

# Transfusion Solution

## A Team Approach to Blood Management in Open-Heart Surgery

### AT A GLANCE

Abington Memorial Hospital is a 665-bed, regional referral center and teaching hospital in Abington, PA, about six miles north of Philadelphia. Its Heart and Vascular Center includes four specialty centers, six cardiac catheterization laboratories, and a hybrid operating room. One of the specialty centers is the Porter Institute for Valvular Heart Disease, led by Rohinton J. Morris, MD, chief of cardiothoracic surgery. The cardiothoracic surgery team has performed more than 3,500 open-heart operations.

In 2010, Dr. Morris came to Abington from the Hospital of the University of Pennsylvania, arriving at about the same time as perfusionists from SpecialtyCare with whom Dr. Morris had worked previously. Each had implemented some best practices in blood management at other hospitals. At Abington, they saw an ideal opportunity to implement a comprehensive program. Use of blood and blood components was above national averages. Senior hospital leadership trusted Dr. Morris' skills and acumen. With buy-in from fellow cardiothoracic surgeon Mauricio J. Garrido, MD, Dr. Morris pursued a team approach, with anesthesiologists, perfusionists, and critical care nurses asked to play key roles.

The project included changes to the equipment used on the heart-lung machine (the device used to support the patient's cardiovascular function during open-heart surgery). These changes were designed to minimize the need for blood transfusions and reduce post-surgical complications, shortening lengths of stay, and improving patient outcomes. The protocol changes were designed to ensure that patients are not hemodiluted; a condition occurring when the fluid content of the blood increases, lowering the concentration of red blood cells, and clotting proteins.

Regular Friday meetings disseminated information to the team insuring open communication among the key participants. The blood management program and changes to protocols were discussed with these key team members including surgeons, operating room nurses, ICU nurses, cardiologists, anesthesia, and perfusion. "It was one of the most significant communications enhancements that was made; it permitted changes to be implemented smoothly and effectively," said Charles Yarnall, national clinical specialist with SpecialtyCare and a key member of the perfusion team at Abington.

"What we have done is implement best practices in blood management, but these are not common practices," Dr. Morris said. "They require teamwork and every member of the team to work a bit harder. Perfusionists, anesthesiologists, and first assistants need to be actively working to prevent the need for transfusion."

The results of the work at Abington are notable from both a quality of care and financial perspective, one of many smaller victories in the effort to improve the delivery of healthcare in the age of reform.

Comparing the first nine months of 2010 with the same period in 2012:

- The average rate of transfusion decreased by 22%
- Average amount of red blood cells transfused per case decreased by .98 units
- There was an average per-case reduction of \$3,500 cost for blood and blood component use; annualized savings of \$1.05 million
- The average post-operative length of hospital stay decreased by .61 days

Furthermore, the relationships between red blood cell (RBC) units and patient outcome variables were examined.

The findings showed that as fewer RBC units were transfused:

- Hours on the ventilator decreased
- Incidence of acute kidney injury decreased
- Post-operative length of stay decreased

Moreover, the usage of platelets and plasma also decreased.

### Statistically Significant Findings Open-Heart Surgery

As RBC usage went down, so did the patients' number of post-operative hours on the ventilator.

As RBC usage went down, the incidence of acute kidney injury decreased.

As RBC usage went down, so did the usage of Platelets Units.

As RBC usage went down, so did the usage of Plasma Units.

As RBC usage went down, so did the patient's post-operative length of stay.

## THE BACK STORY

When the team arrived at Abington, it found that use of blood and blood components surrounding open-heart surgery was above national averages. There was a wealth of evidence that better quality control on blood administration leads to faster patient recovery and improved outcomes; the protocols to achieve that control were not in place.

Exposing blood to the surfaces within the heart-lung machine provokes an inflammatory response that can damage red blood cells. The patient can dilute and lose fluid from blood vessels to tissue and outside the body. To reduce intravascular depletion, the patient receives additional volume at the risk of hemodilution.

Furthermore, the heart-lung pump must be primed with an isotonic crystalloid solution. Essentially, this solution maintains sufficient blood volume between the machine and the patient for survival during surgery. The downside is that this fluid also dilutes the patient's blood, often to the point where needed blood components, including clot-forming proteins, are ineffective, resulting in excessive patient bleeding which can cause the patient to become acutely anemic.

By minimizing the size of the circuit to which the blood is exposed, the need for allogeneic blood transfusions (donor blood) is reduced.

Research over the past few years by Colleen Koch, MD, cardiac anesthesiologist at Cleveland Clinic, and colleagues has helped raise concern about the overuse of transfusions. A large study published in *Critical Care Medicine* in 2006 and based on more than 10,000 coronary artery bypass operations at the Clinic found significantly higher rates of death, kidney failure, heart attacks, surgical-incision infections, postoperative bleeding, significantly longer stay in the hospital, and other complications among transfused patients compared with those who did not receive blood product transfusions.

Administering banked donor blood is equivalent to a liquid organ transplant. Through that "transplant," the recipient's own immune system is altered for a period of time. In addition, 60 or more human interactions must occur for a patient to receive a unit of blood. The human events begin from the moment that blood is collected from a donor or that a patient has his or her blood drawn for blood typing until it is infused into a recipient. Human error can include mislabeling, contamination, using the wrong unit, or confusing one patient's blood sample with another patient's sample.

"Across the country, the lay public is certainly becoming more aware of the dangers of receiving a blood transfusion,"

said Timothy A. Dickinson, MS, director of clinical performance improvement at SpecialtyCare. "It is becoming more common for surgical teams to minimize bleeding and preserve patients' red blood cell mass, so their chances of getting an allogeneic transfusion are minimized."

## THE PUMP AS ALLY

Mark Napoli, chief perfusionist at Abington, said the project was aided by a shared history on the team. "Charles (Yarnall) and I both worked and trained with Dr. Morris in the past. Throughout the years, we have instituted many of these techniques. So when Charles and I and Dr. Morris hit the door, so to speak, about two years ago, we saw a tremendous opportunity to employ best practices at Abington, and as a result, save a lot of blood products."

"Heart surgery is dangerous, mainly because of the risks associated with the heart-lung pump," Dr. Morris said. "I and some of my colleagues felt that instead of treating the pump as our nemesis, why not use it to actually help get the patient back from surgery looking like he did before surgery, instead of looking 20 pounds heavier? Why have the patient take a week to recover from being hooked up to the pump? If I treat the pump as a methodology that reduces the amount of fluid given and decreases hemodilution factors, we are doing the right thing. Patients are going home two to three days earlier looking more normal."

The heart-lung machine carries blood from the right atrium of the heart to a main reservoir called a cardiotomy and then through an oxygenator (this is termed cardiopulmonary bypass). Oxygen diffuses from the gas phase through the gas-filled membrane pores into the blood. The now oxygen-rich blood cells then travel to the arterial filter. This filters the blood down to 29 microns, removing any hazards before the blood travels through a plastic tube back to the patient's aorta, the main blood conduit of the body.

The technical changes to the heart-lung machine undertaken at Abington included raising the oxygenator and cardiotomy to the level of the patient, thus reducing the length of the circuit through which blood had to follow. The team then began using vacuum assist instead of gravity to bring blood more quickly from the patient, reducing time that the blood spends in the tubing.

A hemoconcentrator, akin to an artificial kidney, was added to the tubing circuit. This device removes plasma water – the fluid that separates red blood cells, platelets, and clotting factors – so the team could retain a higher concentration of those products during the bypass period.

With less crystalloid volume coursing through their bodies, patients are bleeding less at the surgical site and through chest tubes.

Once the patient comes off bypass, a key intervention is initiated by the perfusionist. The remainder of the volume left in the circuit is ultrafiltrated, placed in a transfer bag and transferred to the anesthesiologist, who then returns to the patient all of his or her own blood components through a post-op transfusion.

Another goal of the project was to reduce use of the cell processor, a device that takes blood lost from the surgical field, runs it through a centrifuge and washes and separates red blood cells from plasma, which must be discarded. The remaining red blood cells may be returned during or post-bypass to the patient, but plasma proteins that are essential to clotting are absent; therefore, the transfusion adds red blood cell volume at the risk of edema.

Initially, there was pushback from cardiologists, who would see readings of anemia in post-op tests and see an immediate need for transfusions. In short, this is often a “false anemia”; the patients actually have sufficient stores of essential blood components. “It took them seeing the results over a period of time so they knew the anemia was not physiologically significant and that patients recovered (hemoglobin) quickly without the need for transfusions,” Dr. Morris said.

Another important factor in ensuring that only truly necessary transfusions occurred was a change that Dr. Morris and Dr. Garrido made to post-operative protocol; the patient would stay under the cardiac surgeon’s care for the first couple of days post-surgery, said John Lanzidelle, region president for SpecialtyCare’s Greater Delaware Valley Region. “That keeps blood management and usage under the direction of the surgeons in a critical period,” he said.

The techniques succeeded in reducing lengths of stay based on time spent on the ventilator, a measure of recovery time needed. The team also saw a drop in the time spent in the cardiac care unit, where the nurse-to-patient ratio is 1:1. Duration spent in the next level of care, the step-down unit, was also reduced. “We initiated this project to improve patient care, and were simultaneously realistic in understanding that care is being delivered within the context of the changing economic and political healthcare environment. We need to save on costs, too,” Dr. Morris says.

## A SENSE OF TEAM

Lanzidelle thinks the most important element of the blood management project is the teamwork involved from the operating room to the ICU to cardiac care and patient room.

“Before, there were no guidelines followed; people just did what they did, without any realization of the consequences of what they were doing. In the OR, they may not give blood, but in the ICU, a physician would walk in, see test results and order blood.”

The teamwork is reinforced in the Friday meetings and patient rounds later the same day. All nurses, anesthesiologists, and perfusionists participate. “Here at Abington, perfusionists are involved in patient rounds, where we discuss all aspects of surgical and post-surgical care at the bedside,” Yarnall says. “The surgeon takes at least 5-10 minutes on each patient to describe the history, what was done, what could have been done, why we see what we see now and the rate of recovery of a patient.” The communication continues in the operating room. “Everyone in the room is encouraged to speak up when they see something. This is unusual in my experience, and enormously valuable,” Napoli says.

Dr. Morris sees a philosophical divide in organizational attitudes in healthcare. At many hospitals, nurses, perfusionists, and physicians provide cardiothoracic surgery services, but there is no sense of being part of a surgical team. “Here at Abington, somebody can come up with a suggestion as part of the team, and I just can’t ignore it. I have to give a valid reason why it will or will not be pursued. I find the ideas we have from staff at the bedside tremendous.”

One example is an idea that came from a perfusionist. A patient had been placed on ECMO (extracorporeal membrane oxygenation), which is a rescue tool used when a patient cannot oxygenate and circulate their own blood. “The perfusionist asked whether we should try using cerebral oximetry on both the head and the lower extremities so we could ascertain whether there were any disparities in perfusion,” Dr. Morris said. “It turns out there were, so we put another cannula into the patient’s neck, and the disparity disappeared. This was just a great idea; as far as I can tell, it had never been written up anywhere. Because it came from a member of a team, not just a service provider, the suggestion was taken seriously, we followed it and it worked.”

In particular, Dr. Morris sees Napoli and Yarnall, his SpecialtyCare perfusionists, as critical members of the team. “The reason these clinicians are invaluable to me is that instead of simply saying, ‘this is what I do every day,’ and just showing up to do a job, they really think about what they are doing and ask questions. These clinicians exemplify teamwork. I have worked with many perfusionists who are very good at pumping the case. These clinicians want to do more; they want to affect outcomes.”

 **Abington Memorial Hospital**

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