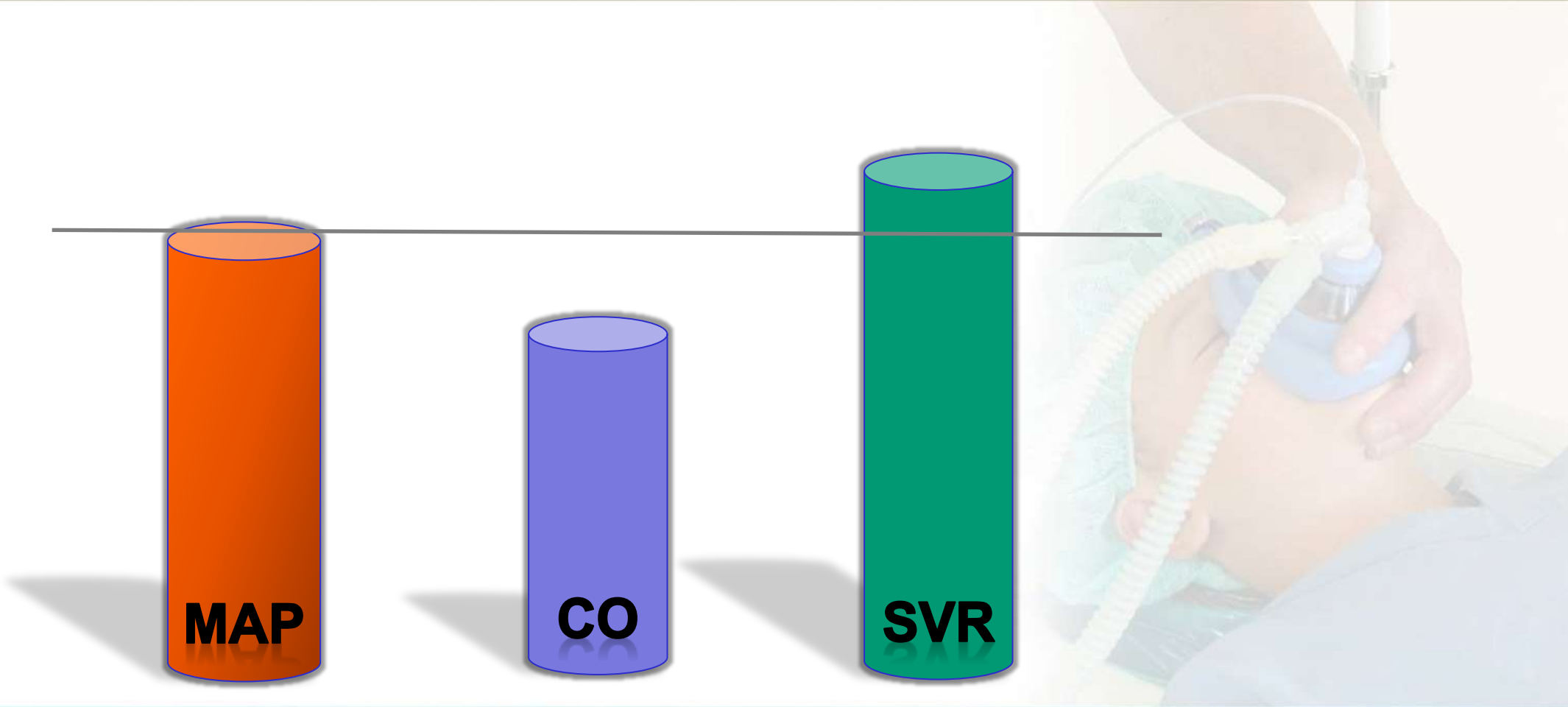

$$\text{MAP} = \text{CO} \times \text{SVR}$$

mean arterial pressure (MAP) = cardiac output (CO) x systemic vascular resistance (SVR)

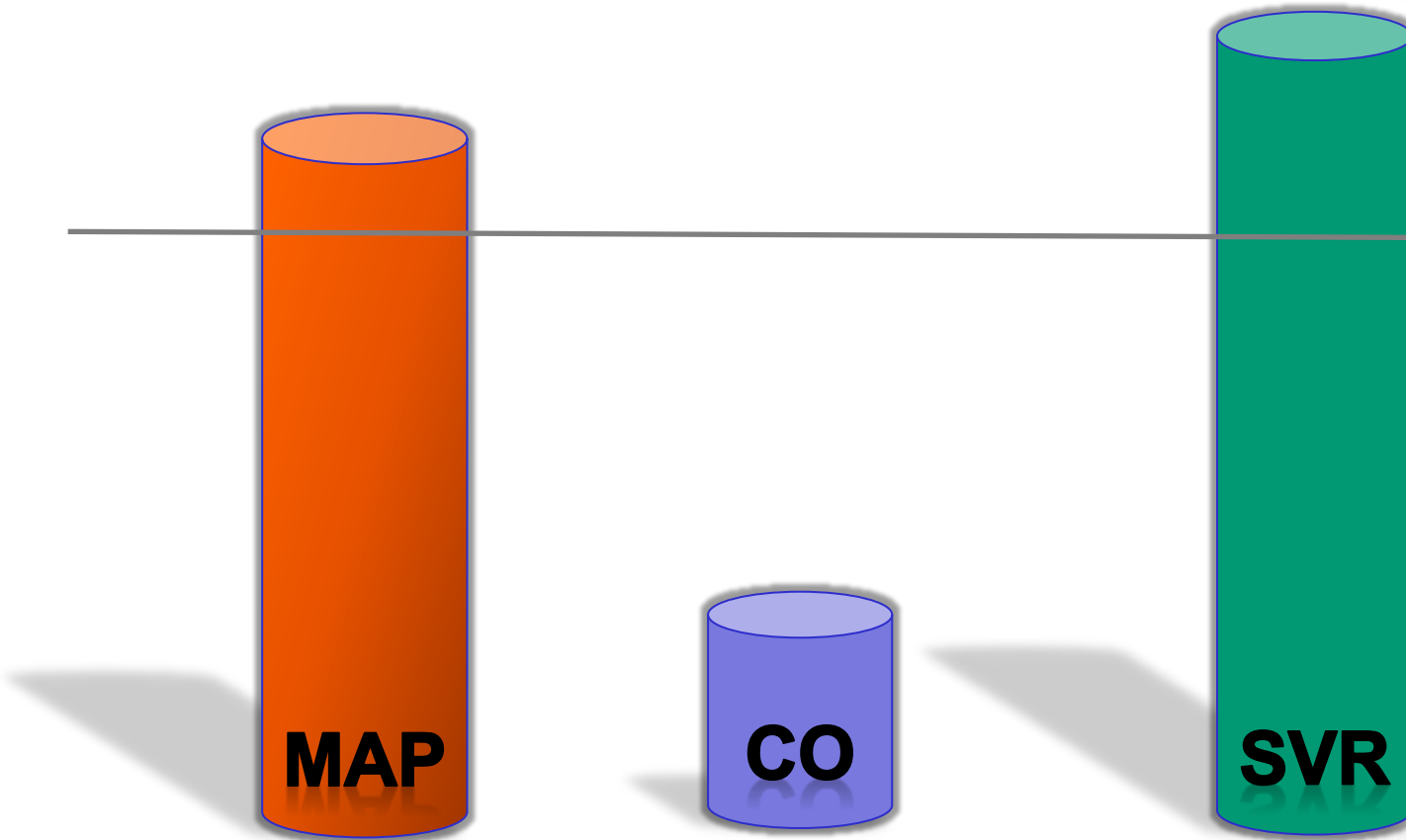
Normal Circulation



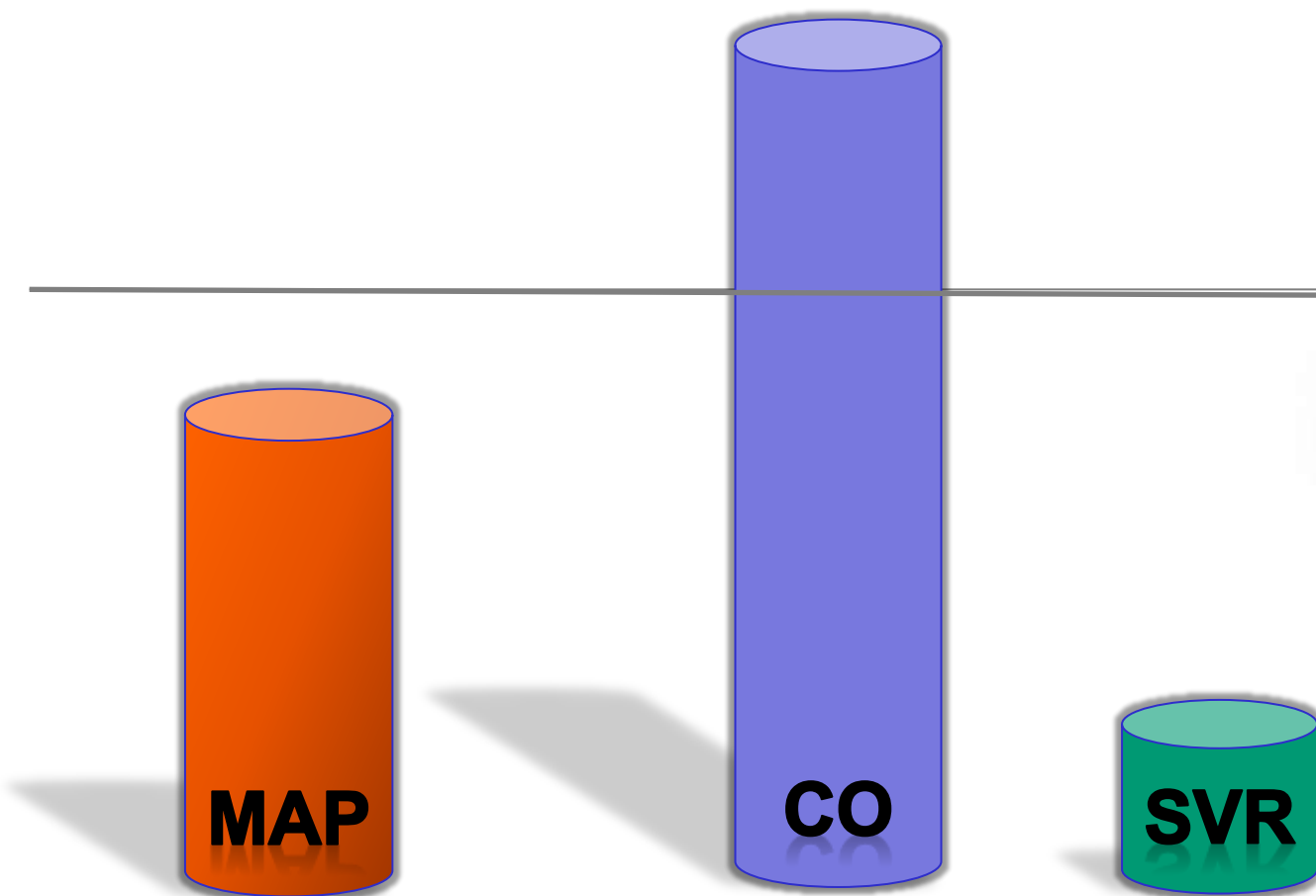
Hemodynamic Shock (Compensation)



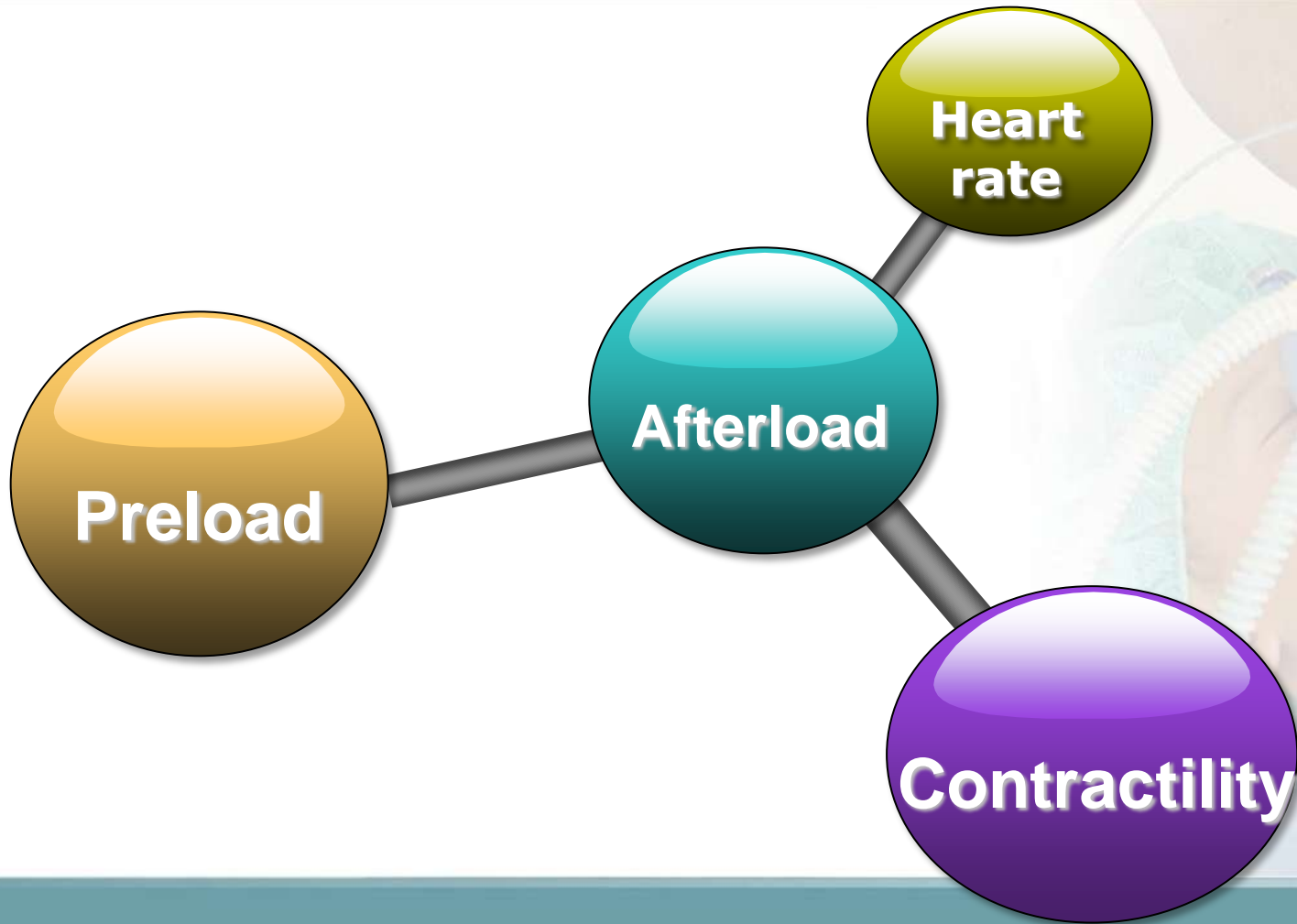
Hemodynamic Shock (Drug therapy)



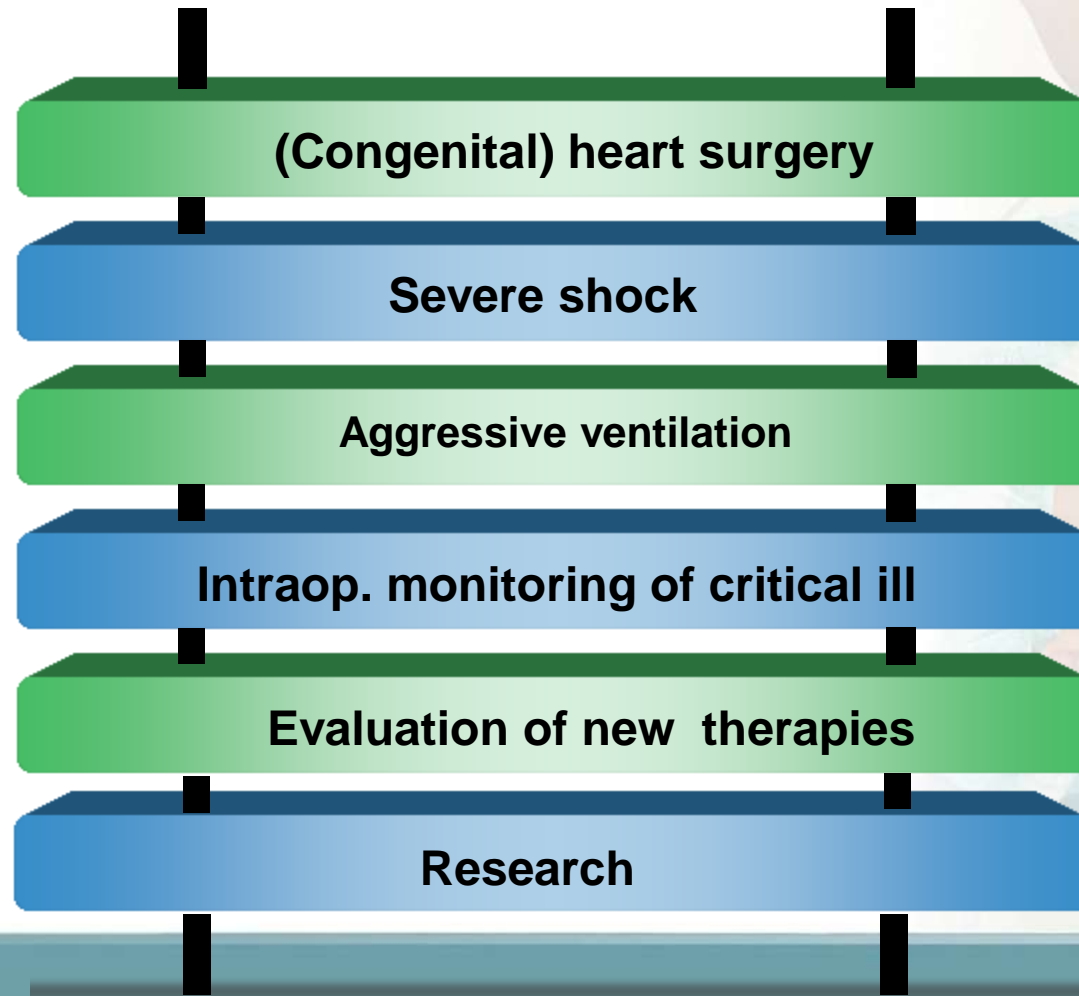
Septic Shock



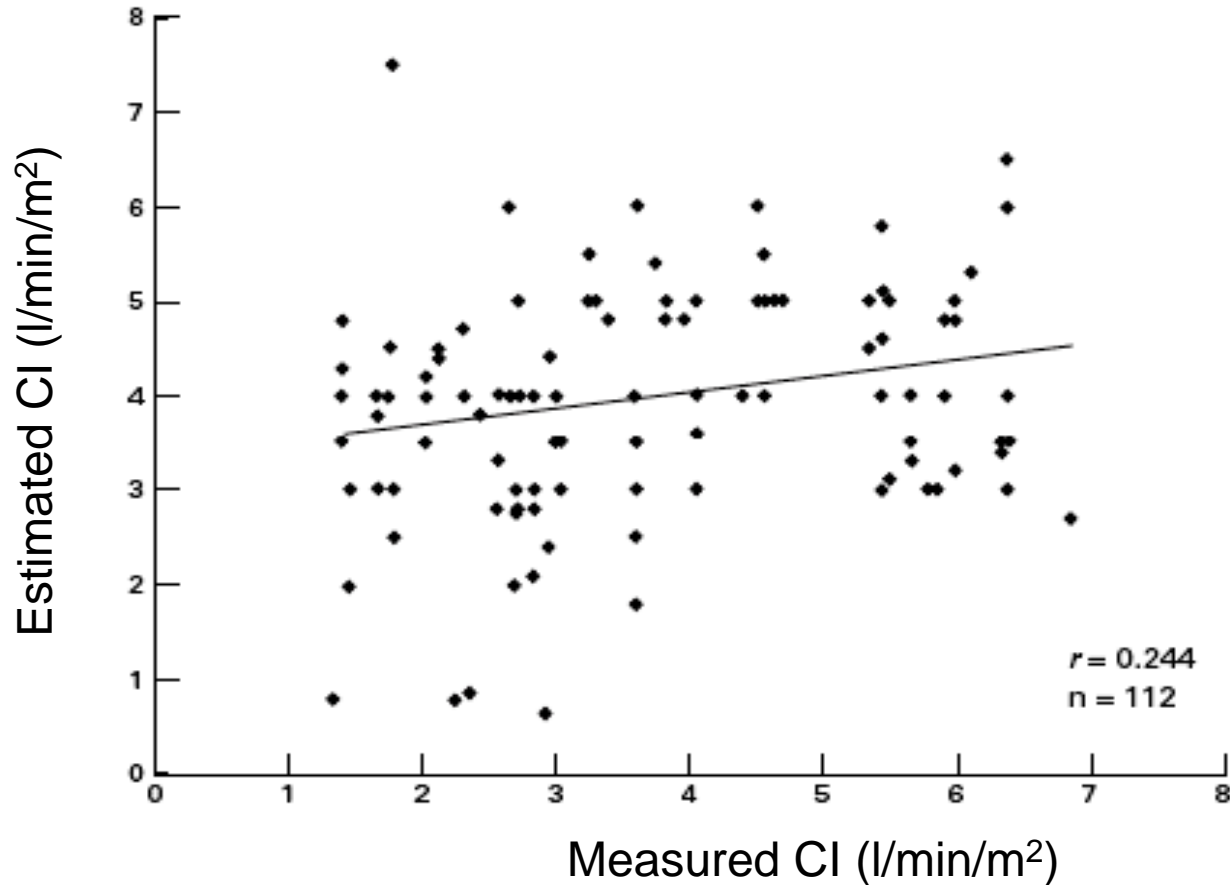
Determinants of cardiac function

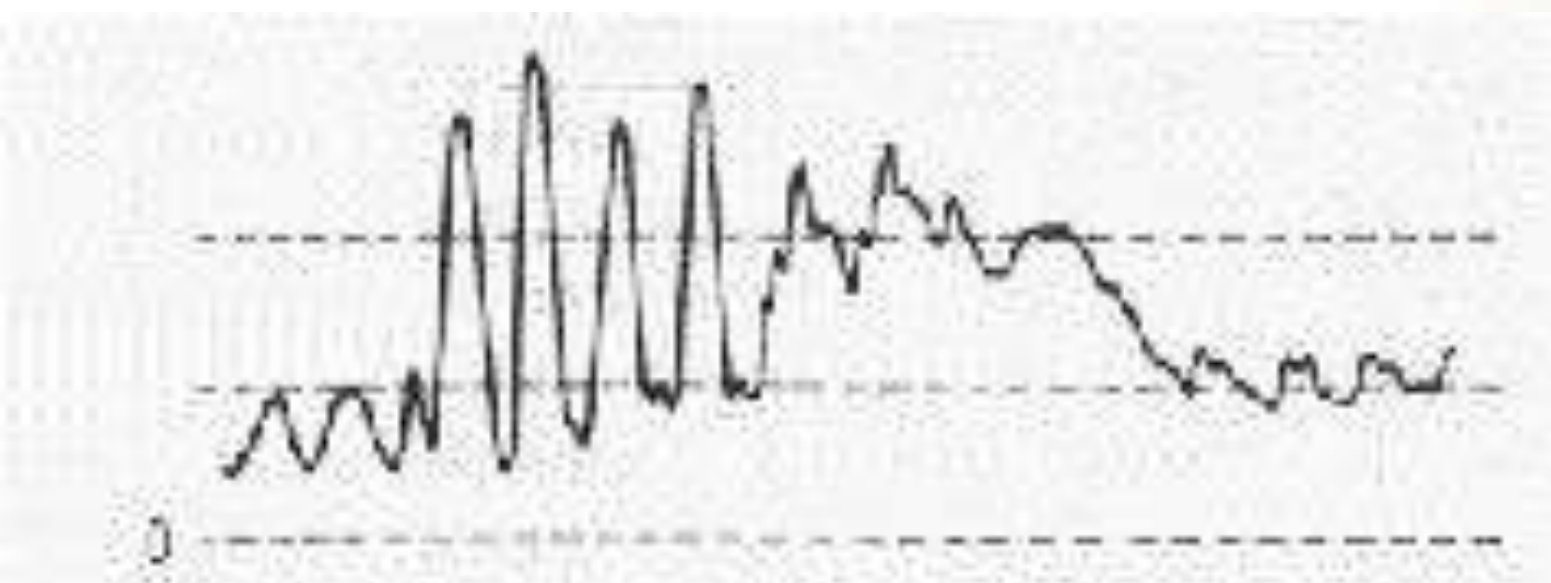


When should we measure CO?



Estimation of CO in children: is that possible for the clinician?





Intensive care physicians' insufficient knowledge of right-heart catheterization: time to act?

Zentrum für Kinderanästhesiologie
Sankt Augustin



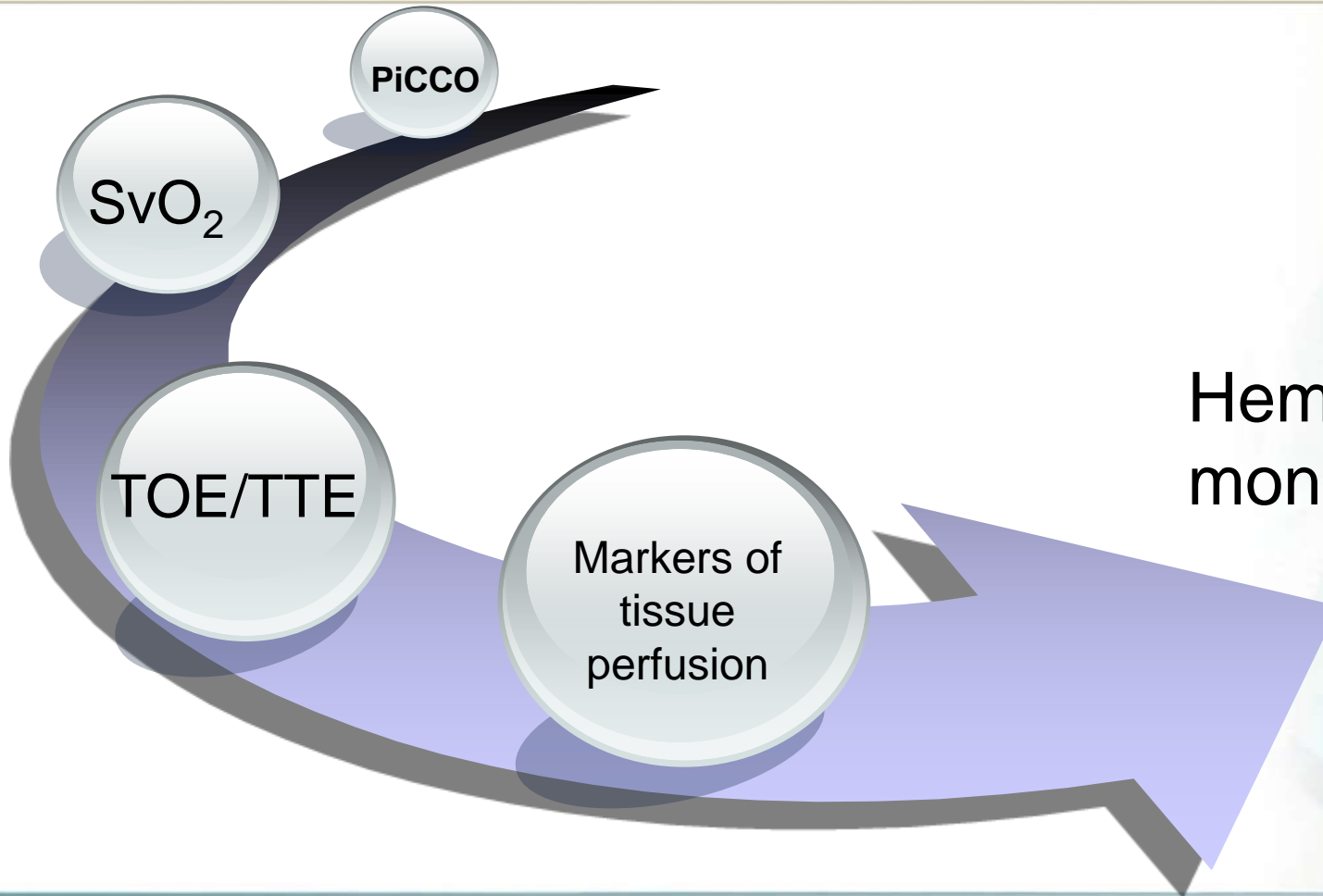
„The proportion of incorrect answers to some basic items was disturbingly high. For instance, [approximately] 50% of the respondents, whether trained or in training, did not correctly identify pulmonary artery occlusion pressure from a clear chart recording.“

Hemodynamic monitoring is changing our therapy regime

TABLE 1. Changes in Cardiovascular Therapies Instituted After Initial Evaluation of CI and SVRI

	Added Vasodilator	Added Catecholamines	Changed Therapy Regimen	Increased Class of Therapy
Group I	<i>n</i> = 8 Nitroprusside	<i>n</i> = 3 Epinephrine	<i>n</i> = 5 Changed from vasopressor to inotrope	<i>n</i> = 8 Increased or added new inotrope
Group II		<i>n</i> = 3 Norepinephrine	<i>n</i> = 2 Changed from inotrope to vasopressor	<i>n</i> = 4 Increased or added new vasopressor
Group III		<i>n</i> = 4 Epinephrine	<i>n</i> = 2 Changed from inotrope alone or vasopressor alone to inotrope and vasopressor	<i>n</i> = 1 Increased inotrope
		<i>n</i> = 2 Norepinephrine		<i>n</i> = 2 Increased vasopressor

Methods for estimation of CO



Hemodynamic
monitoring



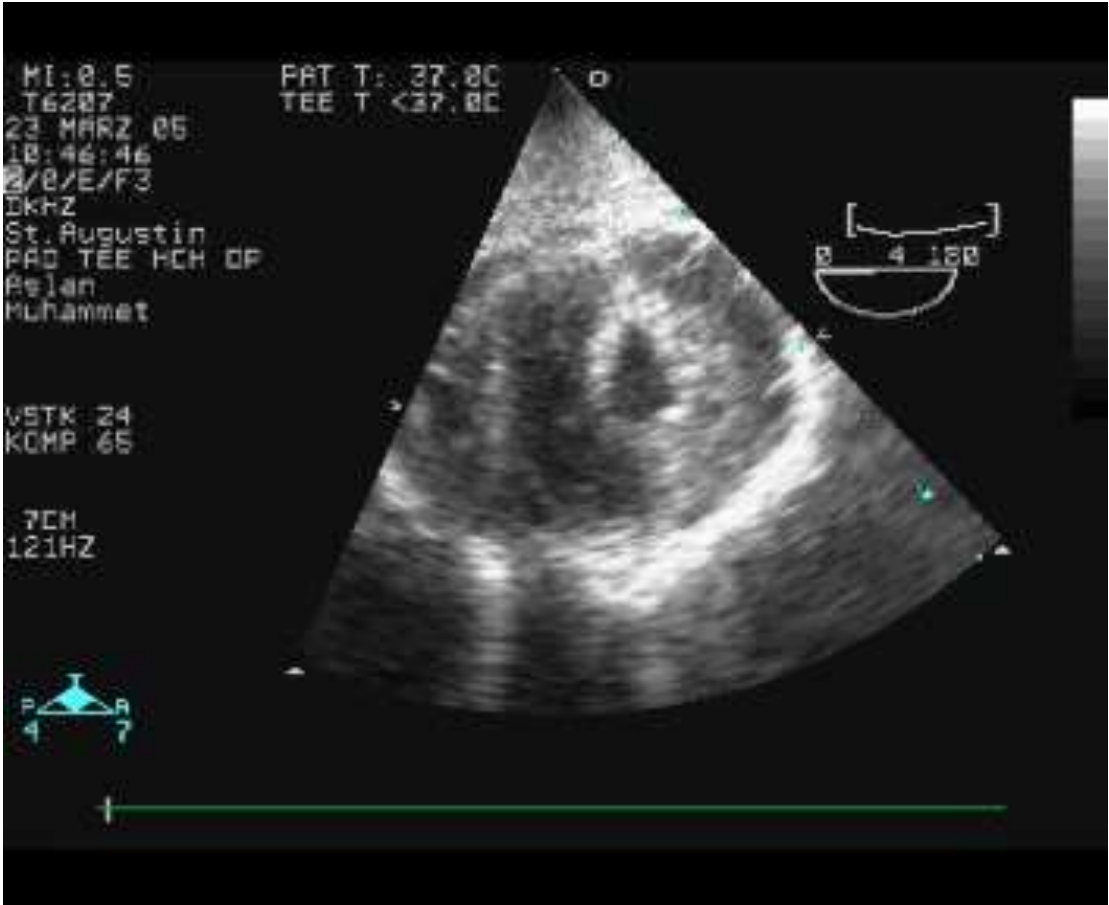
Echocardiography

So what?

Zentrum für Kinderanästhesiologie
Sankt Augustin



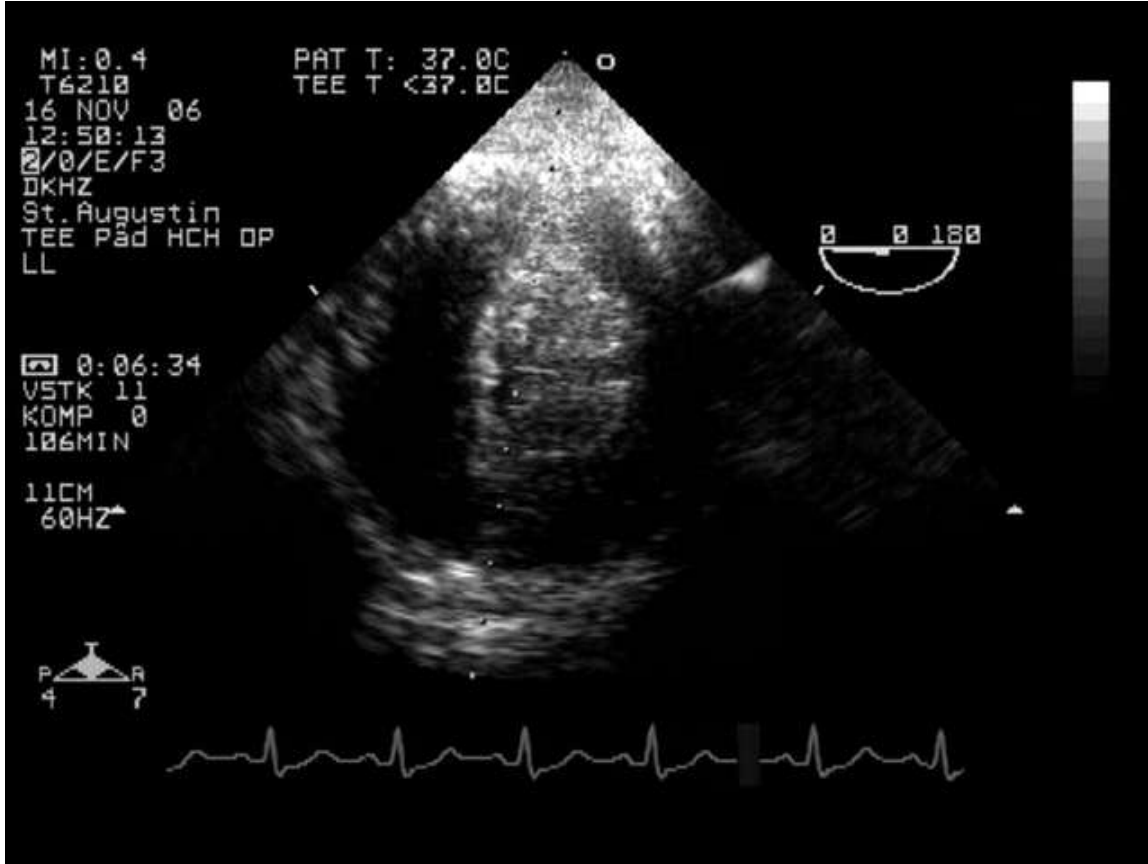
TOE Transgastric, short axis view (TG SAX)



Contractility

TOE

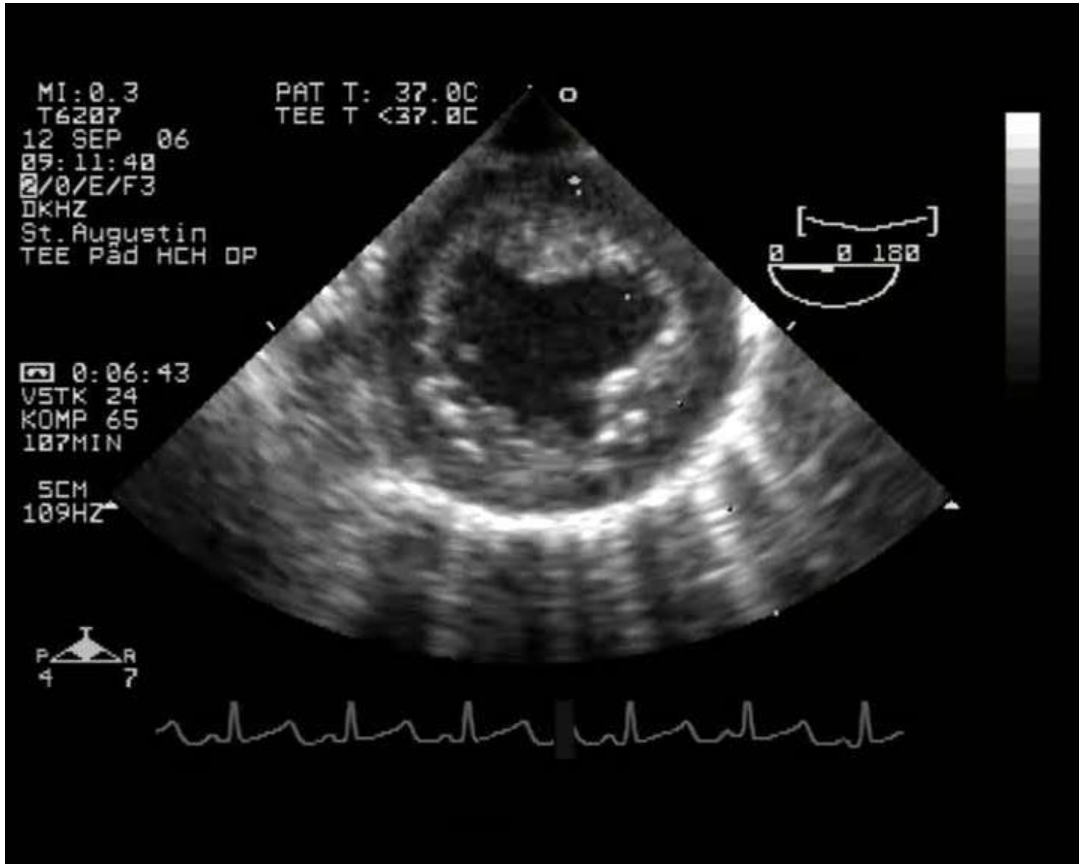
Transgastric, short axis view (TG SAX)



Preload

TOE

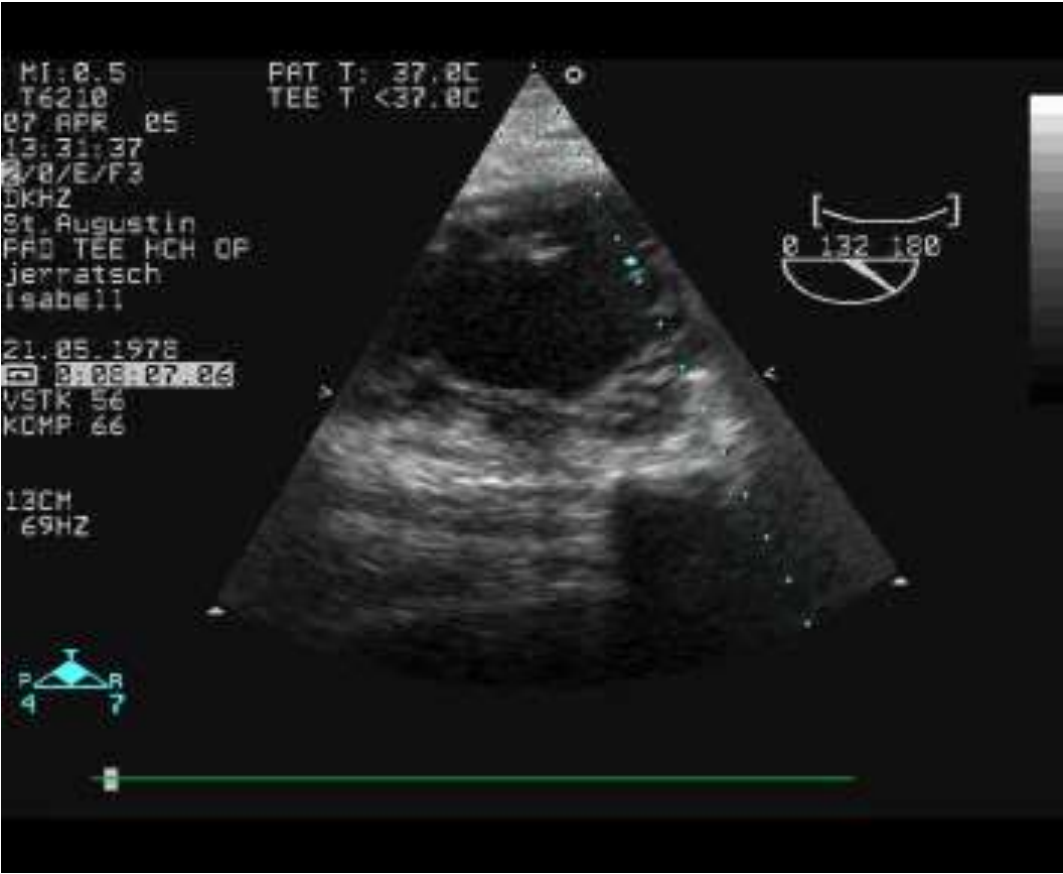
Transgastric, short axis view (TG SAX)



Contractility

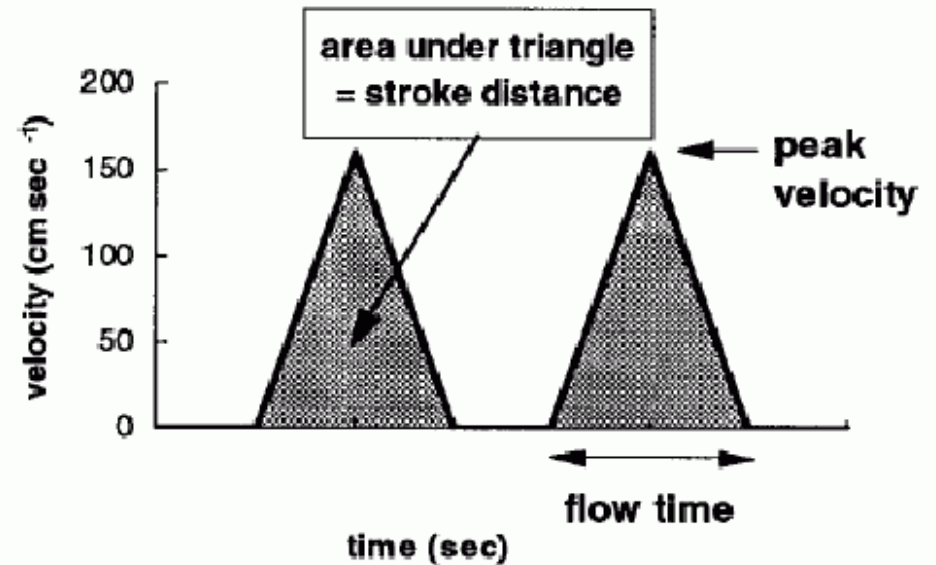
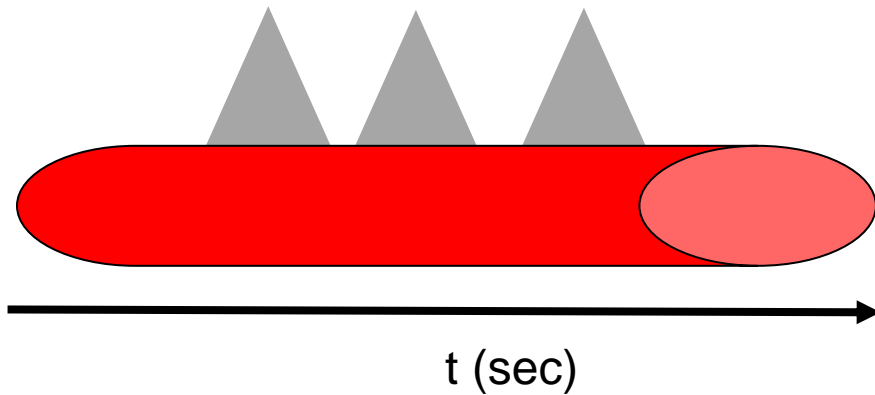
TOE

Transgastric, long axis view (TG LAX)

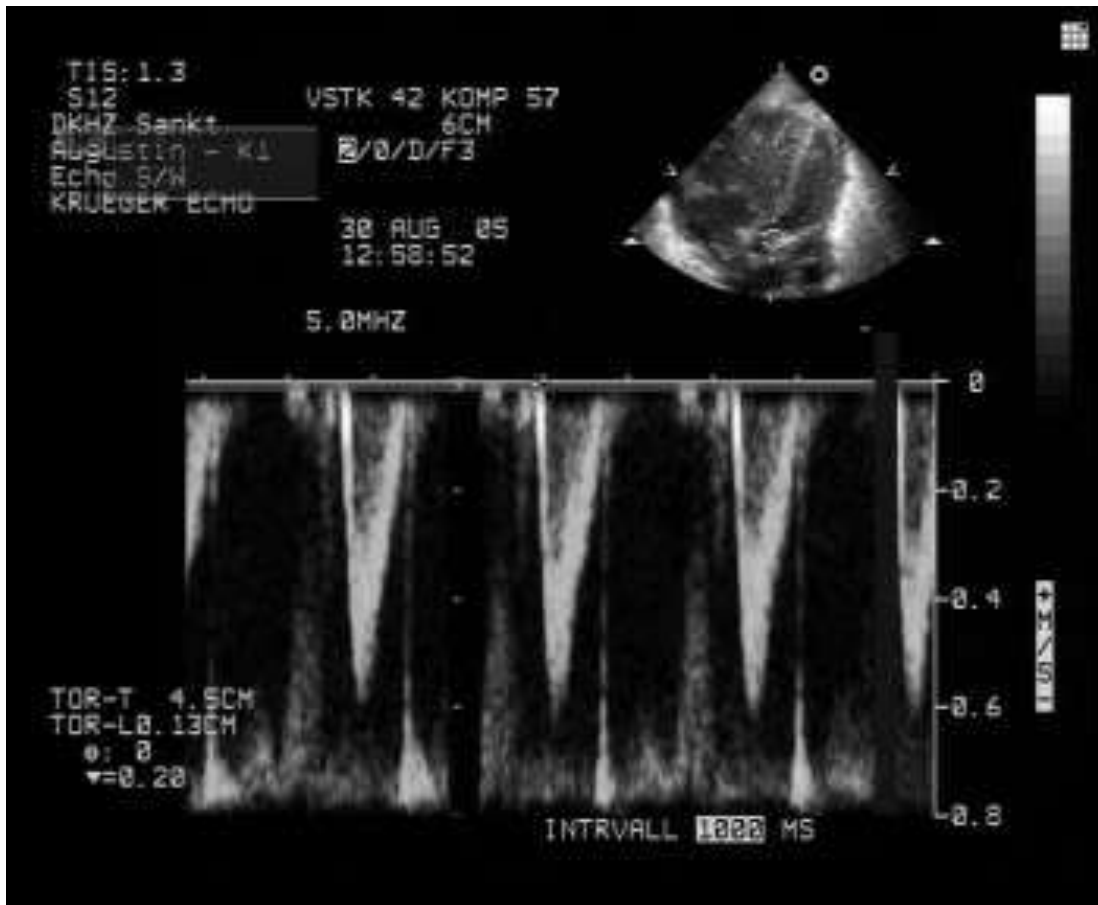


Contractility

Estimation of CO with Doppler: VTI (velocity time integral)



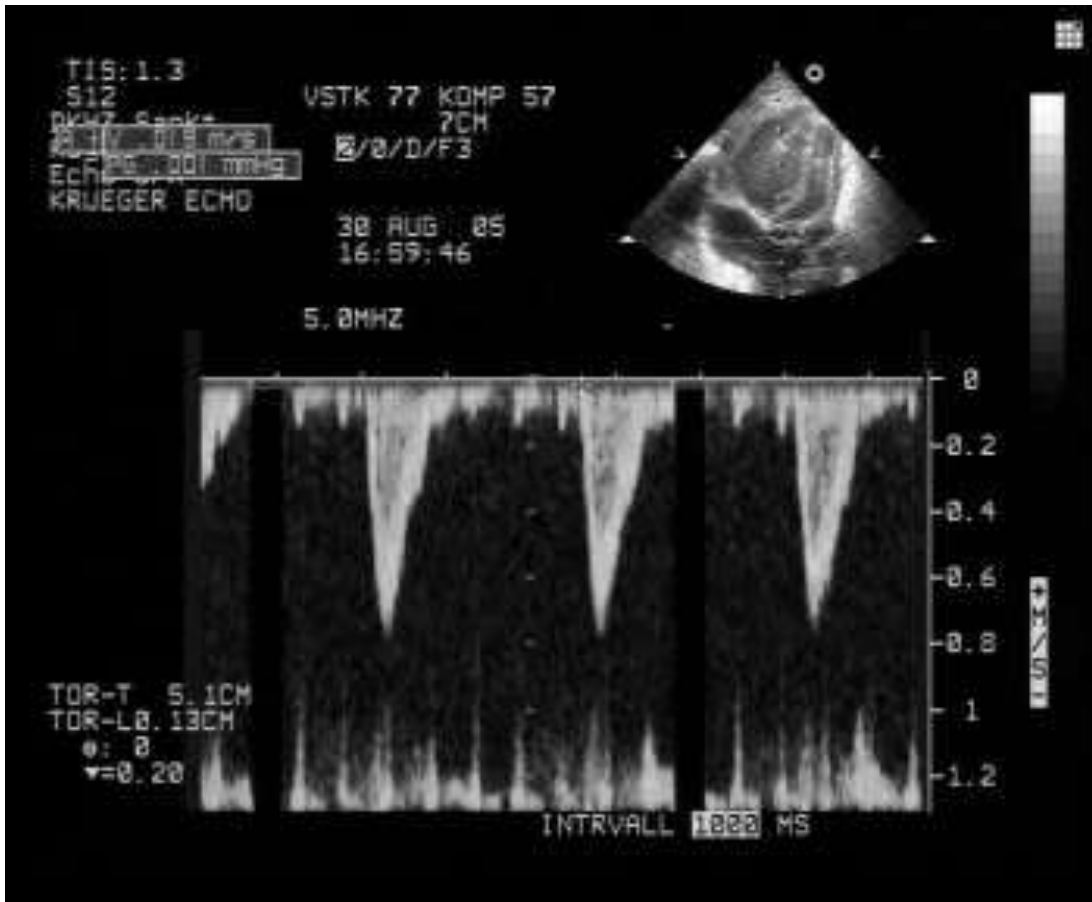
Estimation of CO: VTI



Before
Intervention
VTI= 6.6 cm

transthoracic

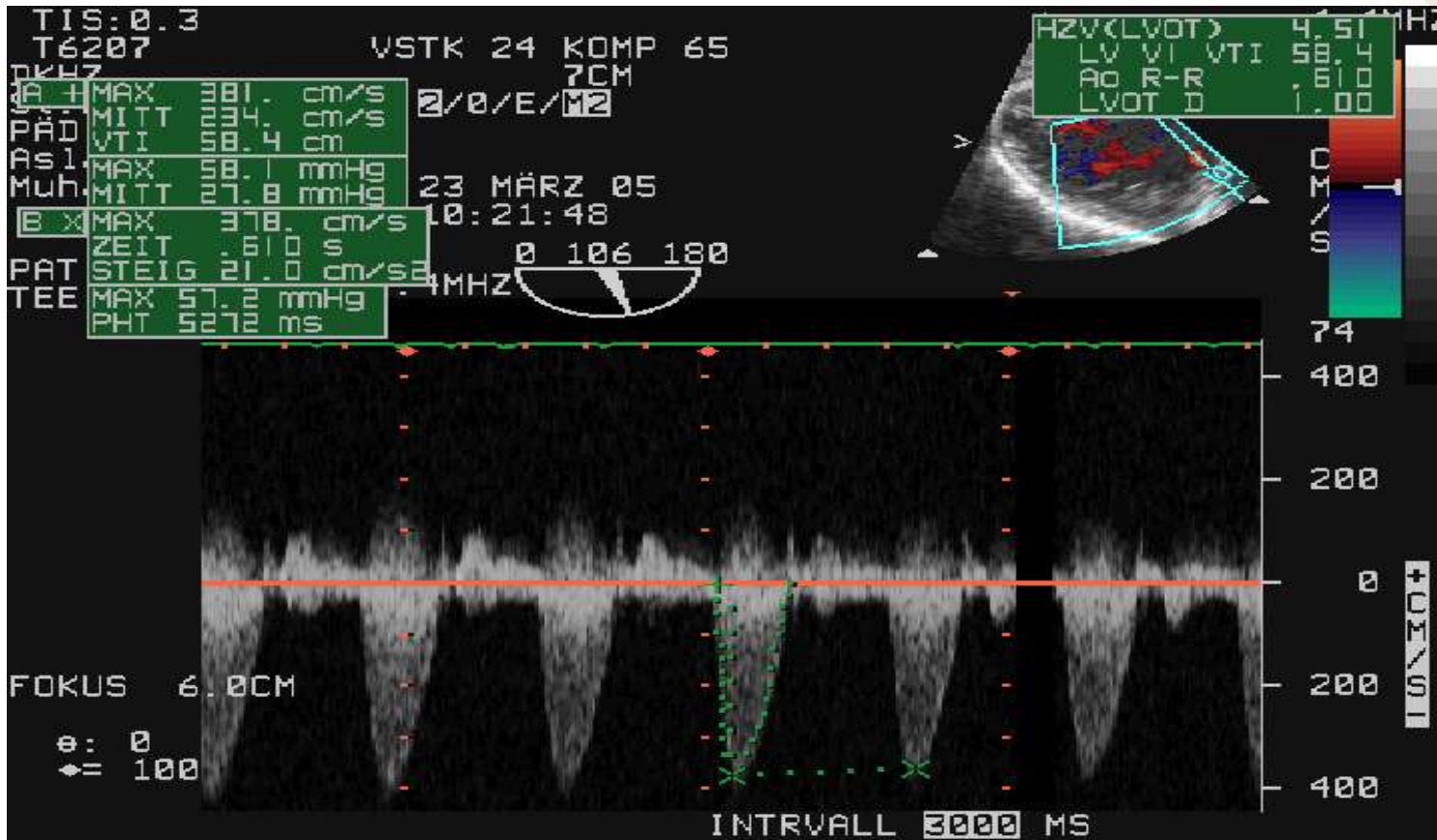
Estimation of CO: VTI



After
Intervention
VTI= 7.9 cm

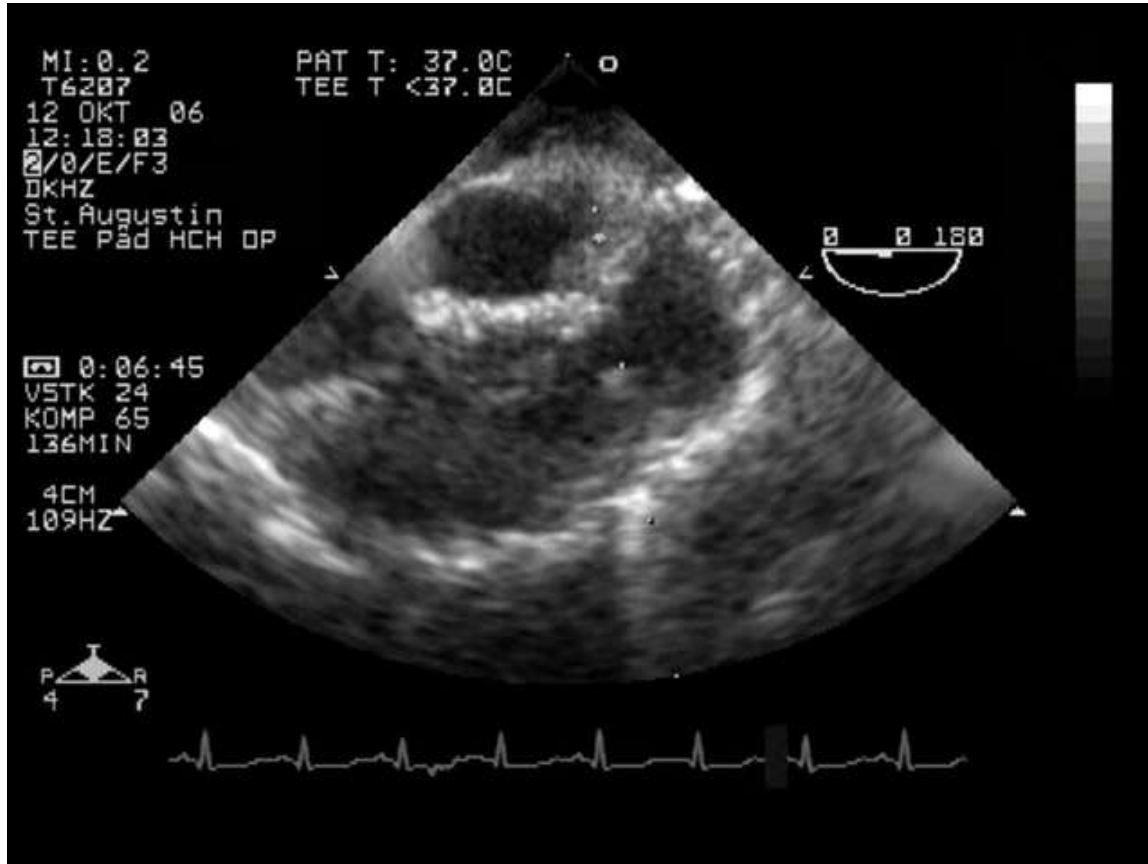
transthoracic

Estimation of CO with VTI: obtained data



transösophageal

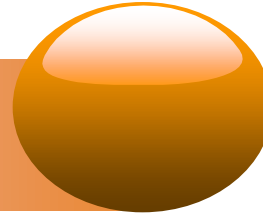
PA Pressure /Pressure gradient Estimation with TOE



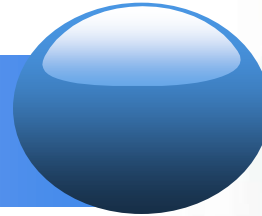
transesophageal

Markers of tissue perfusion

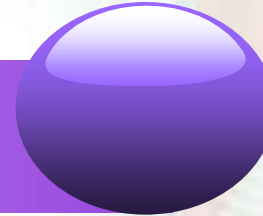
Buffer system



Mixed (central) venous oxygenation



Serial blood lactate measurement



Capillary refill



Serum lactate as a predictor of mortality after pediatric cardiac surgery

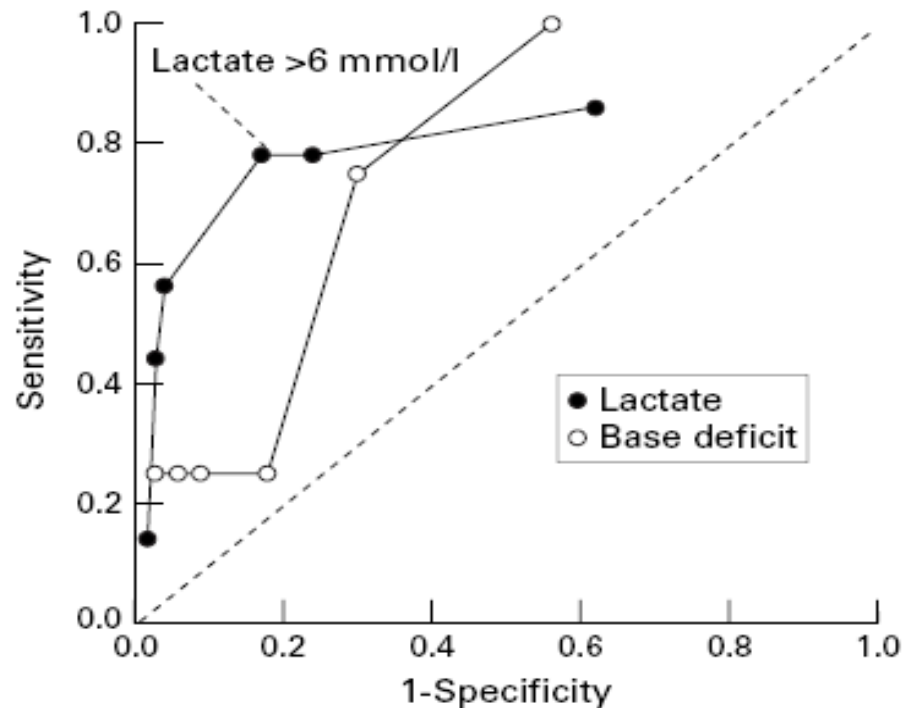
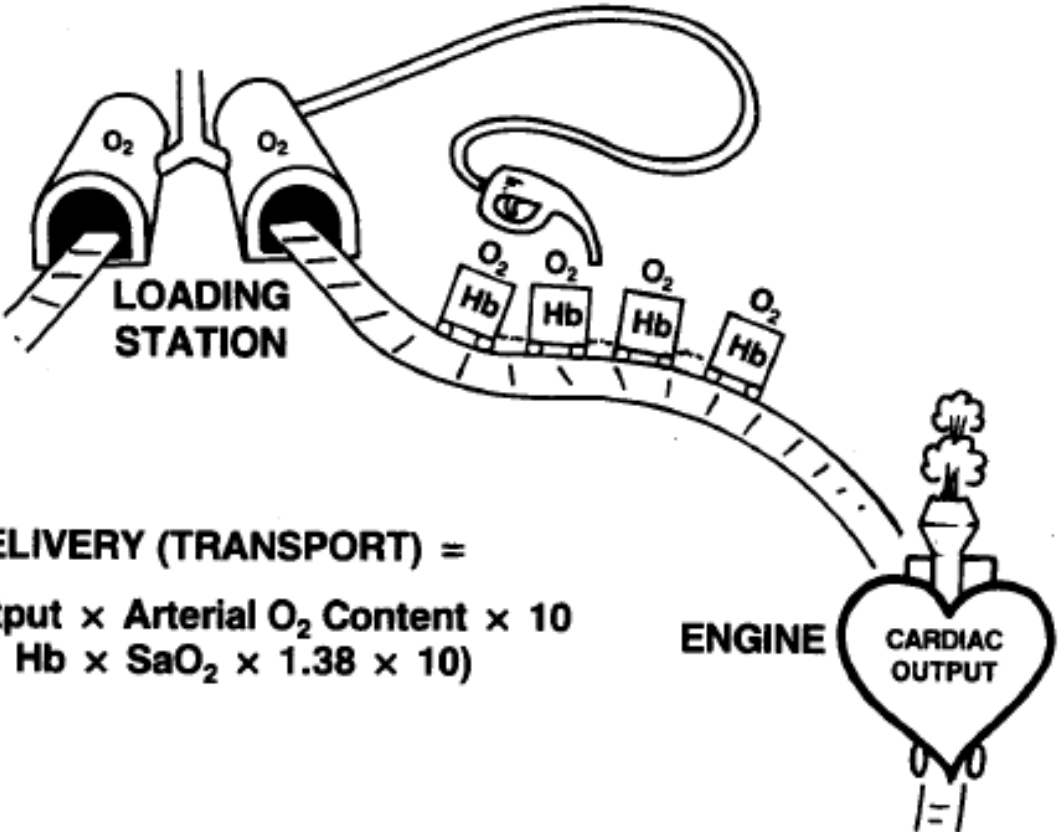


Figure 1 ROC curve showing sensitivity and (1-specificity) of initial serum lactate and base deficit for mortality.



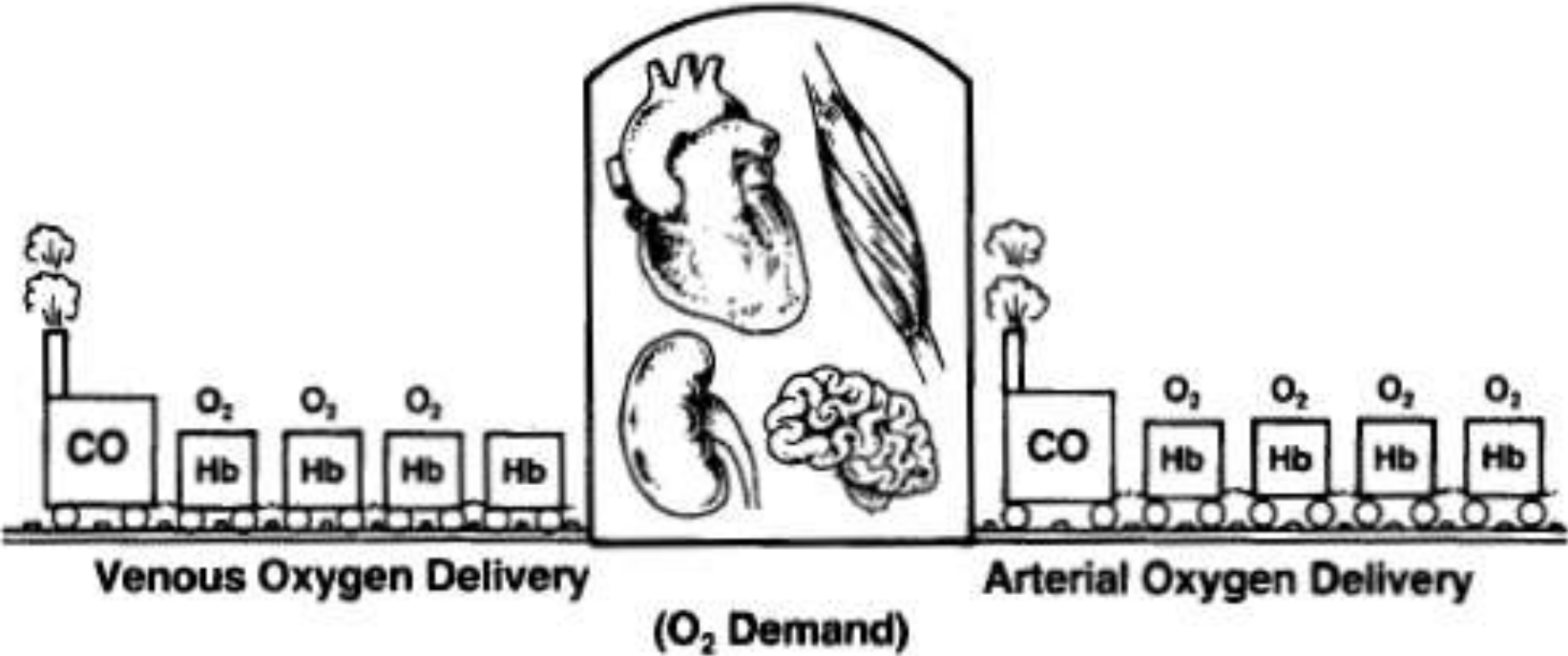
Oxygen Delivery



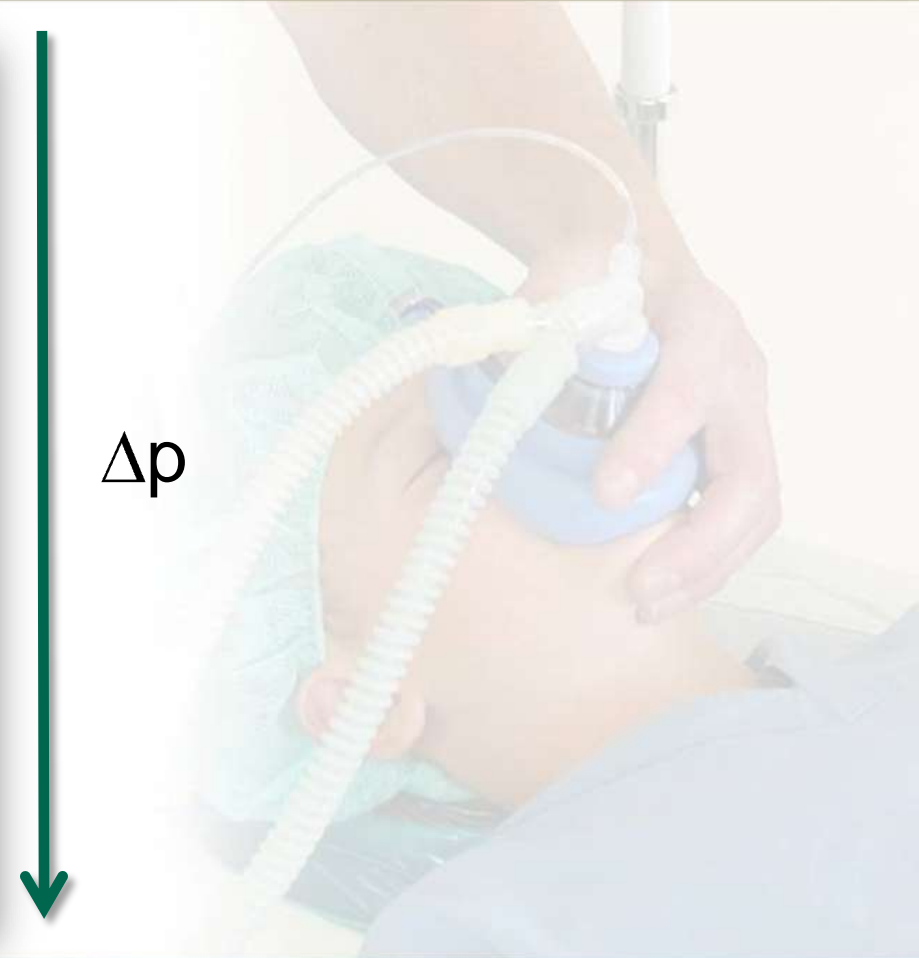
O₂ DELIVERY (TRANSPORT) =
Cardiac Output × Arterial O₂ Content × 10
(CO × Hb × SaO₂ × 1.38 × 10)



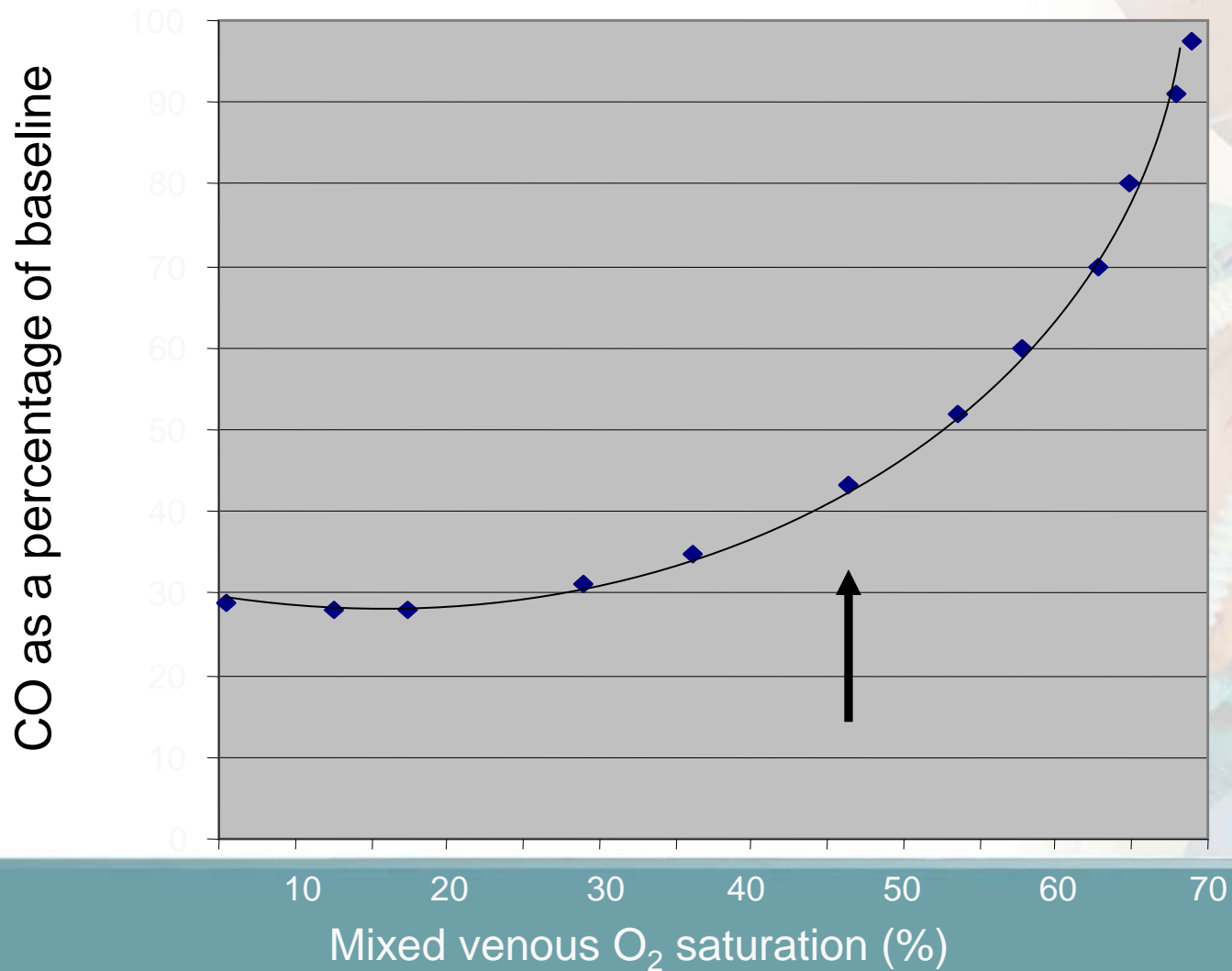
Oxygen Demand



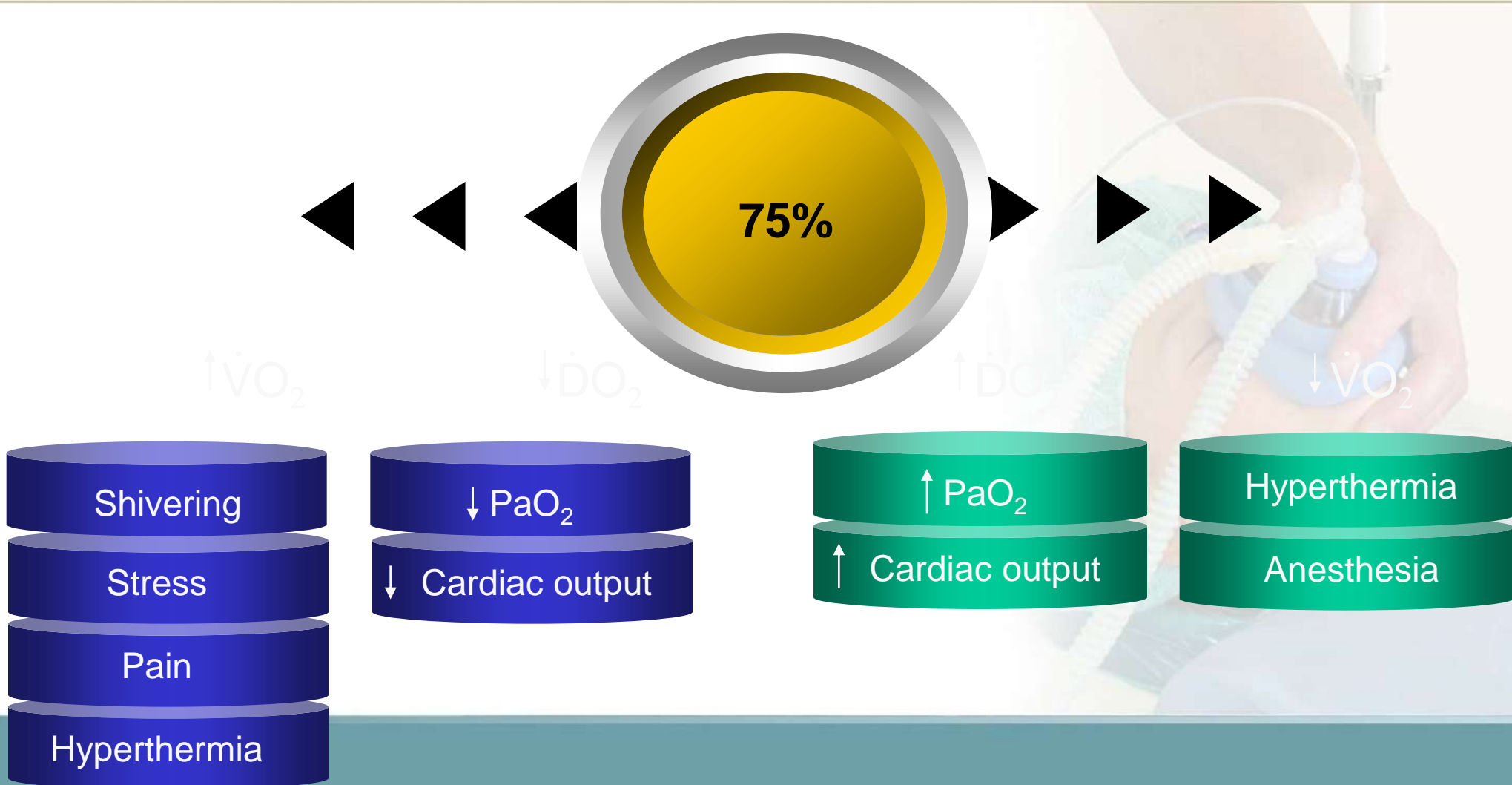
It's all about flow



Relative change in CO vs. change in VO_2

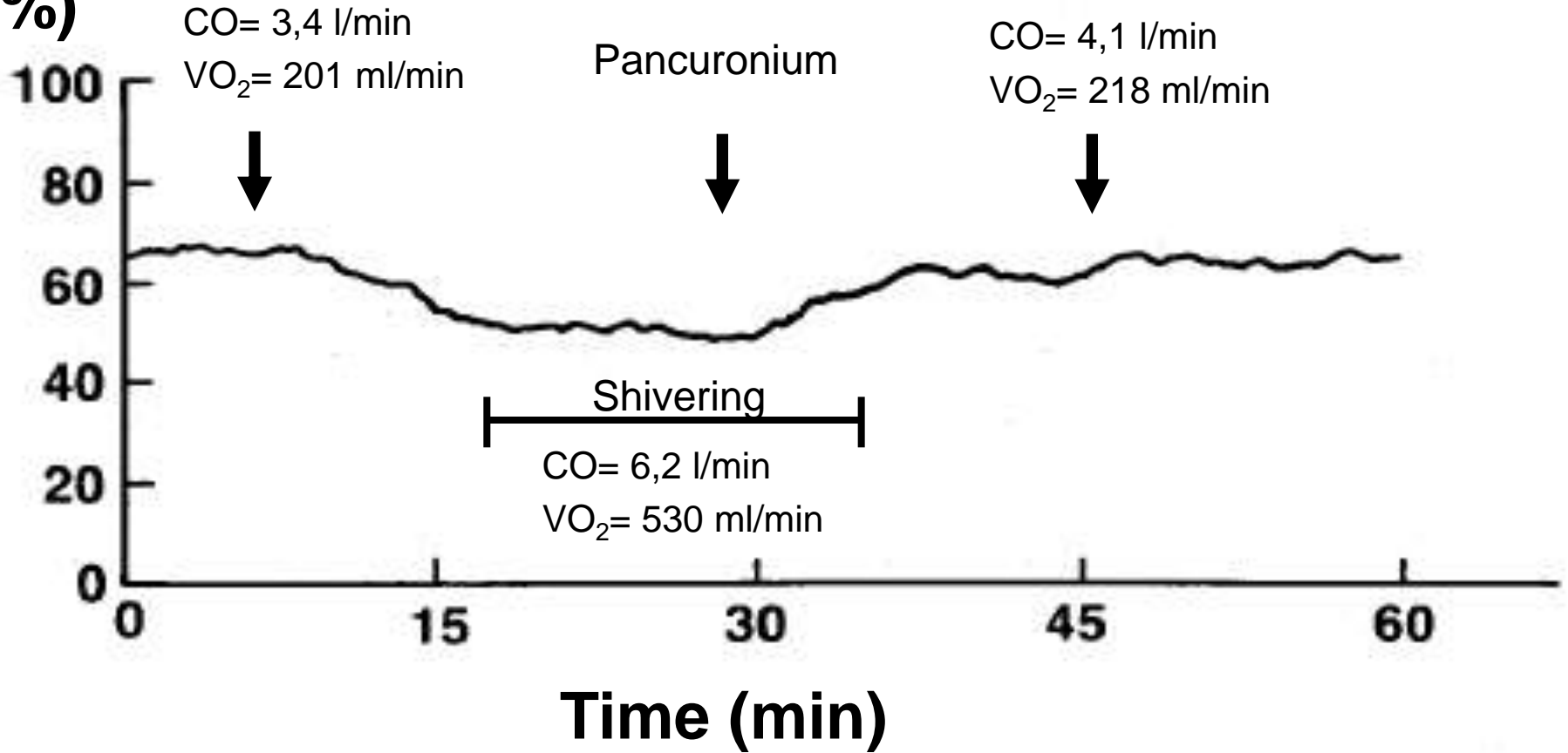


What affect sVO_2 ?

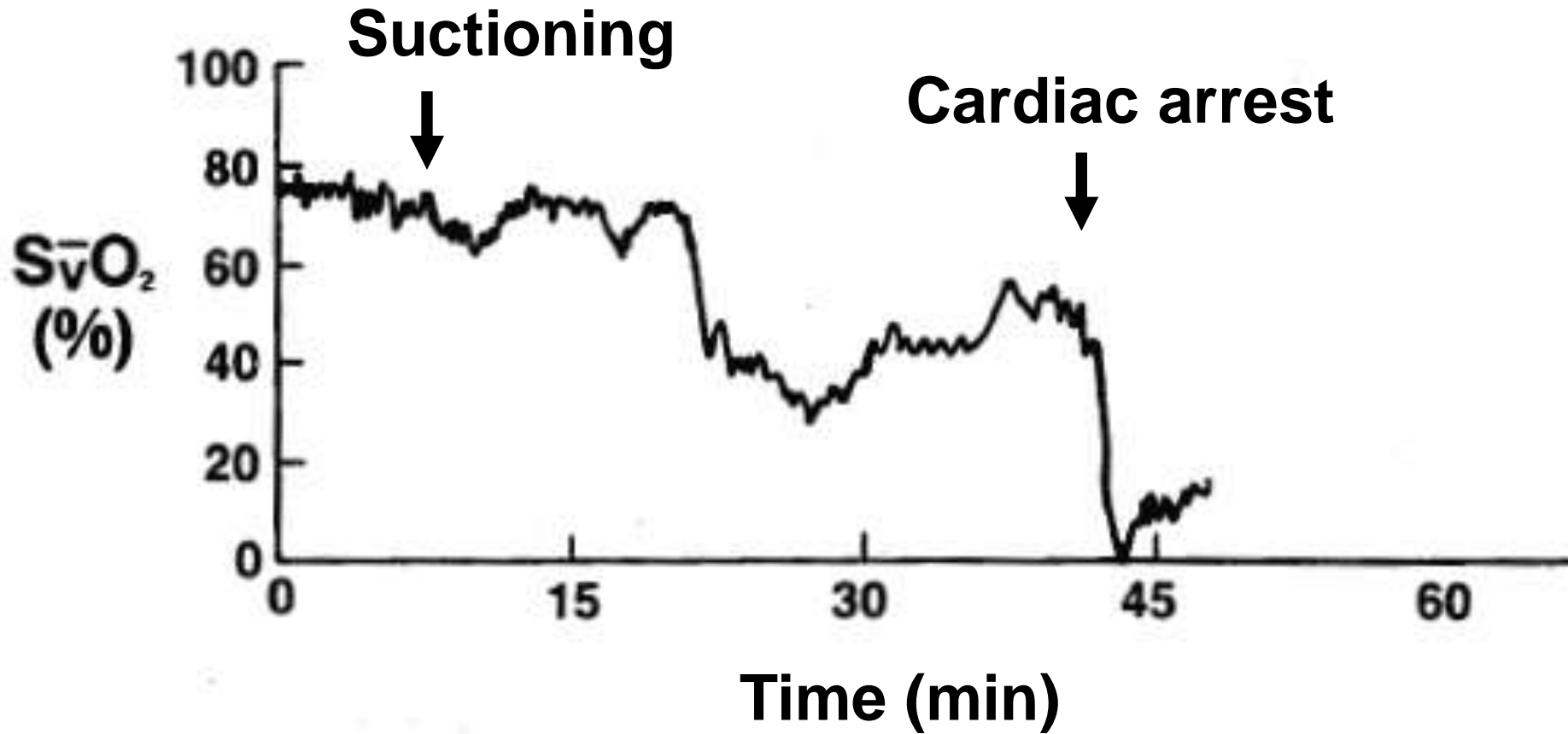


Example 1: Shivering

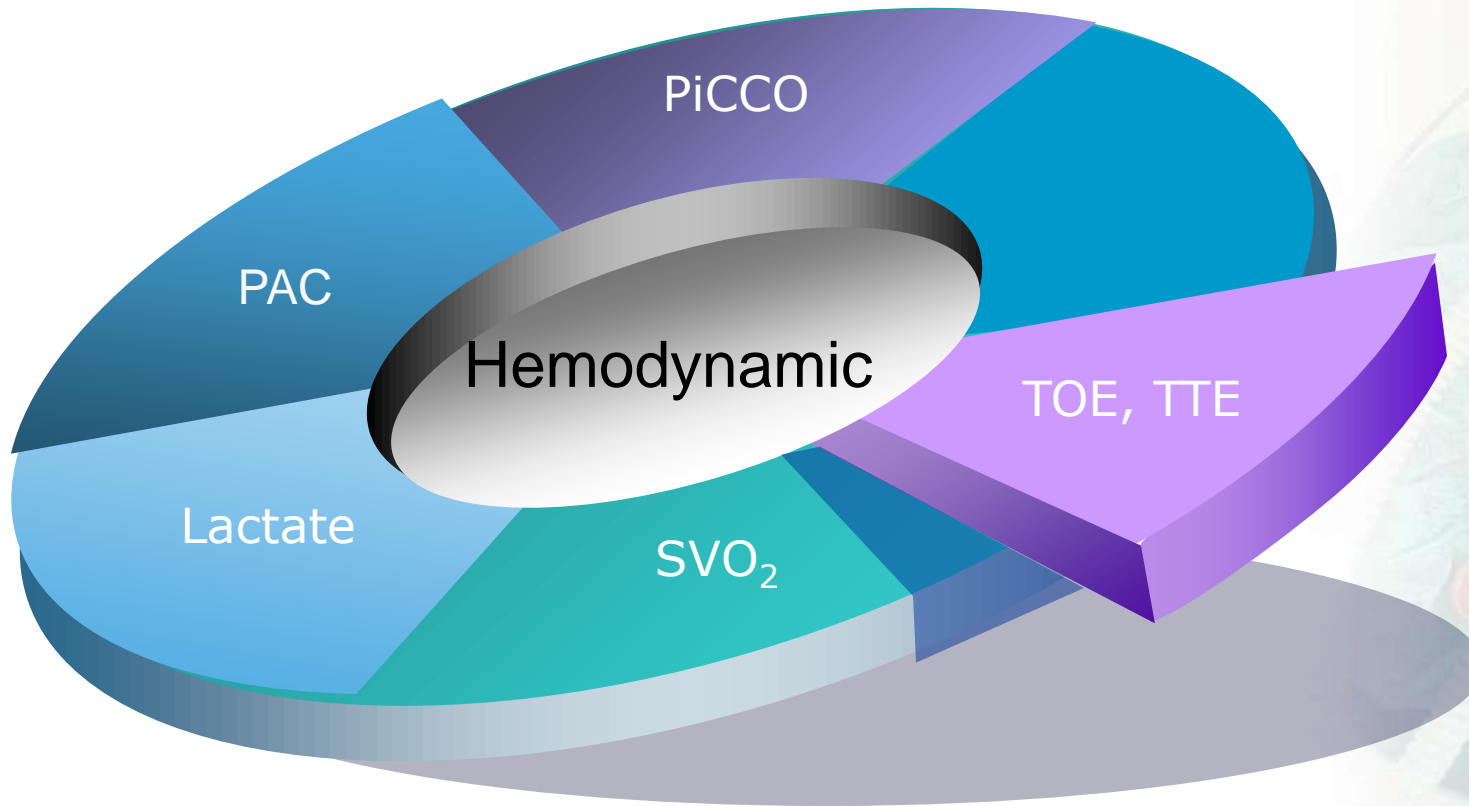
SvO₂ (%)



Example 2: Endotracheal Suctioning



Conclusion



Echocardiography: Rare findings



“სისხლის მიმოქცევის მონიტორინგი კრიტიკულ ავადმყოფებში” ე.შინდლერი (სანქტ-აუგუსტინე, გერმანია)

Zentrum für Kinderanästhesiologie
Sankt Augustin



ფილტვის არტერიის თერმოდიაგნოსტიკა პირველი პროცედურაა, რომელმაც გააუმჯობესა გულის წუთმოცულობა რუტინულ კლინიკურ განსაზღვრაში. ბავშვებში ეს პროცედურები იშვიათია და რთული შესასრულებელი. ბოლო წლებში, სხვადასხვა მინიმალურ-ინვაზიური გულის წუთმოცულობის მოწყობილობა გახდა შესაძლებელი. აქედან, კერძოდ პულს მეტრზე დაფუძნებულმა მოწყობილობებმა (PiCCO, LidCO, Vigileo), აჩვენეს კარგი შესაბამისობა გულის სიმძლავრის გაზომვასთან ფილტვის არტერიის კათეტერის გამოყენებით და ხშირად ცვლიან მას წინასაოპერაციო პერიოდში. უფრო მეტიც, ისინი ასევე საშუალებას გვაძლევენ შევაფასოთ პაციენტის სითხის რეაგირების პარამეტრები. წინა საოპერაციო პერიოდში სითხის მართვამ, იმ გაგებით, რომ ეს არის ადრეული მიზანმიმართული თერაპია, უკვე ავადობის და საწოლდღის შემცირება აჩვენა. ჯერჯერობით, აორტულ ეზოფაგალური დოპლერული კვლევა არის ყველაზე ხშირად გამოყენებული მეთოდი ინსულტის მოცულობის მიზანმიმართული მართვის. თუმცა, არსებობს მტკიცებულება, რომ გულის სიმძლავრის გაზომვის სხვა მინიმალურ-ინვაზიური ტექნიკა შეიძლება გამოყენებულ იქნეს ამავე მიზნით. ოპტიმიზაცია ინსულტის მოცულობის მინიმალურ-ინვაზიური გულის წუთმოცულობის მოწყობილობის ხელმძღვანელობით როგორც ჩანს, იქნებოდა სითხის მართვის მნიშვნელოვანი ელემენტი წინა საოპერაციო მაღალი რისკის ქირურგიულ პაციენტებში.