

# ANEMO CENTRO-SUD '11

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**Alternative trasfusionali integrate nel paziente  
cardiochirurgico o con vasculopatia aortica**

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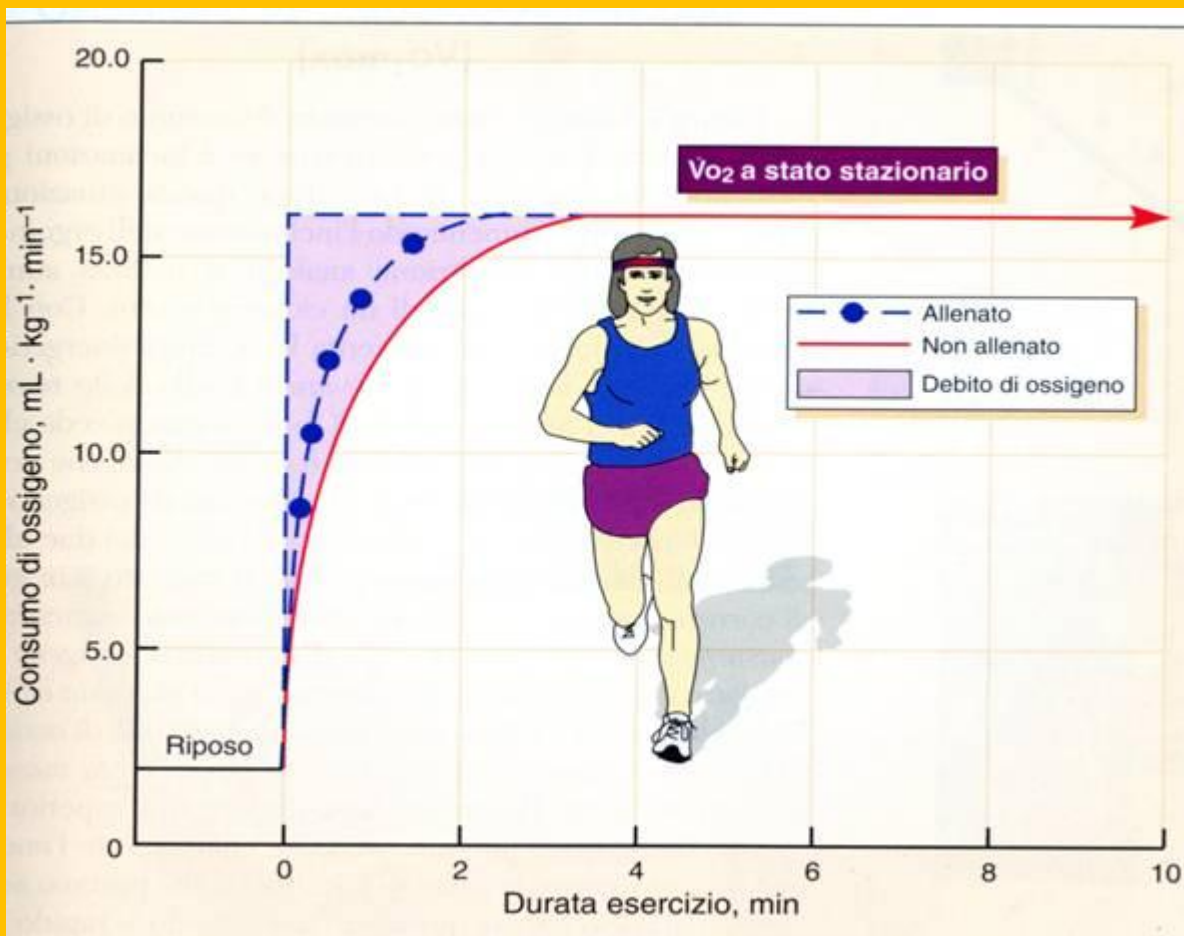
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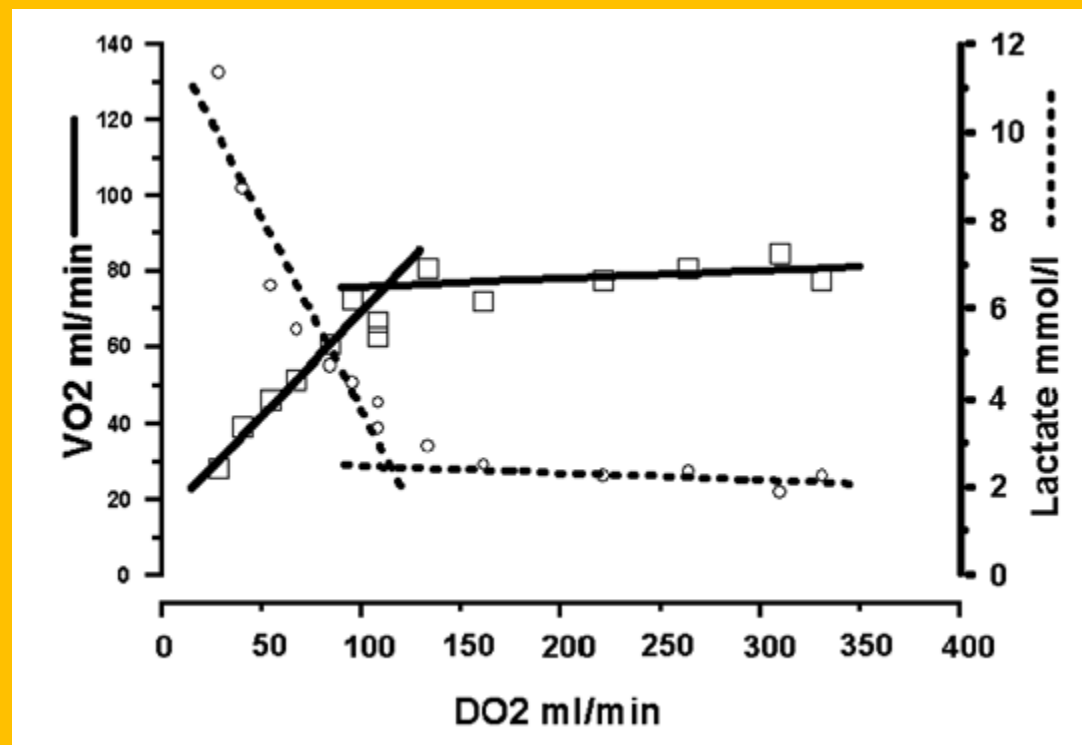
- **I determinanti del trasporto, del consumo e dell'estrazione d'ossigeno**

- Trasporto d'ossigeno ( $DO_2$ ) =  $CI \times Hb \times SaO_2 \times C \times 10$
- Consumo d'ossigeno ( $VO_2$ ) =  $CI \times CaO_2 - CvO_2 \times 10$   
(non considerando la quota di  $O_2$  disciolto) =  $CI \times Hb \times (SaO_2 - SvO_2) \times C$
- Estrazione d'ossigeno ( $O_2ER$ ) =  $VO_2 / DO_2 = (CaO_2 - SvO_2) / CaO_2$   
(non considerando la quota di  $O_2$  disciolto) =  $(SaO_2 - SvO_2) / SaO_2$

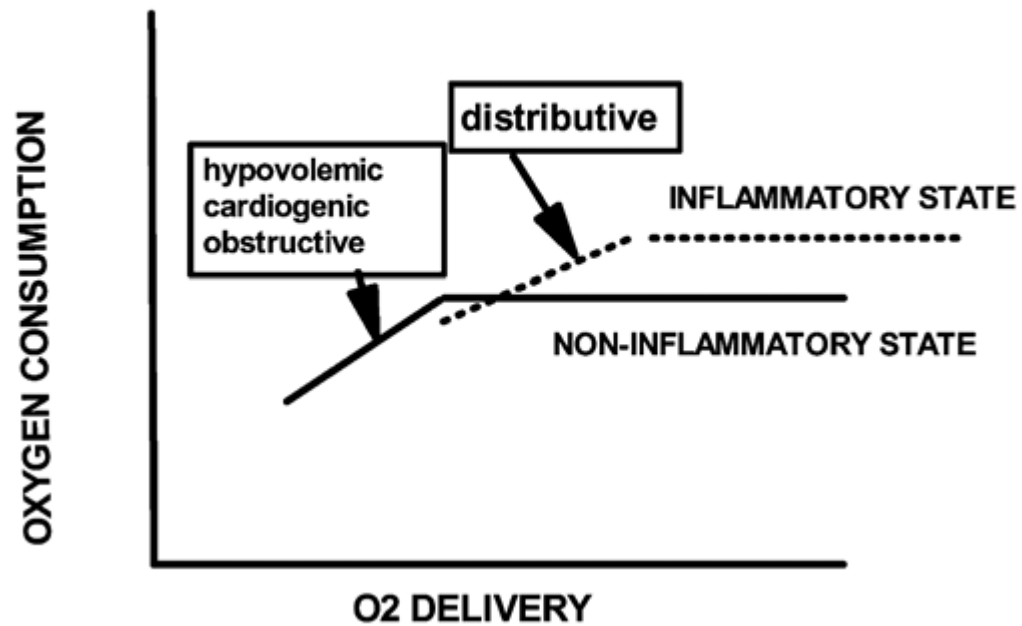
*CO gittata cardiaca, HB concentrazione di emoglobina, SaO<sub>2</sub> saturazione arteriosa d'ossigeno, SvO<sub>2</sub> saturazione venoso di ossigeno, C costante: rappresenta la quantità di O<sub>2</sub> legato ad 1 g di emoglobina (questo valore è abitualmente 1.34 o 1.39)*



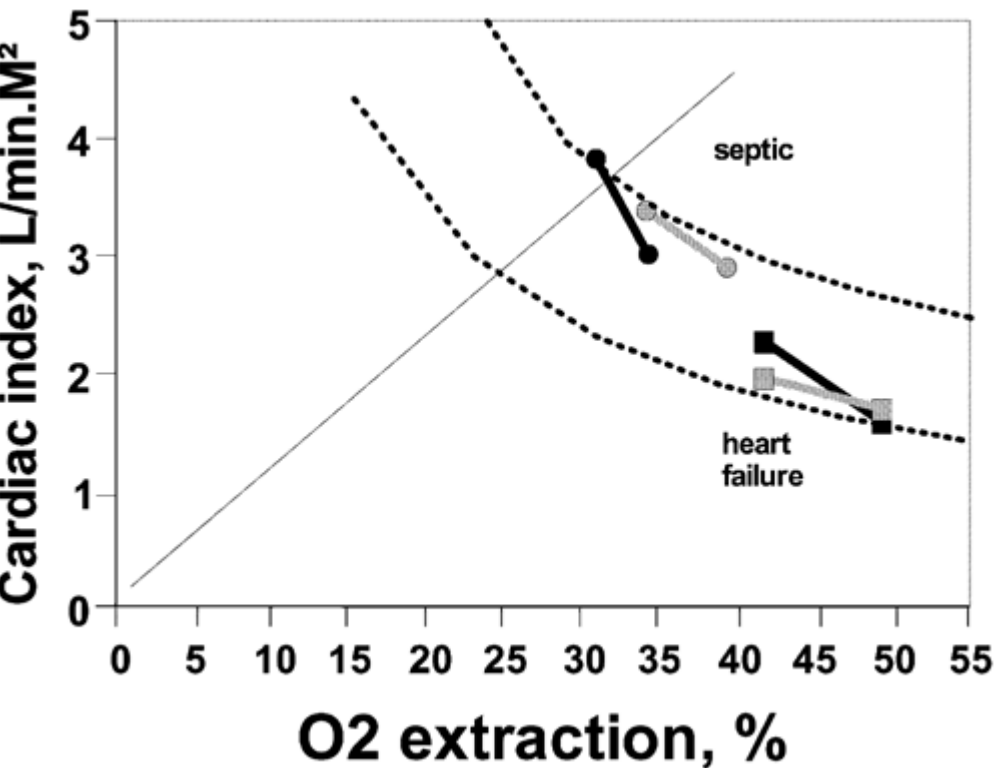
- Nei cardiopatici può non essere possibile compensare la diminuzione di hb con l'incremento della CO, per cui per incrementare la DO<sub>2</sub> si incrementa l'ossigenazione cellulare con
- Incremento dell'assunzione di O<sub>2</sub>
- Con incremento del trasporto di O<sub>2</sub>



## SHOCK STATES



# Diagramma del rapporto indice cardiaco/estrazione di ossigeno



## Diagramma del rapporto indice cardiaco/estrazione di ossigeno

(O<sub>2</sub>ER) durante infusione rapida di dobutamina che indica la dipendenza consumo di ossigeno (VO<sub>2</sub>)/trasporto di ossigeno (DO<sub>2</sub>) in pazienti con livelli aumentati di lattato (*barre scure*) ma non in quelli con normali livelli di lattato (*barre grigie*).

La linea di riferimento si riferisce alla risposta fisiologica allo sforzo.

Le linee tratteggiate curve rappresentano isoplete dei vari livelli di VO<sub>2</sub>. Se il VO<sub>2</sub> rimane stabile ed è indipendente da DO<sub>2</sub> i punti nel grafico si muovono paralleli alle isoplete del VO<sub>2</sub>. Se vi è dipendenza VO<sub>2</sub> /DO<sub>2</sub> i punti attraversano le isoplete VO<sub>2</sub>.

**which decisions to transfuse patients should be based:**

- **(1) surgical patients experience adverse outcomes as result of diminished oxygen carrying capacity, and**
- **(2) red blood cell transfusions, by enhancing oxygen carrying capacity, can prevent adverse outcomes.**

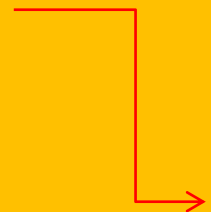


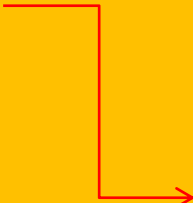
# Stratificazione del rischio di sanguinamento e quindi trasfusionale

- Fattori legati all'anamnesi e alla clinica del paziente
- Fattori legati alle strategie
- Fattori legati alle procedure

# Patient-related variables

- Advanced age or age more than 70 years
- Preoperative anemia
- Female gender
- Body size or body surface area
- Preoperative antithrombotic therapy:
  - high intensity (abciximab, clopidogrel, direct thrombin inhibitors, low-molecular-weight heparin, long-acting direct thrombin inhibitors, thrombolytic therapy)
  - low intensity (aspirin, dipyridamole, eptifibatide, tirofiban)
- Preoperative coagulopathy
- Hereditary coagulopathy or platelet defect (von Willebrand's disease, Hermansky-Pudlak, Bernard-Soulier, Scott, Werlhof, Glanzmann's, hemophilia A or B, clotting factor deficiencies, etc)



- 
- **Acquired coagulopathy or platelet abnormality (nonspecific platelet defect measured by template bleeding time or PFA-100, chronic lymphocytic leukemia, cirrhosis, lupus anticoagulant, drug-related polycythmia vera, myelodysplastic syndrome, ITP, beta thalassemia, etc).**
  - **Cardiogenic shock, congestive heart failure, or poor left ventricular function**
  - **Renal insufficiency**
  - **Insulin-dependent adult-onset diabetes mellitus**
  - **Peripheral vascular disease**
  - **Preoperative sepsis**
  - **Liver failure or hypoalbuminemia**

# Procedure-related variables

- Prolonged CPB time
- Reoperation
- Type of operation (other aortic, complex, etc] valve/CABG
- Increased protamine dose after CPB
- Increased cell-saving volume
- Intraoperative autologous donation
- Need for transfusion while on CPB
- Use of polymerized starch for volume expansion

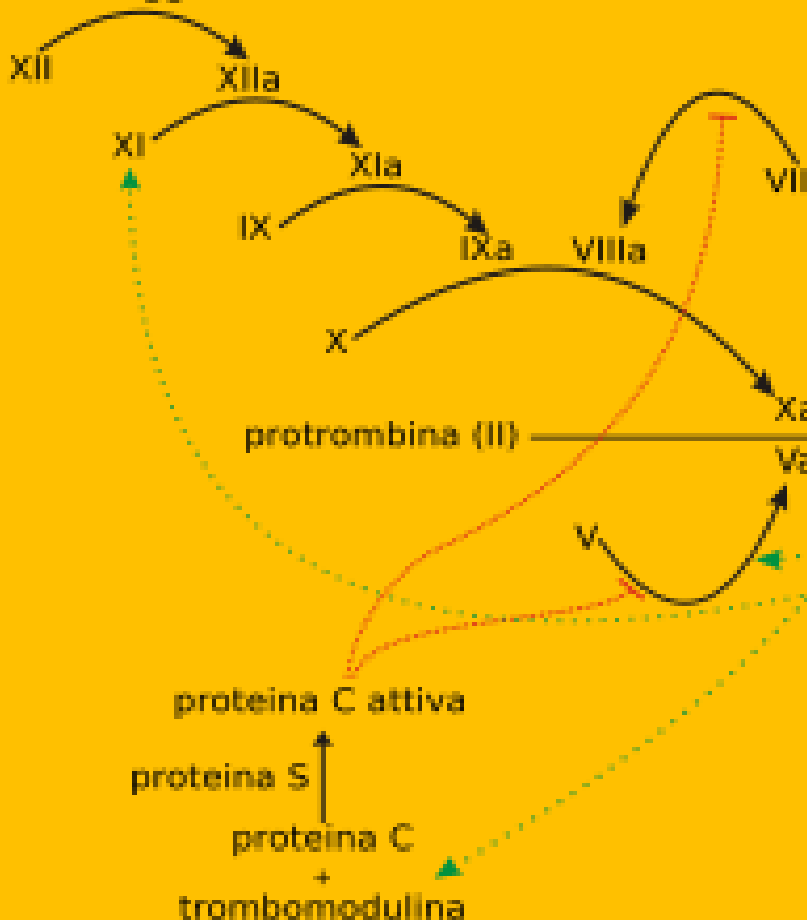
# Process-related variables

- Lack of transfusion algorithm with point-of-care testing
- Use of internal mammary artery (either one or two)
- Reduced heparin dose
- Low body temperature in intensive care unit

## Via intrinseca

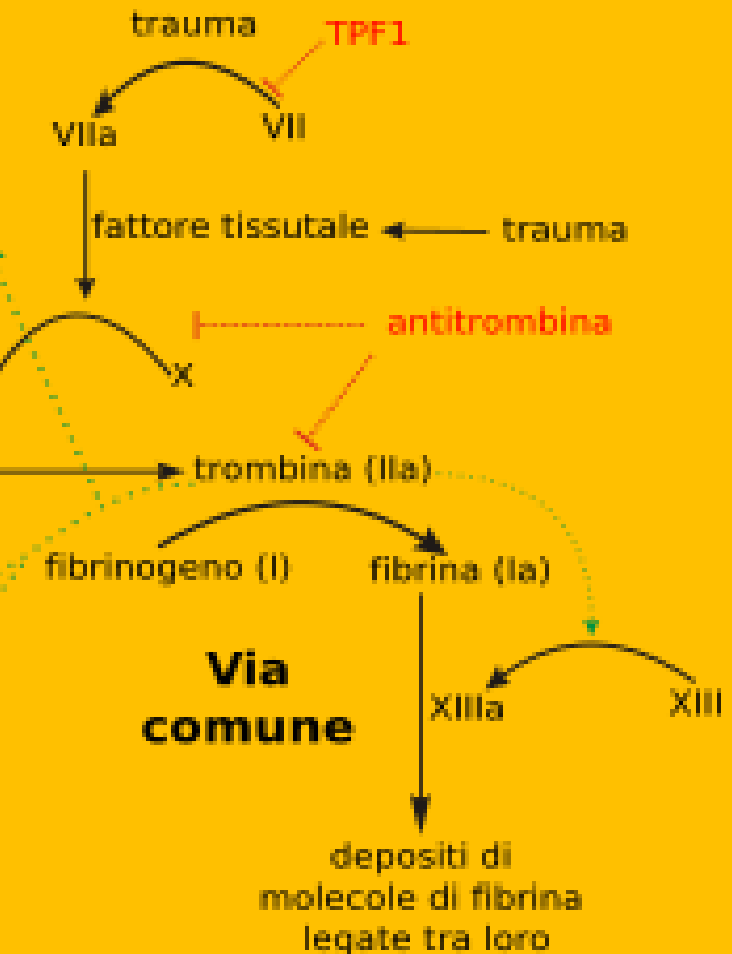
(contatto con superficie non endoteliale)

superficie  
danneggiata



## Via estrinseca

(trauma a livello tissutale)



**A multimodality approach involving multiple stakeholders, institutional support, enforceable transfusion algorithms supplemented with point-of-care testing, and all of the already mentioned efficacious blood conservation interventions will limit blood transfusion and provide optimal blood conservation for cardiac operations.**

**(Level of evidence A)**

## ***American Society of Anesthesiology Guidelines for Transfusion of Packed Red Cells in Adults***

- **Transfusion for patients on cardiopulmonary bypass**

**hemoglobin level 6.0 g/dL is indicated**

**hemoglobin level 7.0 g/dL in patients older than 65 years and patients with chronic cardiovascular or respiratory diseases justifies transfusion [177, 685].**

- **For stable patients with hemoglobin level between 7 and 10g/dL, the benefit of transfusion is unclear**
- **Transfusion is recommended for patients with acute blood loss more than 1,500 mL or 30% of blood volume.**
- **Evidence of rapid blood loss without immediate control warrants blood transfusion.**



# PROTOCOLLO TRASFUSIONALE




## EMOGLOBINA

- EC 1 U SE < 8 GR \DL



# PROTOCOLLO TRASFUSIONALE

## FIBRINOGENO

- $<70 \text{ MG/DL}$   PFC 15 ml/kg
- $>70 \text{ MG/DL} < 100$   PFC 12 ml/dl
- $>100 \text{ MG/DL}$   no PFC

# PROTOCOLLO TRASFUSIONALE

PTT > 1,6



50 MG PROTAMINA






PTT > 1,6



50 MG PROTAMINA

# PROTOCOLLO TRASFUSIONALE

- $INR < 1,29$   NO PFC
- $INR > 1,3 < 1,9$   PFC 8ML\KG
- $INR > 2$   PFC 12 ML\KG

# PROTOCOLLO TRASFUSIONALE

- PIATRINE

- <75000



PLT 10U

- >75000 <100000



PLT 5 U

- >100000



NO PLT

**Table 2. Risks of Blood Transfusion**

<b>Type</b>	<b>Occurrence in Red Blood Cell Units Transfused</b>
<b>Infectious</b>	
Human immunodeficiency virus	1 in 1.4–2.4 10 <sup>6</sup>
Hepatitis B	1 in 58,000–149,000
Hepatitis C	1 in 872,000–1.7 10 <sup>6</sup>
Bacterial infection	1 in 2,000
<b>Immunologic reactions</b>	
Febrile nonhemolytic transfusion reactions	1 in 100
Anaphylactic transfusion reactions	1 in 20,000–50,000
ABO mismatch	
Hemolysis	1 in 60,000
Death	1 in 600,000
Leukocyte-related target organ injury	1 in 20 to 1 in 50
Transfusion-related acute lung injury	1 in 2000
Post-transfusion purpura	Rare
<b>Transfusion services error</b>	
Donor screening error (malaria, <i>T cruzi</i> , babesioses, Creutzfeld-Jakob disease)	1 in 4 10 <sup>6</sup>
Transfusion services error	1 in 14,000

# Strategie di risparmio di sangue

- **Farmacologiche**

aprotinina (classe I)

analoghi della lisina (classe I)

eritropoietina (classe IIa)

- **Tecniche**

circuiti CEC eparinati

tipo di ossigenatore (membrana)

pompa centrifuga (classe IIb)

gestione della coagulazione eparinica (point of care hemostasis system)

dosaggio della protamina

cell saver

# Strategie di risparmio di sangue

## Chirurgiche

tecniche mini invasive

robotica

rivascolarizzazione off pump

mini CEC

priming autologo

bio colle (pz ad alto rischio)

- **ICU**

recupero di sangue dai drenaggi : solo nei sanguinamenti massivi

UF

point of care emocoagulativo (accuratezza e tempestività)

ossimetria anziché emogasanalisi

PEEP (classe IIb)



## ***. Summary of Recommendations for Perioperative Prophylactic Measures for Blood Conservation***

Ann Thorac Surg 2007;83:S27–86

<b>Recommendation</b>	<b>Level of Evidence</b>	<b>Class</b>
• Preoperative screening of the intrinsic coagulation system is not recommended unless there is a clinical history of bleeding diathesis.	<b>B</b>	<b>III</b>
• Screening preoperative bleeding time is not unreasonable for high-risk patients, especially those who receive preoperative antiplatelet drugs.	<b>B</b>	<b>IIb</b>
• Preoperative hematocrit and platelet count are indicated for risk prediction, and abnormalities in these variables are amenable to intervention.	<b>A</b>	<b>I</b>
• Devices aimed at obtaining direct hemostasis at catheterization access sites are not unreasonable for blood conservation if operation is planned within 24 hours.	<b>C</b>	<b>IIb</b>
• Alternatives to laboratory blood sampling (eg, oximetry instead of arterial blood gasses) are reasonable means of blood conservation before operation.	<b>C</b>	<b>IIa</b>
• A comprehensive, integrated, multimodality blood conservation program in the intensive care unit is a reasonable means to limit blood transfusion.	<b>B</b>	<b>IIa</b>

Off-pump coronary artery bypass (**OPCAB**) is a reasonable means of blood conservation, provided that emergent conversion to on-pump bypass is unlikely either based on surgeon experience or patient characteristics. (Level of evidence A) I

Routine use of **red-cell saving** is helpful for blood conservation in cardiac operations using cardiopulmonary bypass (CPB), except in patients with infection or malignancy. (Level of evidence A) I

All commercially available blood pumps provide acceptable blood conservation during CPB. It is not unreasonable to prefer **centrifugal pumps** because of perfusion safety features. (Level of evidence B) Iib

It is not unreasonable to use **low prime and minimized extracorporeal bypass** circuits to reduce the fall in hematocrit during CPB as part of a multimodality blood conservation program. (Level of evidence B) IIb

Alternatives to laboratory **blood sampling** (eg, oximetry instead of arterial blood gasses) are reasonable means of blood conservation before operation. (Level of evidence B) Ia

A comprehensive, integrated, **multimodality blood conservation program** in the intensive care unit is a reasonable means to limit blood transfusion. (Level of evidence B) IIa

With hemoglobin levels below 6 g/dL, red blood cell transfusion is reasonable, as this can be life-saving. Transfusion is reasonable in most postoperative patients whose hemoglobin is less than 7 **g/dL** but no high-level evidence supports this recommendation. (Level of evidence C) IIa

It is reasonable to transfuse non–red cell hemostatic blood products based on clinical evidence of bleeding and preferably guided by **point-of-care tests** that assess hemostatic function in a timely and accurate manner. (Level of evidence C) IIa

**Total quality management (TQM)**, including continuous measurement and analysis of blood conservation interventions as well as assessment of new blood conservation techniques, is reasonable to implement a complete blood conservation program. (Level of evidence B) II

**III 16 1 Leukoreduction may be helpful for other things besides blood conservation. Direct reinfusion of shed mediastinal blood from postoperative chest tube drainage is not recommended as a means of blood conservation and may cause harm.**

**(Level of evidence B)**

**III 16 1 May replace red cell mass in excessive bleeding.**

**Routine use of ultrafiltration during or immediately after CPB is not helpful for blood conservation in adult cardiac operations. (Level of evidence B)**

**III 15 2 May have small but significant effect.**

**Topical hemostatic agents that employ bovine thrombin are not helpful for blood conservation during CPB and may be potentially harmful. (Level of evidence B)**

**III 17 0**

**Preoperative screening of the intrinsic coagulation system is not recommended unless there is a clinical history of bleeding diathesis. (Level of evidence B)**

**III 16**

**1 Useful but low yield.**

**Given that the risk of transmission of known viral diseases with blood transfusion is currently rare, fears of viral disease transmission should not limit administration of INDICATED blood products. (This recommendation only applies to countries/ blood banks where careful blood screening exists.) (Level of evidence C)**

**Ila 15**

**2 Concerned that new  
viral or other infectious agents  
will change this recommendation.**

**S82 BLOOD TRANSFUSION/CONSERVATION IN CARDIAC SURGERY FERRARIS ET AL Ann Thorac Surg**

**STS AND SCA PRACTICE GUIDELINE 2007;83:S27–86**

# Pregressa terapia anticoagulante o antiaggregante

## anticoagulanti

- Antitrombinici
- LMWH
- Inibitori dei recettori ADP
- Inibitori delle glicoproteine piastriniche
- Attivatori del plasminogeno tissutale

## Antiaggreganti

- Thienopyridine
- aspirin