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AmSECTOMORROW

Unique Bypass Techniques

BY: ISABELLE TEASEL, NKU (Editor in Chief)

Hyperthermic Intraperitoneal Chemotherapy (HIPEC)

Hyperthermic intraperitoneal chemotherapy is the practice of cancer treatment of the abdomen cavity utilizing heated chemotherapy drugs such as cisplatin or mitomycin. The larger, visible tumors are removed followed by the chemotherapy drug and saline being pumped into the abdomen. The temperature will reach 42 degrees Celsius, so the patient will be laying on a cooling blanket. The surgeon will rock the abdomen back and forth for the selected amount of time (i.e., 60 minutes, 90 minutes, or 120 minutes) in an effort to remove the remaining cancer cells. This method can be performed to reduce the number of cancer treatments to only one intense dose. The chemotherapy medication will stay in the abdomen 90% of the time, which minimizes the systemic toxicity.

Isolated Limb Perfusion

Isolated Limb Perfusion is utilized to reach high chemotherapy drug concentration within the selected limb with cancer that is unable to be resected. This method also minimizes systemic toxicity. The limb circulation is limited to the selected limb and circulated via extracorporeal systems. The high temperature chemotherapy medications such as TNF or melphalan via perfusion circuit once both the whole limb and tumor site are the same temperature usually around 41.5 degrees Celsius. Doses are divided into three parts with 5 minutes between each. Perfusion time is 60 minutes after medication is initiated into the circuit. Drug leakage is important to minimize toxicity and maximize its concentration to the tumor. Femoral cannulation and iliac vessels are isolated.

Hyperthermic Isolated Limb Perfusion

Hyperthermic isolated limb perfusion can be modified as an effective treatment for end-stage tissue sarcoma (i.e., carcinoma of the right leg). Melphalan and TNF-alpha are the most common chemotherapy medications for these conditions due to their high efficacy. Conditions such as this would not be treated by HIPEC, since that technique is used for abdomen-focused cancers and peritoneal malignancies. Chemotherapy medications of HIPEC will not spread outside of the abdomen which is one of the pros. Similarly, chemotherapy with isolated limb perfusion should be expected to stay within the designated limb.

Veno-Venous Bypass and Liver Transplants

Liver transplants allow up to 12 hours of donor ischemic time until morbidity and mortality increase. The method of transplant techniques should be discussed with the surgical team.

One of the various techniques involves the re-sectioning of the recipient's IVC along with portal vein clamping and end-to-end cavo-caval anastomosis. When the IVC is cross-clamped, hemodynamic instability may arise and lead to excessive bleeding, extreme hypotension, FHF, poor cardiac and renal function, instability post-cross-clamp, and intestinal congestion. Veno-Veno bypass may be required to maintain proper hemodynamic stability and organ perfusion for improved survival. It can also attempt to reduce the amount of blood transfusion and provide a longer anhepatic phase. The only absolute contraindication for veno-veno bypass is acute Budd-Chiari syndrome. However, the surgical team must consider worsened ischemic reperfusion injury, complications, vascular issues, and IVC malignancies before deciding on the utilized technique. For example, the ischemic time must be reduced. Additionally, cell savers are normally used due to the excessive bleeding from the liver. However, if the patient has cancer, cell saver utilization is contraindicated. The patient will not receive their own blood cells. Patients will be given large amounts of donor RBCs through a Belmont rapid infuser for faster transfusion.

AngioVac

Certain patients may not be candidates for surgical embolectomy, so they may be opted into a vacuum assisted thrombectomy such as the AngioVac with veno-venous extracorporeal bypass. These patients can present with soft endovascular or intracardiac thrombi or emboli such as pulmonary embolism. Perfusionists must collect the required AngioVac aspiration system, sterile circuit disposals, and cannulas. Components can include circuit tubing, clamps, scissors, T-connection, centrifugal pump, waste line tubing, prime line, priming fluid bag, AngioVac Collection system, reinfusion cannula, and bubble trap. The 22Fr coil-reinforced, expandable ballon-actuated cannula is used for venous drainage and removal of soft thrombi. The distal, funnel shaped tip is used to improve venous drainage, prevent clotting of the cannula, and control thrombi removal. The AngioVac circuit can be used for up to 6 hours of bypass. The perfusionist must also maintain adequate anticoagulation and measure it with proper equipment.

SPECIAL CONSIDERATIONS IN PERFUSION: JEHOVAH'S WITNESS PATIENTS
BY: LANETTE CHOI, RUSH

Jehovah's Witness (JW) patients refuse transfusion of whole blood and its primary components (red blood cells, plasma, platelets) based on their religious doctrine. Some JW patients may accept extracorporeal circulation if it maintains continuous connection with their circulation; therefore, they present unique challenges in cardiopulmonary bypass (CPB). As JW patients have increased risk due to limited physiologic margin for blood loss, current CPB practices emphasize minimizing stress, blood loss, and hemodilution. Guiding principles can include:

- Respect for patient autonomy
- Strict adherence to documented consent
- Maintenance of a continuous blood circuit whenever possible
- Exhaustive use of blood-sparing strategies

Preoperative Considerations

Acceptance of certain blood components or techniques vary significantly between Jehovah's Witness patients, therefore meticulous discussion and planning between the patient, perfusionist, and surgical team are essential prior to surgery. Preoperatively, hemoglobin can be optimized via erythropoietin and iron therapy, which has shown to increase mean hemoglobin levels by 2.0g/dL in treated patients. Erythropoietin therapy is a common preoperative treatment that approximately a third of JW patients receive. The target level of hemoglobin varies between providers and institutions, but commonly hemoglobin levels are above 14g/dL before being taken into surgery.

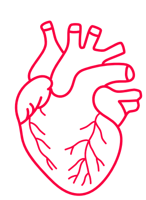
Intraoperative Strategies

Perfusionists must minimize CPB prime to reduce hemodilution. Prime can be adapted to include glucose or other colloids to assist fluid management by maintaining intravascular volume and raising osmotic pressure. There are a variety of surgical techniques which promote meticulous hemostasis for JW patients. Antifibrinolytics such as tranexamic acid or aprotinin can substantially reduce perioperative blood loss via inhibition of fibrin breakdown. Depending on provider and feasibility, off-pump coronary artery bypass (OPCAB) can reduce hematocrit decrease by approximately 25% compared to on-pump procedures (25±9% vs. 33±6%, $p=0.01$) by completely avoiding effects of prime hemodilution. Additionally in OPCAB, the patient's blood is not exposed to the pump nor artificial surfaces, which reduces blood trauma and activation of blood elements. If OPCAB is not an option for JW patients, vigorous cell salvage has also been beneficial by conserving 474±101 mL of autologous blood. Additionally, reinfusing autologous blood from blood in the field ensures that no allogenic blood products enter the circuit. In the scenario where the patient requires more volume replacement, lactate ringers and hydroxyethyl starch can be utilized as synthetic plasma substitutes.[3] Given that CPB is intrinsically a high-bleeding risk, vigorous blood conversation strategies and monitoring of hematocrit are imperative to optimize surgery for JW patients.

Postoperative Management and Outcomes

Often, postoperative management includes the same therapies utilized preoperatively. This includes continued erythropoietin and iron supplementation, as well as minimizing laboratory phlebotomy, and ongoing cell salvage from chest tube drainage.[1,2] Therapies are centered around decreasing the risk for bleeding and anemia. Prior studies have demonstrated reduced morbidity and mortality when strict blood management protocols are followed versus controls. Postoperative therapies are especially important in JW patients because without the option of transfusion, management has to focus on preventing further blood loss and promoting native erythropoiesis to preserve tissue perfusion. Although perfusionists do not primarily monitor JW patients postoperatively, it is important to understand the effects of prior blood conservation efforts and therapies administered during bypass.

In conclusion, JW patients undergoing CPB require meticulous planning and attention to blood conservation. Long-term survival can be equivalent to non-JW patients when perfusionists and other clinicians apply multimodal blood conservation strategies. Ultimately, the care of JW patients needs to be centered around best practices in patient-centered techniques and therapies.



Open thoracoabdominal aortic aneurysm (TAAA) repair
BY: CHANDRA DUDLEY, USC

Open thoracoabdominal aortic aneurysm (TAAA) repair is a complex procedure involving progressive aortic cross-clamping, putting the spinal cord and distal organs at risk for ischemia. The standard approach uses the beating heart to perfuse the upper body and extracorporeal circulation to perfuse the lower body distal to the clamp.

Since TAAA repair is highly dynamic, meticulous monitoring is essential. NIRS and neuromonitoring can detect early ischemia. Volatile anesthetic gas can suppress motor evoked potentials (MEPs), so perfusionists should coordinate with anesthesia and neuromonitoring teams to minimize interference. Arterial pressure should be monitored in the upper and lower body to assess perfusion on either side of the clamp; femoral pressure is typically maintained above 60mmHg while radial pressure may reach 80-100mmHg.

Common perfusion strategies for TAAA repair are left-heart bypass (LHB) and standard CPB. In LHB, a closed circuit drains the left atrium and reinfuses blood into the distal aorta or femoral artery. ACT and heparinization targets are relatively low because no oxygenator is used. Because the left heart is being drained, increased flow shifts volume to the lower body, decreasing upper body pressure, whereas decreased flow increases upper body pressure. This cannulation strategy may also be used with a full circuit and full heparinization.

Standard CPB for TAAA repair typically uses femoral cannulation, with venous drainage from the right atrium and reinfusion in the femoral artery via a full circuit. Reservoir volume should remain stable, using transfusion or autotransfusion as needed. If the upper body MAP falls, the venous line can be partially clamped to fill the heart. Decreasing the clamp increases drainage and decreases upper body MAP. Simultaneously low upper and lower body MAPs suggest a global need for additional volume in both LHB and CPB.

Several protective techniques further reduce ischemic risk. Lumbar CSF drainage improves spinal cord perfusion pressure. Cold blood, crystalloid, or enriched solutions such as Custodiol HTK delivered through the cardioplegia circuit can protect the kidneys. Additional strategies include passive warm blood perfusion of the abdominal organs and VAVD to improve drainage through femoral cannulae.

FUNtan Physiology
BY: Anne Phillips, UNMC

The Fontan procedure is the final operation in a series of palliative interventions for a single ventricle congenital defect (preceded by the Norwood and Glenn procedures). This operation redirects nearly all venous blood from the heart to the pulmonary circulation by anastomosing the IVC to the RPA. This means that the venous blood circulates through the lungs without ventricular support. Because the pulmonary circulation is passive, this patient population is incredibly sensitive to pulmonary vascular resistance (PVR) and preload. Should the patient experience an acute rise in PVR, the systemic venous blood will be unable to overcome the pressure in the lungs, and there will be no preload for the single ventricle to pump, directly impacting cardiac output (CO).

Some key considerations for a perfusionist caring for a patient with Fontan physiology are venous drainage, hemodilution, and coagulopathy. These patients present with elevated central venous pressures and venous congestion due to the passive return of blood to the lungs. Adequate venous drainage is paramount in ensuring that any damage to organs (specifically the liver) from congestion is not exacerbated and in ensuring that hemodynamics remain stable. As these patients rely heavily on passive blood return to the lungs as their source of preload, they must have sufficient hemoglobin levels to support oxygen delivery (as the body cannot augment CO as effectively as in normal biventricular physiology), so special attention to hemodilution is required. Finally, venous congestion can lead to liver damage, and the liver is responsible for producing most coagulation factors. It is important to be aware of this, as it can complicate anticoagulation management and the return to hemostasis after bypass.

PEDIATRIC PALOOZA: Neonates with Congenital Diaphragmatic Hernia and the Need for VA ECMO

BY: Lauren Dudeck, SUNY

Congenital diaphragmatic hernia (CDH) is a common congenital anomaly, affecting 1 in every 2,500-3,000 live births. CDH occurs when the diaphragm does not close properly during fetal development, allowing abdominal organs, like the stomach, intestine, and liver, to transpose into the chest. The abdominal organs compress the heart and lungs, preventing the lung(s) from developing normally. Fetuses with CDH are born with pulmonary hypoplasia and underdeveloped blood vessels in that lung, which can lead to pulmonary hypertension. CDH can occur on the left, right, or both sides of the diaphragm. Nearly 83% of neonates with CDH have a left-sided CDH.

After delivery, these newborns are immediately taken for stabilization and/or resuscitation. They are intubated to assist with breathing, and an NG or OG tube will be placed to compress the stomach to give the lungs room to expand. When neonates become unstable, VA ECMO is initiated within the first day of life to allow the heart and lungs to rest by oxygenating the blood and removing carbon dioxide. These newborns are cannulated in the neck, with the venous cannula inserted into the right internal jugular vein and the arterial cannula inserted into the right common carotid artery. During this time, the newborn undergoes a CDH repair procedure. The type of repair performed depends on the size of the hole and the patient's anatomy.

Typically, ECMO runs last for 14 days, but can go longer depending on the how the patient's recovery is proceeding. To wean off ECMO, various factors must be considered, including the patient's pulmonary hypertension severity, ventilator requirements, pharmacologic requirements, and volume status. Several trial weans may occur before the patient is successfully weaned off ECMO to assess the patient's stability off ECMO; key factors to look for include ventilator settings, pulse pressure, and inotrope requirements. Once patient can be fully weaned from ECMO, the patient will be decannulated and continue recovery in the ICU until they are ready to be discharged.

THE BILATERAL, BIDIRECTIONAL GLENN
BY: Graham Downing, Lipscomb

The Bidirectional Glenn repair is a common second-stage approach to the management and palliation of patients with complex cardiac anatomy that results in single-ventricle physiology. Typically performed between 4-6 months of age, this procedure can be safely performed off-pump; however, in situations with more complex anatomy or additional procedures, CPB will be utilized.

In this case, the patient is a 6.4kg 6-month-old female with hypoplastic left heart syndrome, dextrocardia, and bilateral superior vena cava. The planned procedure is the takedown of the current BTT shunt and placement of bilateral, bidirectional Glenn anastomoses with enlargement of the atrial septal defect for improved communication.

The typical cannulation style for the Glenn procedure is bicaval utilizing a single aortic cannula; however, this is complicated by the presence of a second right-sided SVC. Of note, the right-sided SVC is slightly too small for direct cannulation and will require direct atrial cannulation with a 10fr right-angle in addition to the bicaval approach. This complicates the procedure, as a significant portion of the venous drainage will be lost upon opening the atrium for septal manipulation, necessitating the use of a partial sucker bypass.

Direct communication between the surgeon and perfusionist was a key component of this case. Announcing each cannula as it was placed allowed the perfusionist to assess drainage at each stage and thus plan accordingly for the drainage that would be lost with the opening of the atrium. With cannulas placed and multiple sucker lines prepared, the right atrium was opened and, as expected, drainage dropped by half. Efficient communication of status to the surgeon by the perfusionist allowed positioning of sucker tips in the chest to augment the lost drainage. Pump flows were adjusted and maintained as able during sucker bypass, within ~10% of full at any given time during the 18 minutes the atrium was open. With the atrium closed, the procedure was completed without further concern, and the patient was successfully weaned from bypass, with a cross-clamp time of 56 minutes and a total bypass time of 102 minutes.

Goofs & Blunders
We've all been there!

"Spiked the heparin bag instead of the wash saline bag for the cell saver, oops!"

"I said, 'that's 30 minutes on cardioplegia'... the cross-clamp was off."

SUBMISSIONS FROM AMSECT STUDENTS

Before You Go!

The AmSECT Student Council exists to promote student involvement within AmSECT. While our current members hail from over 19 different programs, our goal is to have every perfusion program in the country represented on the council. Our major projects include an annual fundraising event, the perfusion bowl, and this very newsletter, with multiple opportunities for student leadership!

Our current officer team consists of a president/chief student liaison, vice president, fundraising project lead, communications coordinator, and newsletter editor, pre-perfusion coordinator, events, and perfusion bowl coordinator. The Student Council meets monthly via Zoom for one hour, so the time commitment is designed to be manageable! Don't forget to sign up to come to the annual AmSECT Conference in the spring! It's a great way to network and see the student council in action.

INTERESTED IN JOINING THE STUDENT COUNCIL?

PLEASE EMAIL AMSECTSTUDENTHQ@GMAIL.COM AND BE SURE TO INCLUDE YOUR CONTACT INFORMATION. SHARE YOUR VOICE, DEVELOP YOUR NETWORKING AND LEADERSHIP SKILLS, AND BECOME INVESTED IN THE PROFESSIONAL DEVELOPMENT OF OUR FIELD! WE LOOK FORWARD TO SEEING YOU JOIN OUR TEAM.

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