Autologous blood transfusion (autotransfusion, ABT) means the return of a patient's own shed blood back to circulation, whether lost or removed. Homologous blood transfusion is blood from one individual of the same species but separate donor and recipient individuals; also called allogenic transfusion. Xenotransfusion is transfusion of blood from one species to another.

The first documented case of ABT was by Dr. Blundell in 1818; he salvaged blood from blood-soaked gauze rinsed with saline for a postpartum patient. Transfusions (particularly ABTs) have only been reported sporadically until the 1940s, although there are sporadic cases reported through the early 1900s, it was not until the second world war that there was large, organized use of allogenic transfusions. The Russians and Americans were among the first to demonstrate and organize successful blood banking techniques as the war had placed a large amount of stress on blood banks, making people search for alternatives.

Modern reports of ABT first started coming out in the 1960s, and took off a little bit during the 1980s. This occurred for several reasons: there was a new disease at the time called human immunodeficiency virus that made physicians and patients quite worried about received blood transfusions and at the same time advanced in medical and surgical procedures (Cardiopulmonary bypass, dialysis, etc.) as well as survival from disease placed a higher stress on blood banks. In the 1950s and 1960s, several physicians (Dryer, Kelbanoff, Wilson and Taswell) developed machines that could process (suction, wash and separate) red blood cells from surgical fields and make them available for ABT. Since then, several commercial machines have been developed that can perform these operations for cell salvage. Typically, however these machines are only used in human facilities due to their expense. There are several large veterinary facilities in the USA (mostly universities) that do have these machines for use, but are not typically widely available.

There are many advantages and several (mostly theoretical) disadvantages of ABT. On the positive side, use of ABT delivers RBC and other blood proteins that are not foreign to the patient; this eliminates the time and resources necessary to perform a cross match prior and decreases the risk of acute or delayed reactions secondary to immunostimulation. There is no worry for transmission of non-autologous diseases (such as FeLV, FIV, hepatitis, Babesia, etc.). In addition, the blood is often readily available (as it pools in the thoracic or abdominal cavity) for many of the veterinary patients (trauma, GDVs, coagulopathies, etc.). This can be particularly useful when blood products are either not available or when blood bank products or donor resources are exhausted. Other advantages of ABT: the blood is often already at body temperature, which may help prevent further hypocoagulation associated with hypothermia; collecting the blood for an ABT can even be easier than collecting blood from a donor, such as with an abdominal or thoraco centesis or surgical suction; and there is minimal equipment necessary to collect ABT. ABT blood collected has some positive cellular aspects as well: the cells have higher levels of 2,3 DPG compared to stored blood, making their ability to on and offload oxygen better than banked RBCs, the cells are functionally
superior compared to stored blood as well: they are more deformable, have active transport mechanisms, the pH of ABT is more normal, the potassium level is lower, and the cells may have a longer lifespan. There are other advantages as well, with rising costs associated with purchasing blood or having a donor program, ABT is relatively inexpensive (at our hospital, depending on the volume given, may be several hundreds or thousands of dollars less expensive, depending on the volume required).

Potential **disadvantages** may include hemolysis, emboli and blood that is depleted of platelets and coagulation factors. Hemolysis, which occurs due to the shearing stresses experienced by the cells as they are aspirated may potentially lead to pigment nephropathy. Although hemolysis has been demonstrated in people and dogs receiving blood transfusion, it typically resolves quickly; reports of transient increases in creatinine has been reported, but no permanent renal damage has been demonstrated. ABT is depleted of platelets (as is stored blood), as well as clotting factors and fibrinogen. In stable patients that have received ABT, there are reported elevations of PT/aPTT, which typically normalize within 3 days. If large volumes of ABT are given (>50-75% of the total blood volume), the author does recommend additional fresh frozen plasma to be administered. There are risks of emboli of fat, protein, cell aggregates, etc., however if a filter is used (which is always recommended), this risk is minimal; there are few reports of emboli causing a clinical problem. Blood that has been sitting in a cavity for more than 24 hours old should not be used, as it contains a large number of microaggregates, is associated with a higher incidence of coagulopathies and can be severely hemolyzed.

When a **massive transfusion** is administered (this is more than one blood volume in 12 hours or acute administration of ½ of the total blood volume), one must be aware of common complications, whether the blood is autologous or banked. Reported complications of massive transfusion include thrombocytopenia, hypocoagulation (due to consumption of coagulation factors), reduced deformability of the cells, altered electrolytes (low calcium), acute lung injury and facial edema. In particular, when large volumes of blood with anticoagulant (citrate) are used, one should monitor for hypocalcemia and treat as needed.

There is some argument that ABT may be associated with fewer complications compared to banked blood. Two “hot topics” in (human) critical care includes transfusion associated immunomodulation (TRIM) and transfusion related acute lung injury (TRALI). TRALI is an inflammatory condition of the lung that often results in need for ventilation and occurs in human medicine quite frequently (several cases per thousand transfusions) and is an important morbidity associated with transfusions; there is only one case report in veterinary medicine. TRIM is a long-term complication associated with transfusions which results in immunomodulation or immunosuppression that makes people more susceptible to infections – this is not a phenomenon that has been investigated in veterinary patients. It is very interesting how very dangerous homologous (banked) blood transfusions can be. In human medicine, regardless of how sick patients are (APACHE II matched cohort studies), receiving a transfusion will increase your morbidity and mortality. The same information is not known for ABTs, but warrants investigation.

**Use of autologous blood** transfusion is most common in cases of hemorrhage associated with trauma (lacerated large vessels, spleen or liver), gastric dilation and volvulus (GDV), ruptured masses in the abdomen or thorax, prolonged, complicated or lengthy surgery, coagulopathies and obstetrics (such as uterine torsion). There are two areas in particular that give physicians and veterinarians concern about ABT: disseminated neoplasia and
contamination of the blood. However, even when associated with neoplasia or GI contamination, if the alternative is exanguination and death, ABT is generally considered acceptable therapeutic option.

When the literature is examined, there is little evidence to support complications associated with ABT even with gross GI contamination or obvious neoplasia. At least 7 studies in humans varying from 18 to 120 patients each undergoing surgery for a variety of neoplastic conditions (pulmonary, liver, genitorurinary, colorectal) have received autologous blood, and overall, there has not been found to be significant changes in overall survival nor evidence of increased metastatic disease. In fact one study found DECREASED complications (TRIM) associated with ABT and another found DECREASED tumor recurrence with ABT use. To date, there is no report that has demonstrated an increase of metastatic disease or a decreased patient survival despite ABT being 'contaminated' with viable neoplastic cells. Unfortunately, there is no data pertaining to the most common malignancies seen in veterinary medicine (hemangiosarcoma and hepatocellular carcinoma).

There are multiple reports of ABT being given with gross GI contamination. There is evidence to say that blood cultures are positive shortly after ABT infusion, however these are negative within 24 hours. An interesting experimental study was performed in dogs in 1978, when ABT was administered to dogs. Autologous blood was grossly contaminated with fecal material and incubated in the peritoneal cavity. Dogs were bled 20%, 30% or 40% of their blood, a control group was bled the same volume, but not contaminated with feces. There was little effect on survival at 20% and 30% shed blood; with 40% shed blood, the survival rate in the ABT group decreased from 90% to 30%, however, with addition of antibiotics, the survival increased to 90%, similar to that of the control group. At least 5 studies have been performed in clinical human cases varying from 11 to 154 trauma patients who received autologous blood transfusions with GI contamination; good survival rates were found, without increases in infection. Antibiotics are recommended.

There is theoretical concern for administering ABT to patients with preexisting hepatic or renal insufficiency. At this time, the only evidence of renal injury is transient elevations of creatinine. Monitoring serum color and creatinine levels is warranted. There is no clear evidence of associated liver injury, however one could argue that ABT may be better than banked blood for severe liver disease as there are lower levels of NH3 present in ABT compared to banked blood. Large volumes of ruptured RBCs, particularly in Japanese breeds dogs may warrant monitoring potassium levels. In rare cases, where ABT may be used in an obstetrical case, filtering the blood is essential to avoid emboli associated with fetal membranes/fluids. Blood that is collected from a multitrauma cases (eg, HBC) should be AVOIDED when concurrent biliary or urinary tract rupture is suspected.

ABTs are relatively simple to perform. Although cell salvage devices are available and used in some tertiary veterinary hospitals, they are expensive enough to prohibit their use in the majority of veterinary facilities. However, ABT is relatively simple to collect; blood from the abdominal or thoracic cavity may be collected with a sterile centesis, and collect the blood with direct (manual) aspiration. The blood can be collected into a syringe and then reinfused directly IV (through a filter), or it can be collected into an empty/sterile IV fluid bag or blood collection bag, and then administered intravenously. If a surgical procedure is being performed, the blood can be directly aspirated into a syringe, or it can be collected with a mechanical suction unit (with suction pressures set at 100 mmHg or less). The ABT can be easily transferred into a sterile IV bag and administered through a filter with gravity drip,
manual compression of the bag (or with an IV pump (although some mechanical pumps may contribute to damaging of RBCs). If using suction, the suction tip (Frazier-Ferguson or Poole) or IV tubing should be completely submerged into the blood to avoid mixing with air. Typically ABT is administered through rapid IV (or intraosseous, IO) infusion as a bolus (as these patients are often hypovolemic or hemorrhaging), however if they are not in shock and just require red cells, they can be administered over a longer period of time like a typical transfusion to avoid volume overload. Anticoagulant generally does not need to be added to ABT, as the blood is typically defibrinogenated. If hemorrhage is ongoing at the time of collection anticoagulant (ACD or CPDA) may be added to the collected blood. Reported doses range from 0.07 to 0.14 mL anticoagulant per mL of blood (eg, 35-70 mL per 500 mL of blood). Hemonate filters (18 um) will filter out the majority of cellular aggregates (as well as many WBCs and potentially neoplastic cells), however these filters clog relatively quickly and can often clog after only 50-180 mLs of blood passes through. These filters become largely impractical for large dogs and/or large volumes of blood. Typical blood administration filters are 210 um in size and are appropriate for larger volumes of blood.

After administration of an ABT, a patient’s PCV/TS, coagulation times, BUN, Creatinine, and temperature should be monitored along with typical vital signs, blood pressure and other blood parameters as warranted.

The author currently has the largest case series to date of dogs that have received ABT accepted for publication in JVECCS. These dogs received ABT for a variety of diseases including coagulopathies and hemorrhage from trauma and ruptured neoplasia. Despite these patients having a high likelihood of death from exanguination, a survival rate of 68% was found with few clinical complications (hemolysis, hypocalcemia, prolonged clotting times). Of those that survived to discharge, most were alive more than two weeks afterwards.