Perioperatif Hemodinamiye Dayalı Transfüzyon Yaklaşımları

Emre ÇAMCI

İTF Anesteziyoloji AD

Akış

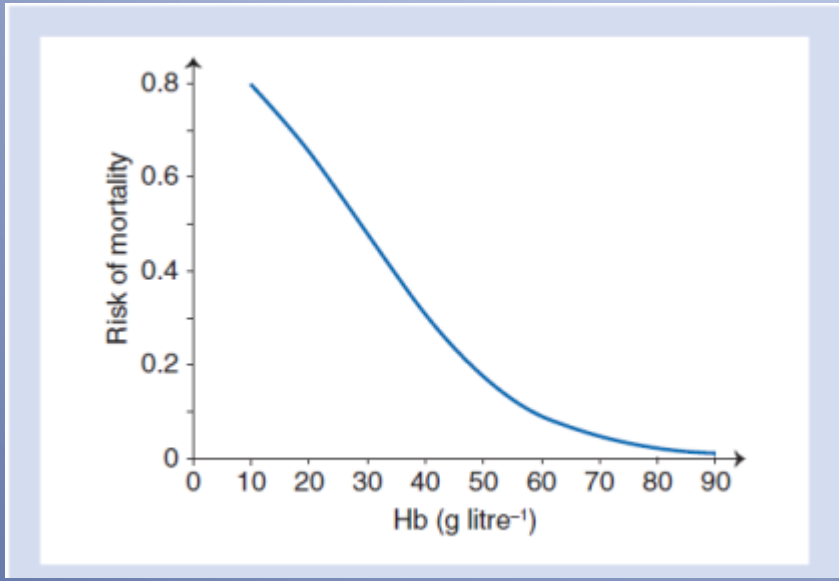
- Anemi-Transfüzyon kıskacı
- Transfüzyon Tetikleyicileri
  - Hemoglobin
  - Hemoglobin dışı
- Kılavuzlar
- Uygulamalar

British Journal of Anaesthesia **107** (S1): i41–i59 (2011)
doi:10.1093/bja/aer350

BJA

What is really dangerous: anaemia or transfusion?

A. Shander[1,2,3,4*], M. Javidroozi[1], S. Ozawa[5] and G. M. T. Hare[6,7]



- Anemiye adaptasyon
- Organlar arası fark
- Maladaptasyon
- Fatal Hb düzeyi?

ANEMİ

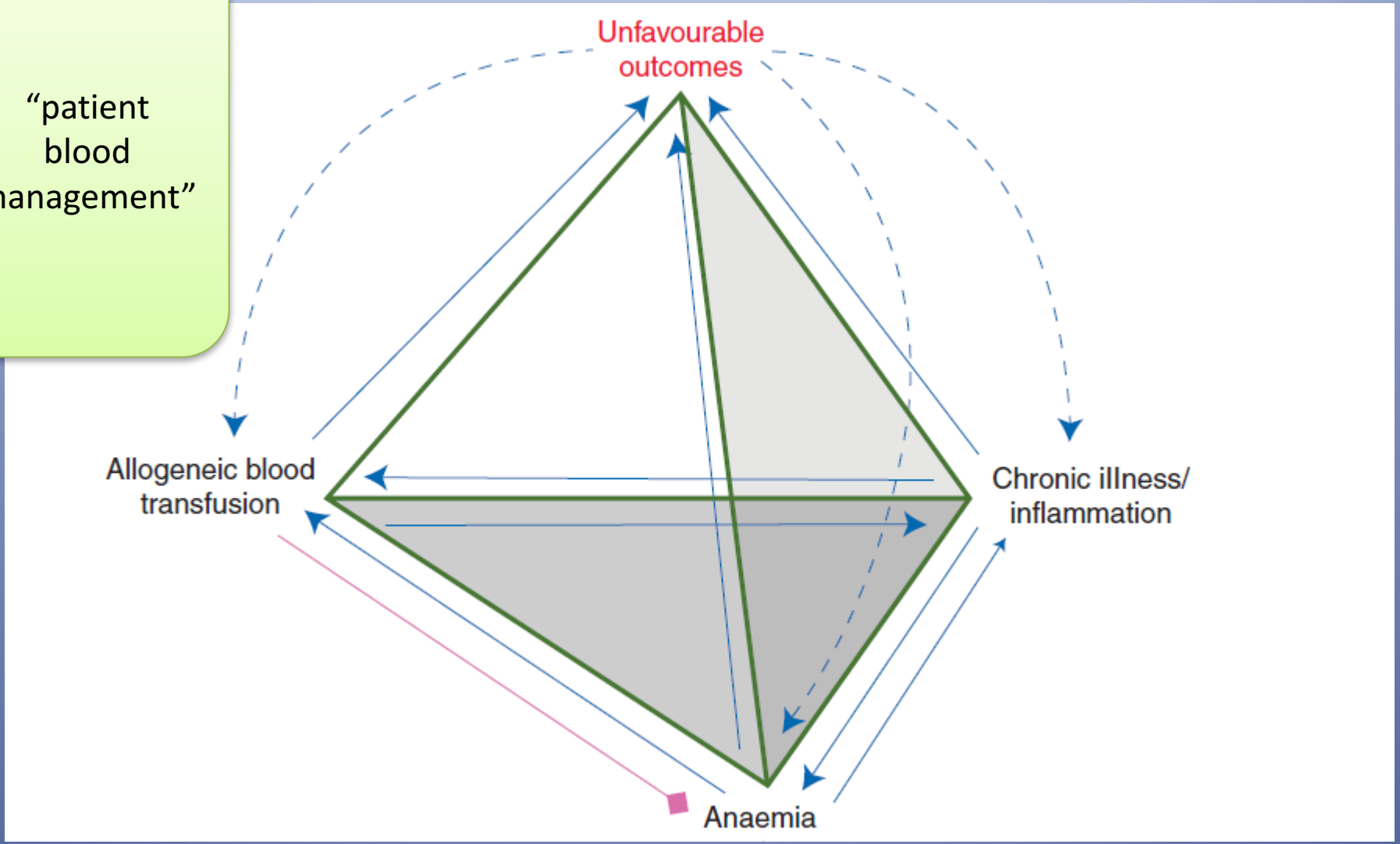
- Anemi bağımsız bir risk faktörü mü ??
- Hastalığın ciddiyetinin bir belirteci mi??

Carrascal and colleagues[105]	227 80-to-90-yr-old patients who underwent CPB	41.9% (WHO criteria)	In multivariate analysis, immediate postoperative Hct <24% (OR 2.78, P=0.039) and transfusion (OR 10.57, P<0.01) were independent predictors for in-hospital mortality
De Santo and colleagues[108]	1214 patients undergoing CABG	28% in preoperative period (WHO criteria)	Anaemia was an independent predictor of acute kidney injury (OR 2.06)
Ranucci and colleagues[96]	3003 patients undergoing CPB without receiving blood transfusions during hospital stay	NA; mean preoperative and lowest CPB Hct values were 40.4% and 27.8%, respectively	After adjustment for the other explanatory variables, preoperative Hct and lowest Hct on CPB were independent risk factors for major morbidity
von Haehling and colleagues[100]	627 patients admitted with acute HF	29% (WHO criteria)	Patients with moderate or severe anaemia (Hb <12 in men or <110 g litre^{-1} in women) had increased 12-month mortality (HR 1.5, P=0.01) after adjusting for other factors
Hasin and colleagues[107]	1065 patients with acute MI	34.7% at discharge, 19.5% persistent at follow-up, and 5.2% new-onset at follow-up (WHO criteria)	Marked increase in mortality and heart failure in patients with persistent (HR 1.8) and new-onset anaemia (HR 1.9)
Kruk and colleagues[101]	1880 patients with STEMI treated with primary PCI	21.1% (Hct <36% in women and Hct <39% in men)	In multivariable analysis including important baseline risk factors, anaemia was independently associated with in-hospital death (HR 2.67)
Kurek and colleagues[94]	1497 patients with acute MI treated with PCI	16.6% (WHO criteria)	Multivariate analysis identified anaemia as an independent predictor of any-cause death (HR 1.46, P<0.05)

Transfüzyon

Bahrainwala and colleagues[138]	617 patients undergoing cardiac surgery with CPB	Not specified	Higher quartile of PRBCs transfused was associated with higher risk of postoperative stroke (OR 1.37)
Ferraris and colleagues[137]	8728 nonvascular cardiac operations	9.8%	After propensity adjustment, transfusion of 1–2 units of PRBC increased the risk of composite morbidity, pulmonary complications, systemic sepsis, wound complications, and postoperative LOS
Koch and colleagues[150]	16847 patients undergoing on-pump CABG, valve or combined procedures	Not specified	RBC transfusion was associated with more risk-adjusted complications including respiratory distress and failure, longer intubation time, ARDS and reintubation
Mohnle and colleagues[144]	945 patients undergoing CABG	20.4%	In multivariate analysis, RBC transfusion was associated with cardiac events (OR 1.39, $P=0.04$) and harvest-site infection. Other possible associations included increased risk of composite morbidity, in-hospital mortality, renal morbidity, pneumonia, and mediastinitis
Salvin and colleagues[141]	802 paediatric patients discharged after cardiac surgery	46.2%	In a multivariable model, both the low transfusion group (HR 0.80, $P=0.02$) and high transfusion group (HR 0.66, $P<0.01$) were associated with increased LOS
van Straten and colleagues[151]	10 435 patients undergoing CABG surgery	23.3%	RBC transfusion was an independent, dose-dependent risk factor for early mortality
Veenith and colleagues[147]	874 80-yr-old or older patients undergoing cardiac surgery	73.4%	Transfusion was independently associated with hospital mortality
Vivacqua and colleagues[136]	566 reoperations after CABG, valve, or combined surgeries	36%	More transfusion was independently associated with increased risk of mortality and major morbidity
Whitson and colleagues[152]	741 patients undergoing CABG, valve procedures, or both	54%	In multivariate analysis, transfusions were independently associated with infection, neurological complications, organ dysfunction, cardiac complications, and death

"patient blood management"



British Journal of Anaesthesia 107 (S1): i41–i59 (2011)
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BJA

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İKH'da Transfüzyon İlkeleri

- Transstenotik koroner akım artar
- Normovolemi sağlandığında HR stabil

Kritik Hemoglobin düzeyi

- Myokard iskemi bulgularında ortaya çıkış
- Transfüzyon
- Bulguların ortadan kalkması ??

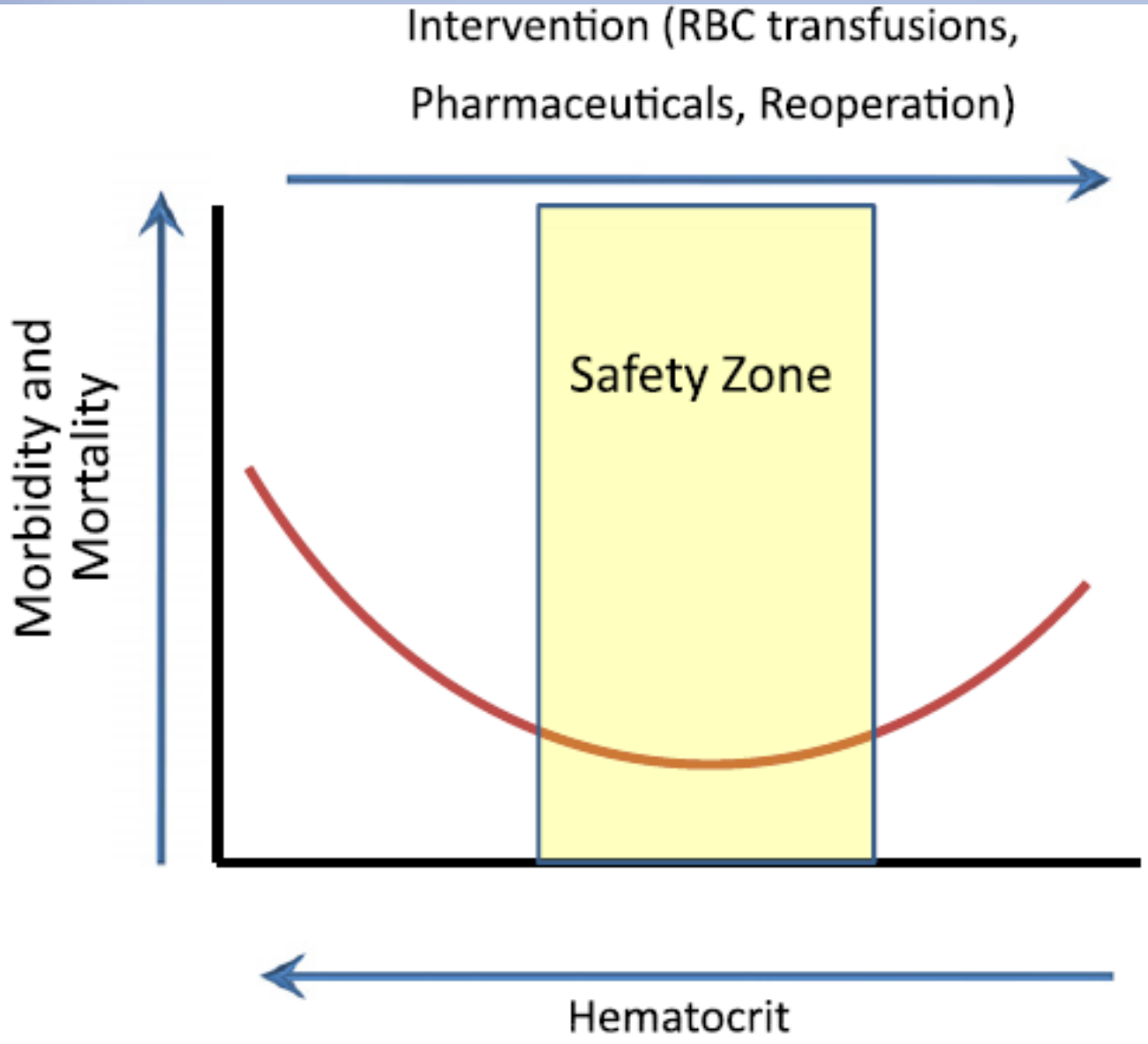
- Koroner lezyonların darlık derecesi
- Tek damar vs. çok damar hastalığı
- İlave risk faktörleri

Kritik Hemoglobin Düzeyi??

Anemiye bağlı yetersiz oksijenasyon

Diğer kategoriler

- Kapak hastalıkları
  - Atrial fibrilasyon?
  - Stenotik lezyonlarda artmış debi?
- Sistolik disfonksiyon
  - EF 25-85 aralığı aynı cevaplılıkta
- İleri yaş



Implications and management of anemia in cardiac surgery: Current state of knowledge

Gabriel Loor, MD,[a] Colleen G. Koch, MD, MS, MBA,[b] Joseph F. Sabik III, MD,[a] Liang Li, PhD,[c] and Eugene H. Blackstone, MD[a,c]

Anesthesiology 2006; 105:198–208

Practice Guidelines for Perioperative Blood Transfusion and Adjuvant Therapies

An Updated Report by the American Society of Anesthesiologists Task Force on Perioperative Blood Transfusion and Adjuvant Therapies

A. Red Blood Cell Transfusion. Intraoperative and postoperative management of potential or actual blood

2. Monitoring for inadequate perfusion and oxygenation of vital organs. Conventional monitoring systems (*e.g.*, blood pressure, heart rate, oxygen saturation, urine output, electrocardiography) should be used to assess the adequacy of perfusion and oxygenation of vital organs. Special monitoring systems should be used when appropriate (*e.g.*, echocardiography, mixed venous oxygen saturation, blood gasses).

Annals of Internal Medicine | Clinical Guideline

Red Blood Cell Transfusion: A Clinical Practice Guideline From the AABB*

Ann Intern Med. 2012;157:49-58. www.annals.org
For author affiliations, see end of text.
This article was published at www.annals.org on 27 March 2012.

Question 2

Recommendations

The AABB suggests adhering to a restrictive transfusion strategy.

Transfusion should be considered at a hemoglobin concentration of 8 g/dL or less or for symptoms (chest pain, orthostatic hypotension or tachycardia unresponsive to fluid resuscitation, or congestive heart failure).

Quality of evidence: moderate; strength of recommendation: weak.

Annals of Internal Medicine | Clinical Guideline

Red Blood Cell Transfusion: A Clinical Practice Guideline From the AABB*

Ann Intern Med. 2012;157:49-58. www.annals.org
For author affiliations, see end of text.
This article was published at www.annals.org on 27 March 2012.

Question 3

Recommendations

The AABB cannot recommend for or against a liberal or restrictive RBC transfusion threshold. Further research is needed to determine the optimal threshold.

Quality of evidence: very low; strength of recommendation: uncertain.

Annals of Internal Medicine | Clinical Guideline

Red Blood Cell Transfusion: A Clinical Practice Guideline From the AABB*

Ann Intern Med. 2012;157:49-58. www.annals.org
For author affiliations, see end of text.
This article was published at www.annals.org on 27 March 2012.

Question 4

Recommendations

The AABB suggests that transfusion decisions be influenced by symptoms as well as hemoglobin concentration.

Quality of evidence: low; strength of recommendation: weak.

REPORT FROM THE STS WORKFORCE ON EVIDENCE BASED SURGERY

Perioperative Blood Transfusion and Blood Conservation in Cardiac Surgery: The Society of Thoracic Surgeons and The Society of Cardiovascular Anesthesiologists Clinical Practice Guideline*

The Society of Thoracic Surgeons Blood Conservation Guideline Task Force: Victor A. Ferraris, MD, PhD (Chair), Suellen P. Ferraris, PhD, Sibu P. Saha, MD, Eugene A. Hessel II, MD, Constance K. Haan, MD, MS, B. David Royston, MD, Charles R. Bridges, MD, ScD, Robert S. D. Higgins, MD, George Despotis, MD, and Jeremiah R. Brown, PhD

The Society of Cardiovascular Anesthesiologists Special Task Force on Blood Transfusion: Bruce D. Spiess, MD, FAHA (Chair), Linda Shore-Lesserson, MD, Mark Stafford-Smith, MD, C. David Mazer, MD, Elliott Bennett-Guerrero, MD, Steven E. Hill, MD, and Simon Body, MB, ChB

b) Transfusion Triggers

Class IIa

1. **With hemoglobin levels below 6 g/dL, red blood cell transfusion is reasonable, as this can be life-saving. Transfusion is reasonable in most postopera-**

sess the needs for transfusion. More advanced measurements such as whole body oxygen-carrying capacity, oxygen consumption, oxygen extraction ratios, and oxygen delivery provide more accurate means to estimate the need for red blood cell transfusions [142].

1. **Transfusion is unlikely to improve oxygen transport when the hemoglobin concentration is greater than 10 g/dL and is not recommended. (Level of evidence C)**

SPECIAL REPORT: STS WORKFORCE ON EVIDENCE BASED SURGERY

2011 Update to The Society of Thoracic Surgeons and the Society of Cardiovascular Anesthesiologists Blood Conservation Clinical Practice Guidelines*

The Society of Thoracic Surgeons Blood Conservation Guideline Task Force:
Victor A. Ferraris, MD, PhD (Chair), Jeremiah R. Brown, PhD, George J. Despotis, MD, John W. Hammon, MD, T. Brett Reece, MD, Sibu P. Saha, MD, MBA, Howard K. Song, MD, PhD, and Ellen R. Clough, PhD

The Society of Cardiovascular Anesthesiologists Special Task Force on Blood Transfusion:
Linda J. Shore-Lesserson, MD, Lawrence T. Goodnough, MD, C. David Mazer, MD, Aryeh Shander, MD, Mark Stafford-Smith, MD, and Jonathan Waters, MD

The International Consortium for Evidence Based Perfusion:
Robert A. Baker, PhD, Dip Perf, CCP (Aus), Timothy A. Dickinson, MS, Daniel J. FitzGerald, CCP, LP, Donald S. Likosky, PhD, and Kenneth G. Shann, CCP

In the setting of hemoglobin values exceeding 6 g/dL while on CPB, it is reasonable to transfuse red cells based on the patient's clinical situation, and this should be considered as the most important component of the decision making process. Indications for transfusion of red blood cells in this setting are multifactorial and should be guided by patient-related factors (ie, age, severity of illness, cardiac function, or risk for critical end-organ ischemia), the clinical setting (massive or active blood loss), and laboratory or clinical parameters (eg, hematocrit, SVO_2, electrocardiogram, or echocardiographic evidence of myocardial ischemia etc.). (Level of evidence C) IIa

- Hasta ilişkili faktörler
  - Yaş, kardiyak fonksiyon
- Kanama
  - Aktif, massif
- Laboratuar ve klinik parametreler
- SvO_2, EKG, Eko

It may be reasonable to transfuse red cells in certain patients with critical noncardiac end-organ ischemia (eg, central nervous system and gut) whose hemoglobin levels are as high as 10 g/dL but more evidence to support this recommendation is required. (Level of evidence C) IIb

Hemoglobin eşikdeğeri!

- «yetersiz oksijenasyon belirtileri»
- Lokal
  - Myokard iskemisi
- Genel
  - Hemodinamik instabilite
    - Hipotansiyon
    - Taşikardi

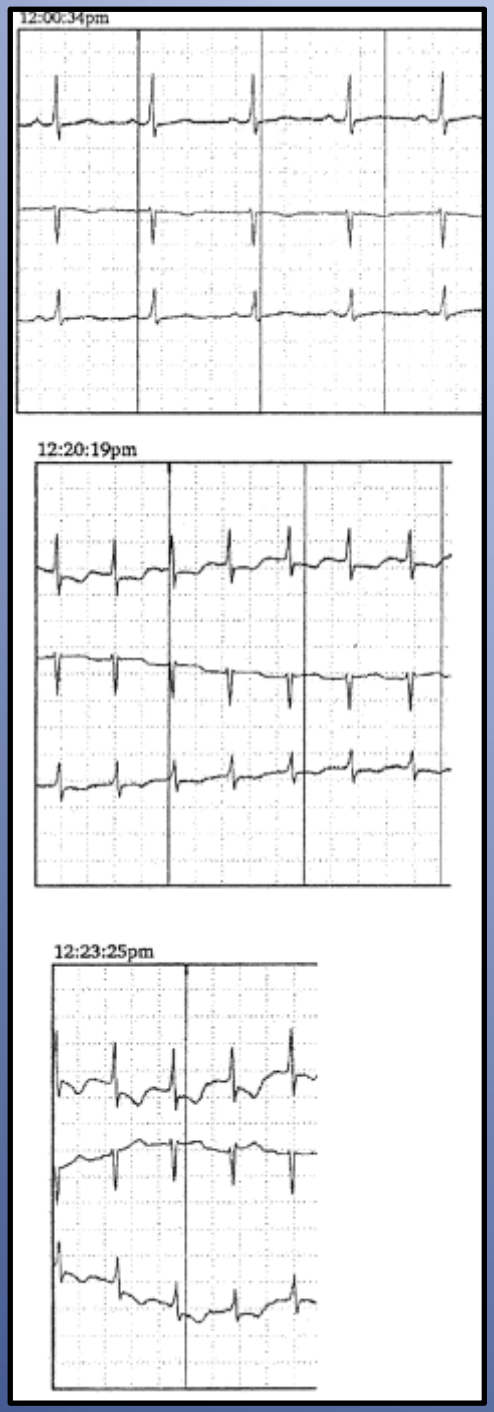
Yetersiz Oksijenasyon Belirtileri

Lokal myokard iskemisi

- ST segment değişiklikleri
  - Daha sıklıkla depresyon
- TEE de duvar hareket bozukluğu
- Tedbir:
  - Kalp hızı manipulasyonu
  - Hb 1-2 g/dL yükseltmek

Genel hemodinamik instabilite

- Taşikardi
- Hipotansiyon
- Yüksek OER
- Düşük venöz oksimetri



Anesthesiology 2000; 93:1004–10

Electrocardiographic ST-segment Changes during Acute, Severe Isovolemic Hemodilution in Humans

Jacqueline M. Leung, M.D., M.P.H., Richard B. Weiskopf, M.D.,† John Feiner, M.D.,‡ Harriet W. Hopf, M.D.,§ Scott Kelley, M.D.,‖ Maurene Viele, M.D.,# Jeremy Lieberman, M.D.,‡ Jessica Watson, M.A.,** Mariam Noorani, B.A.,†† Darwin Pastor,†† Hooi Yeap, R.N.,‡‡ Rachel Ho, B.S.,‡‡ Pearl Toy, M.D.§§*

Conclusion: **With acute reduction of hemoglobin concentration to 5 g/dl, ECG ST-segment changes developed in 3 of 55 healthy conscious adults and were suggestive of, but not conclusive for, myocardial ischemia. The higher heart rates that developed during hemodilution may have contributed to the development of an imbalance between myocardial supply and demand resulting in ECG evidence of myocardial ischemia. However, these ECG changes appear to be benign because they were reversible and not accompanied by symptoms. (Key words: Anemia; ECG; myocardial ischemia.)**

Genel hemodinamik sorunlar

- Taşikardi
- Hipotansiyon
- Yüksek oksijen ekstraksiyonu
- Düşük venöz oksijen saturasyonu

$DO_2/VO_2/OER/SvO_2$

$OER>50$

$pvO_2<35$

$SvO_2<\%65$

Vallet *et al. Critical Care* 2010, 14:213
http://ccforum.com/content/14/2/213

CRITICAL CARE

REVIEW

Venous oxygen saturation as a physiologic transfusion trigger

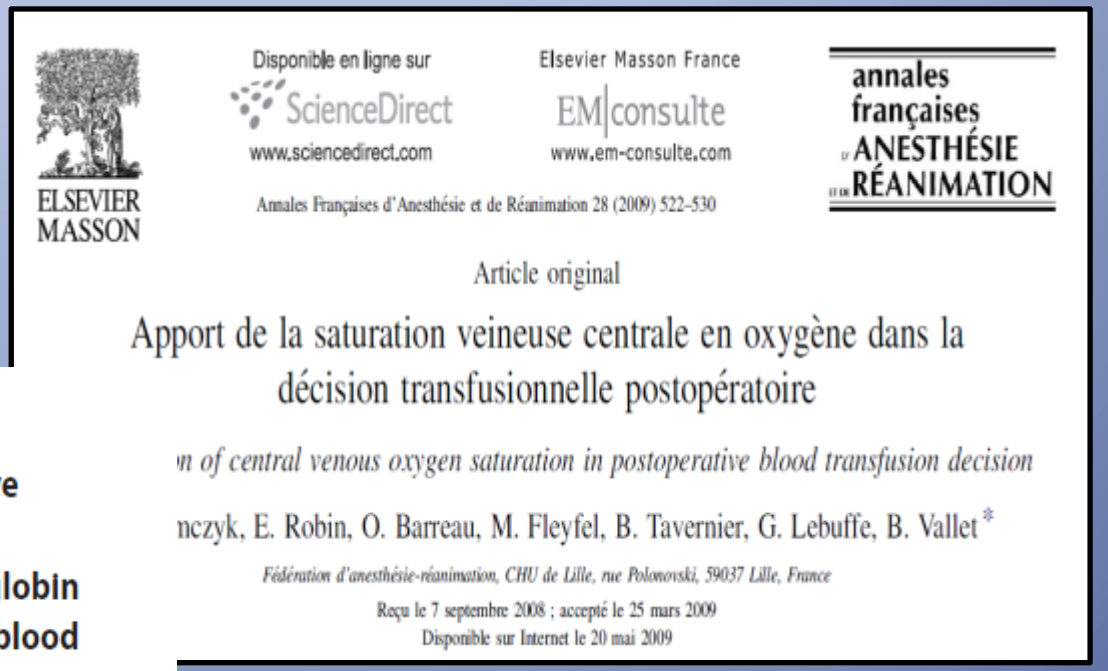
Benoit Vallet*, Emmanuel Robin and Gilles Lebuffe

Kritik DO_2: 4-4.5 ml/kg/dak

Kritik VO_2: 2.5 ml/kg/dak

DO_2/VO_2: %60

Venöz Oksimetri
SvO2 / ScvO2



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Annales Françaises d'Anesthésie et de Réanimation 28 (2009) 522–530

Article original

Apport de la saturation veineuse centrale en oxygène dans la décision transfusionnelle postopératoire

n of central venous oxygen saturation in postoperative blood transfusion decision

nczyk, E. Robin, O. Barreau, M. Fleyfel, B. Tavernier, G. Lebuffe, B. Vallet *

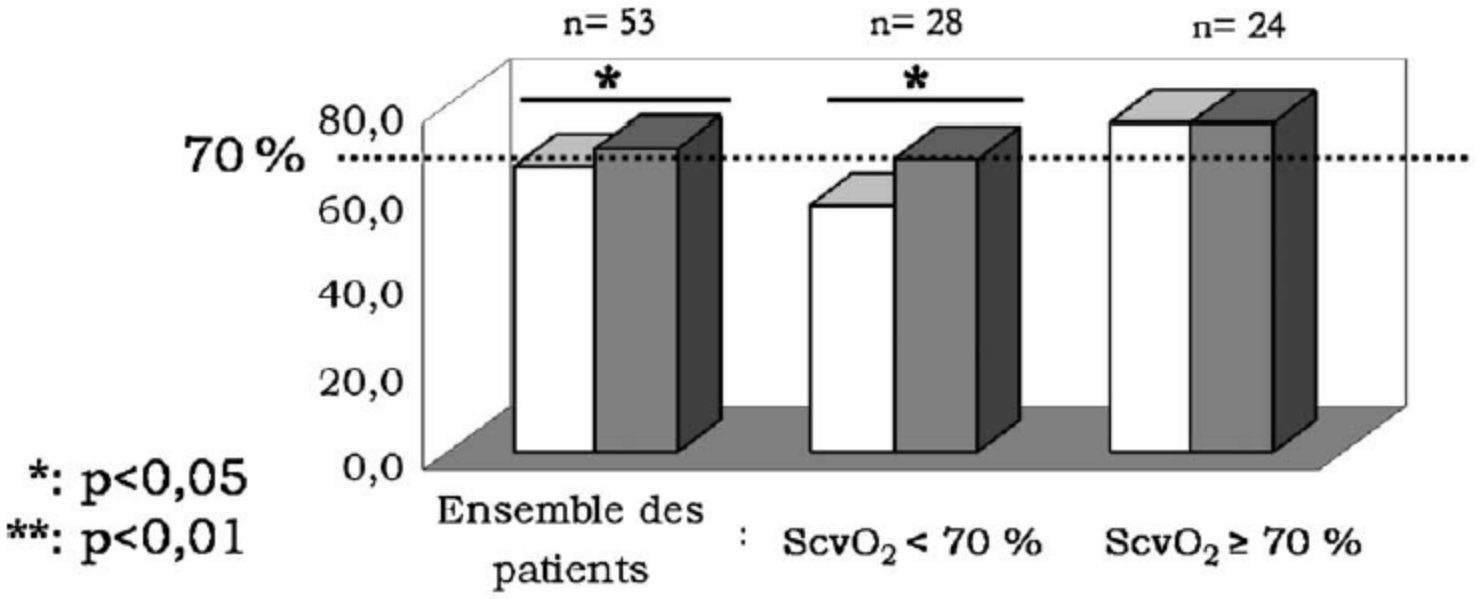
Fédération d'anesthésie-réanimation, CHU de Lille, rue Polonovski, 59037 Lille, France

Reçu le 7 septembre 2008 ; accepté le 25 mars 2009

Disponible sur Internet le 20 mai 2009

Table 1. The French recommendations for blood transfusion in critically ill patients are based on a recent consensus by the French Society of Intensive Care Medicine (Société de Réanimation de Langue Française; SRLF) using threshold values for hemoglobin (Hb) together with the clinical context to indicate blood transfusion [8].

Threshold value of Hb (g/dl)	Clinical context
10	• Acute coronary syndrome
9	• Ischemic heart disease • Stable heart failure
8	• Age > 75 • Severe sepsis
7	• Others



□ $ScvO_2$ avant TE	(%)	66,4	[57,6-76,2]	57,8	[53,0-59,7]	76,8 [76,1-80,0]
■ $ScvO_2$ après TE	(%)	71,0*	[71,5-72,2]	68,5**	[62,4-70,5]	76,5 [72,5-79,9]
Nombre de culots		2	[2,0-2,2]	2	[2,0-2,0]	2 [2,0-2,0]
Hb avant TE (g/dL)		7,6	[7,3-8,2]	7,6	[7,3-8,5]	7,7 [7,4-8,2]
Hb après TE (g/dL)		9,8**	[9,1-10,4]	9,5**	[8,9-10,0]	10,0** [9,3-10,7]

- *Hastaların %40'ı kılavuza rağmen transfüze...*
- *Transfüze edilenlerin % 65'inde ScvO2<%70*
- *Transfüzyonla ScvO2 anlamlı artıyor*
- *Kılavuza bağlı kalınsaydı: "eksik tedavi ??"*

- *ScvO2 >%70 olmasına rağmen %55 hastada kılavuza göre transfüzyon..*
- *Bu hastaların ScvO2 de artış görülmüyor*
- *Kılavuza bağlı kalınmasına rağmen: "gereksiz transfüzyon??"*

Rejyonel Oksimetri StO_2/rSO_2

Vox Sanguinis (2002) **83**, 254–257

ORIGINAL PAPER

Cerebral and peripheral near-infrared spectroscopy: an alternative transfusion trigger?

F. Torella, S. L. Haynes & C. N. McCollum

Academic Surgery Unit, Education and Research Centre, South Manchester University Hospital, Manchester, UK

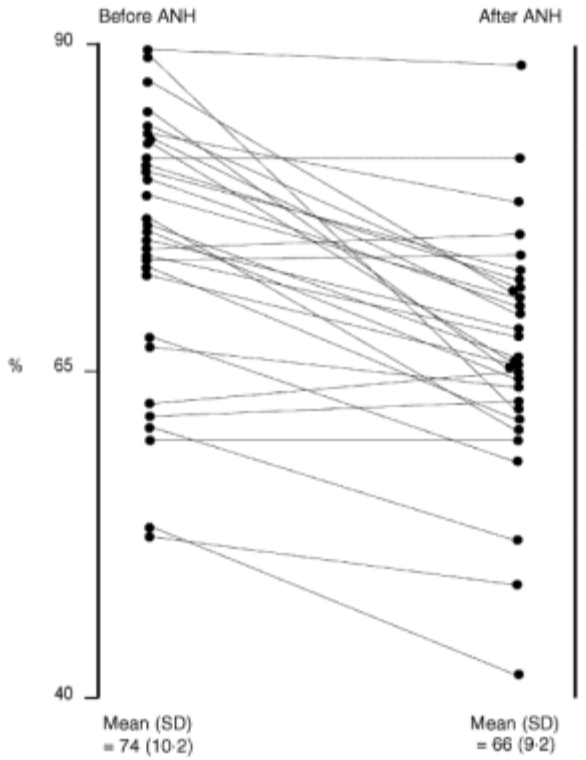


Fig. 1 Changes in regional haemoglobin oxygen saturation from the cerebral cortex (CsO_2) during ANH. The mean fall (95% confidence interval) was 8 (5·3–10·7)%.

Background and Objectives To develop a transfusion trigger based on tissue oxygenation, near-infrared spectroscopy (NIRS) was evaluated in a model of compensated haemorrhage.

Patients and Methods Regional haemoglobin oxygen saturation from the cerebral cortex (CsO_2) and the gastrocnemius muscle (PsO_2) was monitored (using an INVOS 4100 near-infrared oximeter) in 30 patients during acute normovolaemic haemodilution to a target haemoglobin of 11 g/dl. Arterial oxygen saturation, end-tidal carbon dioxide tension, mean arterial pressure and haemoglobin concentration were also measured.

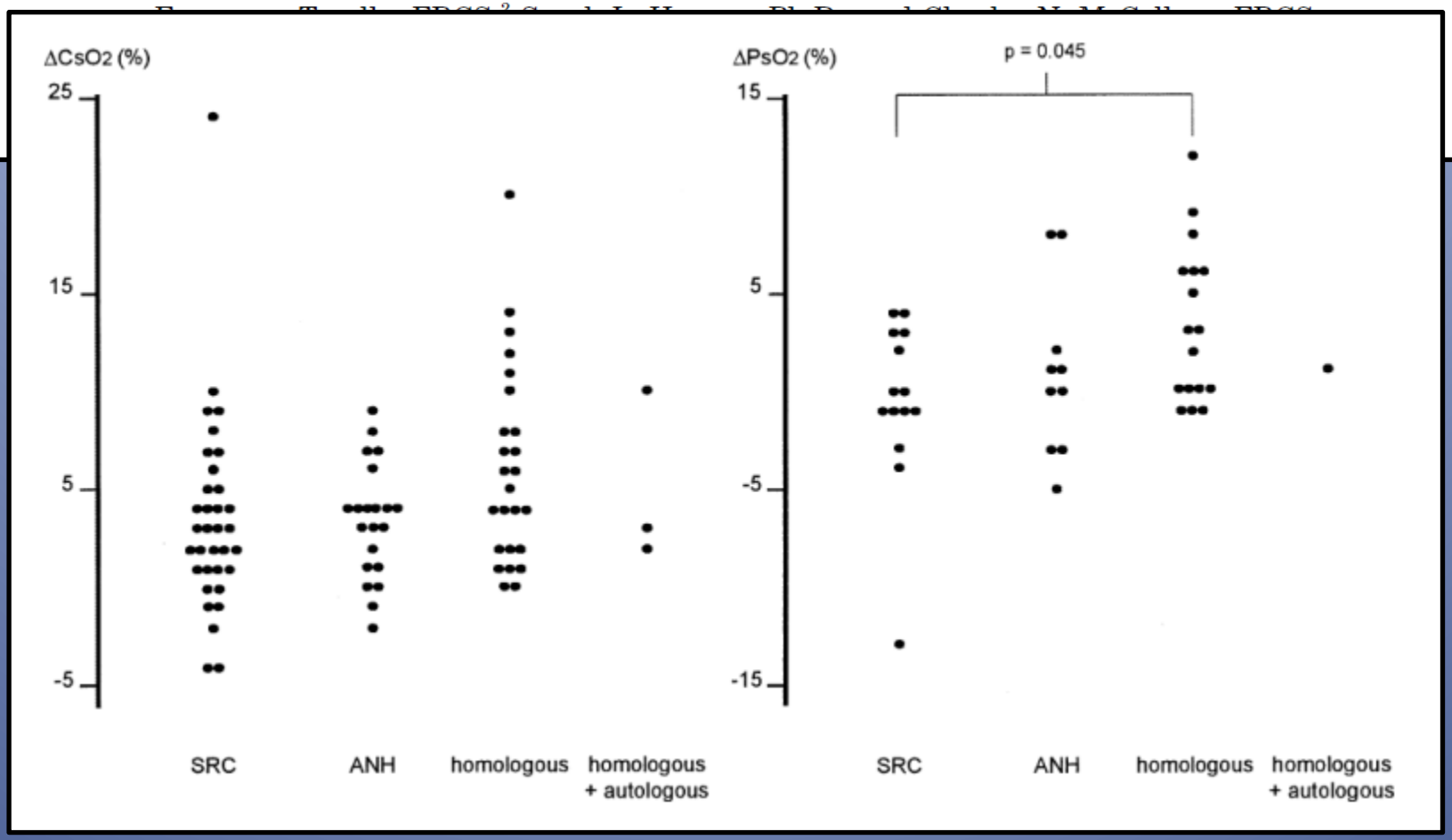
Results During blood collection, CsO_2 and PsO_2 fell by a mean (95% CI) of 8 (5·3–10·7)% ($P < 0·001$) and 5·5 (3·2–7·8)% ($P < 0·001$), respectively. Arterial pressure and oxygen saturation did not change, whilst the end-tidal carbon dioxide tension fell by 2·3 (0·8–3·8) mmHg ($P = 0·004$). Haemoglobin concentration correlated with CsO_2 ($R = 0·76$, $P < 0·001$) and PsO_2 ($R = 0·63$, $P < 0·001$), as did the volume of blood removed.

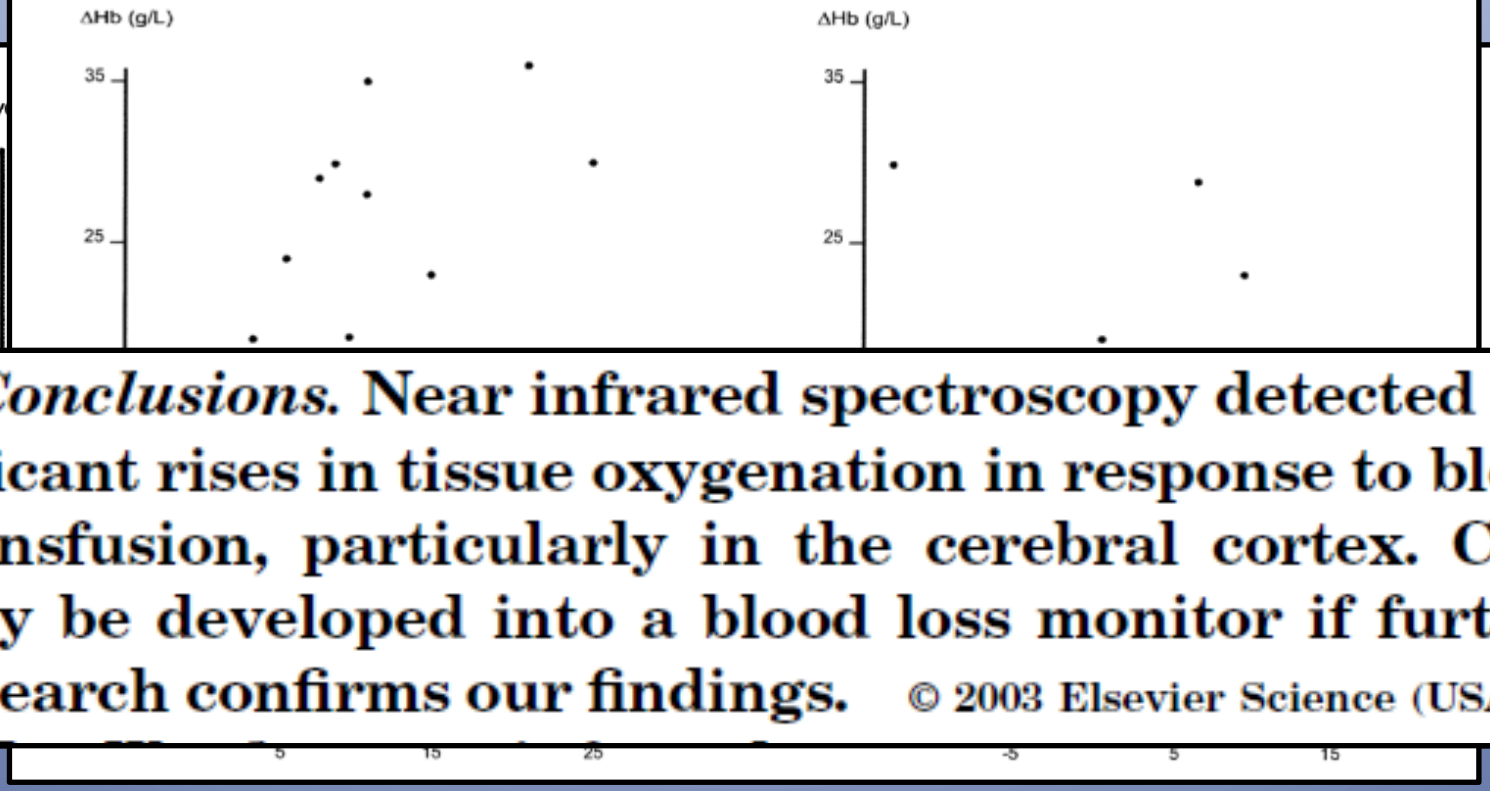
Conclusions CsO_2 and PsO_2 fell predictably during compensated blood loss. With further research, NIRS may be developed into a transfusion trigger.

Key words: acute normovolaemic haemodilution, blood loss, haemorrhage, oximetry, regional oxygen saturation.

Journal of Surgical Research **110,** 217–221 (2003)
doi:10.1006/jsre.2002.6625

Cerebral and Peripheral Oxygen Saturation during Red Cell Transfusion[1]





Conclusions. **Near infrared spectroscopy detected significant rises in tissue oxygenation in response to blood transfusion, particularly in the cerebral cortex. CsO_2 may be developed into a blood loss monitor if further research confirms our findings.**

		Realizable in public/teaching hospitals	
	Evidence-based/ scientific	Intraoperatively and ICU	Postoperatively general ward
New ST-segment depression > 0.1 mV	Yes	Yes	Yes
New ST-segment elevation > 0.2 mV	Yes	Yes	Yes
New wall motion abnormality in TEE	Yes	Yes	Yes
Oxygen extraction rate	> 50%	> 40%	Not applicable
SvO2	< 50%	< 60%	Not applicable
Decrease in oxygen consumption	> 10–50%	> 10%	Not applicable
Hemoglobin transfusion triggers[a]			
All patients	6 g/dL	7 g/dL	7–8 g/dL
Patients > 80 years		7–8 g/dL	8–9 g/dL
Patients with severe CAD		8 g/dL	8–9 g/dL
Patients with signs of CHF		8 g/dL	8–9 g/dL
Patients with > 1 catecholamine		8 g/dL	Not applicable
Patients with SaO_2 < 90%		8–9 g/dL	9 g/dL

Transfusion in the cardiac patient

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Sonuç ve Özet

- Anemi ve transfüzyon ayrı ayrı tehlikeli
- Bir arada olunca tehlike artıyor
- «Hasta Kan Yönetimi»
- Hemoglobine dayalı transfüzyon stratejisi
- Yetersiz oksijenasyona dayalı transfüzyon stratejisi...