More on the Changing Indications for Transfusion of Blood and Blood Components during Anesthesia

In little more than the past decade the human immunodeficiency virus (HIV) was discovered; the association between acquired immune deficiency syndrome (AIDS) and transfusion was established; transfusion of blood and blood components was determined to be an exceedingly efficient method of the transmission of the virus. These discoveries resulted in a burgeoning concern about the safety of blood and blood components, with attention concentrated principally on defining and decreasing the risk associated with these biologics. In fact, concern regarding the safety of blood antedates the introduction of HIV into the blood supply. During the past 20 yr, the overall risk of transfusion-transmitted viral disease has been reduced by a number of factors, including: exclusion of paid donations, improved screening procedures of donors and testing for the presence of viral antigens and antibodies to viruses, expansion of donor education programs, request for self-deferral among high-risk populations, implementation of “look-back” procedures, and provisions for confidential self-deferral of donors. As a result, blood and blood components are safer than ever. Hepatitis C (previously included in the group of hepatitis viruses described as “non-A, non-B”), the agent most likely to result in post-transfusion disease, has a current incidence of transmission of less than 0.03% per unit of blood, compared to the approximate incidence of 3% per unit (10% per recipient) 20 yr ago. In the United States, the risk of transmission of HIV by transfusion is approximately 0.00015%-0.0002% per unit transfused. The risk of fatal hemolytic transfusion reaction is similar. Other risks include alloimmunization, effects on cellular immune function, bacterial contamination, and white cell-mediated acute pulmonary injury.

However, these data define only the numerator of a risk/benefit ratio that provides the clinician with the information needed to judge therapy. Data regarding the benefit(s) or efficacy of blood and blood components are largely lacking. Although approximately 12 million units of red blood cells are transfused per year in the United States, the efficacy of this biologic has not been demonstrated in an appropriately controlled, prospective study, nor are there clear criteria by which one would judge the efficacy of red blood cells. Indeed, the U.S. Food and Drug Administration (FDA) is having difficulty deciding how to judge the efficacy of the angiogenous oxygen-carrying solutions now in various stages of development. Nevertheless, concern within the medical profession, the media, and the political arena (e.g., note the recent formation of the high-level post of “blood safety director” within the U.S. Department of Health and Human Services) has resulted in a number of consensus conferences, and the promulgation of transfusion guidelines (described in various terms) by a number of professional organizations, in an effort to reduce the perceived overtransfusion of blood and blood components and, thus, potentially reduce the incidence of post-transfusion infectious complications. The National Institutes of Health (NIH) published the conclusions of three consensus conferences regarding the indications for transfusion of red blood cells, fresh-frozen plasma, and platelets. Several medical societies also have produced guidelines. One of these societies, the American College of Physicians (ACP), published an algorithm for transfusion of red blood cells, which included their criteria for transfusion of patients during anesthesia (development of unstable vital signs in patients without “risks”: e.g., for myocardial or cerebral ischemia).

Since most blood transfusions occur during surgery, the concern regarding transfusion is immediately relevant to the anesthesiologist. During anesthesia, physiology is altered, symptoms of inadequate oxygen delivery are absent, and signs may be difficult to interpret. These problems have led to the conventional wisdom...
that, whenever possible, inadequate oxygen delivery
should be prevented (in preference to allowing its cre-
ation followed by treatment). Recognizing these issues,
the American Society of Anesthesiologists in 1994 con-
vened a task force (of which the undersigned was a
member) comprised of representatives from societies
of specialties other than anesthesia to develop practice
guidelines for perioperative blood component therapy.
That document appears in this issue of the Journal. 21

Several points regarding these practice guidelines
merit comment. Most importantly, the guidelines are
just that; they are not a mandate. The task force rec-
ognized the lack of adequate data documenting efficacy
of these biologics and the threshold(s) that demand
therapy, the importance of biologic variation, the im-
pact of disease, and the dynamic nature of surgery.
The significance of these factors may be seen in several of
the panel’s recommendations. The panel recognized
such important practical issues as the rate and site of
bleeding, the anticipation of bleeding, and the rapidity
with which results of important laboratory tests are re-
ported. The panel regarded the ACP’s recommendations
for anesthetized patients as inappropriate, because the
ACP panel apparently did not consider these issues or
those that prompted the ASA to convene the task force
(see above). The practitioner will note that the ASA
task force recommended a range of thresholds above
which it is unlikely (but not necessarily unacceptable)
that transfusion of blood components would be re-
quired and below which it is likely (but similarly, not
with certainty) that they would be required. It is con-
ceivable that an anesthesiologist might rationally trans-
fuse (or not transfuse) outside these parameters.
The reasoning used by the task force should aid the reader
in understanding how the recommendations were
reached, and perhaps gauge when these recommenda-
tions might not apply. Practitioners choosing to ad-
minister (or not) these biologics outside the recom-
manded limits should document their decision-making
process.

The strength of this practice guideline is that it is an
"evidence-based" product: an extensive literature
search was conducted, and the strength of the conclu-
sions of the culled articles was carefully reviewed by
a multidisciplinary panel familiar with this literature
and the practice imperatives of the specialty. However,
the reader should also recognize omissions and limits
of this practice guideline as well as those of previously
published. This guideline did not address (1) the
transfusion threshold of the pediatric population; (2)

the use of autologous blood (a recent review by an NIH
expert panel22 served that purpose); (3) techniques,
such as controlled hypotension23 or hemodilution,24,25
that the anesthesiologist may employ in an effort to
decrease blood loss and the need for blood or com-
ponent therapy; (4) the special clinical circumstances
of liver transplantation or special hematologic disorders
(e.g., sickle cell anemia); and (5) when the use of
whole blood is appropriate.

Although the task force did not address sickle cell
anemia, data have been published recently regarding
preoperative transfusion of patients with this disease.
These data indicate that preoperative reduction of the
concentration of hemoglobin S to 30% (by exchange
or multiple transfusion) increases the incidence of
transfusion-related complications without altering the
incidence of other serious perioperative complica-
tions.26

The task force also did not address the use of whole
blood. Whole blood differs from packed red blood cells
importantly in that the latter contains far less plasma
and, thus, coagulation factors. Mathematical analysis
predicts that loss of greater than one blood volume and
its replacement by fluids with absent or greatly reduced
coagulation factors is required to reduce the circulating
factor concentrations to the level consistent with coa-
gulopathy (concentrations less than 30% of normal).
When that degree of blood loss is expected or achieved,
transfusion with whole blood, in preference to a com-
bination of packed red blood cells and fresh-frozen
plasma, reduces the number of donors to which the
recipient is exposed, thereby reducing the risks. Clin-
ical data support that, when whole blood is used to
replace massive blood loss, a coagulopathy does not
result from decreased coagulation factor concentra-
tion, and therefore, administration of fresh-frozen plasma,
in addition, is not efficacious.27 If a coagulopathy de-
velops, it is likely a result of thrombocytopenia, which
requires an even greater degree of blood loss and re-
placement.27,28 In contrast, the use of packed red blood
cells for replacement of massive blood loss produces
a coagulopathy secondary to coagulation factor defi-
ciency earlier than that produced by thrombocytopen-
ia.29

In addition, the risk of transfusion is not static. The
rates of transmitted diseases may change with their ep-
idemiology or improved detection technology. Other
diseases may emerge. The risks of other complications
of transfusion (e.g., transfusion reactions) have re-
mained relatively stable. The possibility of human error
prevents these risks from reaching zero.\textsuperscript{30} While it is appropriate to educate our patients regarding the risks of blood component therapy, we must guard against overconfidence in the greatly improved safety of the U.S. blood supply. The recent decision by the FDA to test donated blood for HIV antigen \$ at substantial cost (perhaps $60,000,000–100,000,000 per year) and against the recommendation of its own extramural Blood Products Advisory Committee (in 1989 and 1995), may detect approximately five to ten antigen-positive, antibody-negative units per year\textsuperscript{31,32} but may increase the number of infected units in the blood supply because of the possibility of attracting potentially infected donors who desire to avail themselves of this test, which is not available elsewhere ("magnet" effect), or by increasing human error of other tests because of the increased number of tests and workload.\textsuperscript{5,6,9,30–32} It is a sobering thought that the majority of noninfectious transfusion-related deaths result from nothing more complicated than ABO group red blood cell incompatibility,\textsuperscript{7} a substantial fraction of these errors occur in the operating room,\textsuperscript{7,33} and the operating room is the most common site of physician error producing a fatal hemolytic transfusion reaction.\textsuperscript{7} The relative freedom of professional judgment afforded by the ASA Task Force's guideline (compared to other guidelines) comes with an implied responsibility. Continued attention to this rapidly moving field is mandatory (the reader should note that the panel's recommendations are based on information available as of mid-1994): Not only are risks likely to change, but undoubtedly, additional data is forthcoming regarding efficacy of blood and its components that might alter the thresholds for their administration.

Richard B. Weiskopf, M.D.
Professor
Departments of Anesthesia and Physiology and Cardiovascular Research Institute
University of California, San Francisco
521 Parnassus Avenue, C450
San Francisco, California 94143-0648

References


18. Murphy MF, Brozovic B, Murphy W, Ouwheald W, Waters AH: Guidelines for platelet transfusions: British Committee for Stan-
EDITORIAL VIEWS


25. Weiskopf RB: Mathematical analysis of isovolemic hemodilution indicates that it can decrease the need for allogeneic blood transfusion. Transfusion 1995; 35:37–41

Anesthesiology, V 84, No 3, Mar 1996