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

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Background. **Practice guidelines reflect published literature. Because of the ever changing literature base, it is necessary to update and revise guideline recommendations from time to time. The Society of Thoracic Surgeons recommends review and possible update of previously published guidelines at least every three years. This summary is an update of the blood conservation guideline published in 2007.**

Methods. **The search methods used in the current version differ compared to the previously published guideline. Literature searches were conducted using standardized MeSH terms from the National Library of Medicine PUBMED database list of search terms. The following terms comprised the standard baseline search terms for all topics and were connected with the logical 'OR' connector—Extracorporeal circulation (MeSH number E04.292), cardiovascular surgical procedures (MeSH number E04.100), and vascular diseases (MeSH number C14.907). Use of these broad search terms allowed specific topics to be added to the search with the logical 'AND' connector.**

Results. **In this 2011 guideline update, areas of major revision include: 1) management of dual anti-platelet therapy before operation, 2) use of drugs that augment red blood cell volume or limit blood loss, 3) use of blood derivatives including fresh frozen plasma, Factor XIII, leukoreduced red blood cells, platelet plasmapheresis,**

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*The International Consortium for Evidence Based Perfusion formally endorses these guidelines.

The Society of Thoracic Surgeons Clinical Practice Guidelines are intended to assist physicians and other health care providers in clinical decision-making by describing a range of generally acceptable approaches for the diagnosis, management, or prevention of specific diseases or conditions. These guidelines should not be considered inclusive of all proper methods of care or exclusive of other methods of care reasonably directed at obtaining the same results. Moreover, these guidelines are subject to change over time, without notice. The ultimate judgment regarding the care of a particular patient must be made by the physician in light of the individual circumstances presented by the patient.

For the full text of this and other STS Practice Guidelines, visit http://www.sts.org/resources-publications at the official STS Web site (www.sts.org).

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recombinant Factor VII, antithrombin III, and Factor IX concentrates, 4) changes in management of blood salvage, 5) use of minimally invasive procedures to limit perioperative bleeding and blood transfusion, 6) recommendations for blood conservation related to extracorporeal membrane oxygenation and cardiopulmonary perfusion, 7) use of topical hemostatic agents, and 8) new insights into the value of team interventions in blood management.

Conclusions. **Much has changed since the previously published 2007 STS blood management guidelines and this document contains new and revised recommendations.**

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1) Executive Summary

Introduction—Statement of the Problem

In the United States, surgical procedures account for transfusion of almost 15 million units of packed red blood cells (PRBC) every year. Despite intense interest in blood conservation and minimizing blood transfusion, the number of yearly transfusions is increasing [1]. At the same time, the blood donor pool is stable or slightly decreased [1, 2]. Donor blood is viewed as a scarce resource that is associated with increased cost of health care and significant risk to patients (http://www.hhs.gov/ophs/bloodsafety/2007nbcus_survey.pdf).

Perioperative bleeding requiring blood transfusion is common during cardiac operations, especially those procedures that require cardiopulmonary bypass (CPB). Cardiac operations consume as much as 10% to 15% of the nation's blood supply, and evidence suggests that this fraction is increasing, largely because of increasing complexity of cardiac surgical procedures. The majority of patients who have cardiac procedures using CPB have sufficient wound clotting after reversal of heparin and do not require transfusion. Nevertheless, CPB increases the need for blood transfusion compared with cardiac procedures done "off-pump" (OPCABG) [3]. Real-world experience based on a large sample of patients entered into The Society of Thoracic Surgeons Adult Cardiac Surgery Database suggests that 50% of patients undergoing cardiac procedures receive blood transfusion [4]. Complex cardiac operations like redo procedures, aortic operations, and implantation of ventricular assist devices require blood transfusion with much greater frequency [4–6]. Increasing evidence suggests that blood transfusion during cardiac procedures portends worse short- and long-term outcomes [7, 8]. Interventions aimed at reducing bleeding and blood transfusion during cardiac procedures are an increasingly important part of quality improvement and are likely to provide benefit to the increasingly complex cohort of patients undergoing these operations.

The Society of Thoracic Surgeons Workforce on Evidence Based Surgery provides recommendations for practicing thoracic surgeons based on available medical evidence. Part of the responsibility of the Workforce on Evidence Based Surgery is to continually monitor published literature and to periodically update recommendations when new information becomes available. This document represents the first revision of a guideline by the Workforce and deals with recent new information on blood conservation associated with cardiac operations. This revision contains new evidence that alters or adds to the 61 previous recommendations that appeared in the 2007 Guideline [9].

Abbreviations and Acronyms

ACS	= acute coronary syndrome
AT	= antithrombin
CABG	= coronary artery bypass graft surgery
CI	= confidence interval
CPB	= cardiopulmonary bypass
ECC	= extracorporeal circuit
ECMO	= extracorporeal membrane oxygenation
EPO	= erythropoietin
FDA	= Food and Drug Administration
FFP	= fresh-frozen plasma
ICU	= intensive care unit
MUF	= modified ultrafiltration
OPCABG	= off-pump coronary artery bypass graft surgery
PCC	= prothrombin complex concentrate
PRBC	= packed red blood cells
PRP	= platelet-rich plasma
r-FVIIa	= recombinant activated factor VII
RR	= relative risk
TEVAR	= thoracic endovascular aortic repair
VAVD	= vacuum-assisted venous drainage
ZBUF	= zero-balanced ultrafiltration

2) Methods Used to Survey Published Literature

The search methods used to survey the published literature changed in the current version compared with the previously published guideline. In the interest of transparency, literature searches were conducted using standardized MeSH terms from the National Library of Medicine PUBMED database list of search terms. The following terms comprised the standard baseline search terms for all topics and were connected with the logical "OR" connector: extracorporeal circulation (MeSH number E04.292 includes extracorporeal membrane oxygenation [ECMO], left heart bypass, hemofiltration, hemoperfusion, and cardiopulmonary bypass), cardiovascular surgical procedures (MeSH number E04.100 includes OPCABG, CABG, myocardial revascularization, all valve operations, and all other operations on the heart), and vascular diseases (MeSH number C14.907 includes dissections, aneurysms of all types including left ventricular aneurysms, and all vascular diseases). Use of

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