Executive Summary:

What is the Safest Way to Infuse Blood in Conjunction With Hemodialysis?

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Overview:

When hemodialysis patients need to receive red blood cell (RBC), transfusions for low hematocrit and hemoglobin levels, many healthcare providers prefer intra-dialysis administration, yet very little information exists as to why during dialysis. Hemodialysis patients may lose red blood cell volume by having a reduced cell life cycle, lack of erythropoietin hormone due to renal failure, and loss of red cell volume in the dialysis tubing used for their treatments. Ideally, dialysis patients' hematology levels would remain at a therapeutic level by only using and adjusting Erythropoietin Stimulating Agents (ESA's) and supplemental iron dosages, but the reality is, sometimes those levels fall below therapeutic levels, requiring a transfusion. An anemic dialysis patient has a decreased ability to oxygenate and remove excess fluid during treatment because they will become hypotensive prior to reaching their fluid removal goal. It has been well researched that RBC's potassium levels become extremely high during storage. This along with the ability to remove the volume of the transfusion, along with the electrolyte correction that occurs during dialysis may be the reason for this intradialytic infusion preference.

Problem:

Currently, there is no clear research based best nursing practice to administer blood transfusions during dialysis. Often hemodialysis nurses transfuse blood based on how they were trained during their career. Some nurses give the blood pre-dialyzer, while others give it post-dialyzer. Does it really make a difference how the unit it infused in terms of pre or post dialyzer? What about how fast? Do providers prefer intradialytic administration because it's safer for the patient or out of convenience? Should there be post transfusion assessments and interventions? All of these questions have led to multiple variances intradialytic transfusion practice. Although further research is needed to determine whether the blood transfusion should be administered pre or post dialyzer, there is also a clear need to use an evidence based practice model to determine how nurses should best administer blood transfusions safely during dialysis.

Blood Transfusion and Hemodialysis

Provider writes order for intradialytic blood transfusion. Order does not specify to give pre or post dialyzer.

Pre Dialyzer

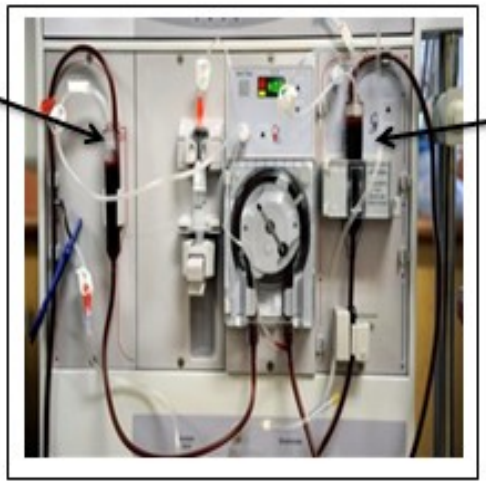
Follow hospital policy to obtain and verify patient information and compatibility

Infusion connected to pre-dialyzer medication port and uses dialysis machine blood pump to pull infusion into dialysis circuit. Infusion rate can be adjusted manually via roller clamp on transfusion tubing and does not need to be set at the same rate as the dialysis machine.

Transfusion passes through dialyzer prior to administration to patient and ideology is pre-dialyzer administration helps buffer the pH and potassium level of the transfused unit.

Current Practice

No standardized nursing procedure. Transfusion infused via method learned during experience.



Note: Considering providers ordering transfusions preference to be given intradialytic, clarification of whether pre or post administration is safest is important.

Post Dilayzer

Follow hospital policy to obtain and verify patient information and compatibility

Infusion connected to venous chamber medication port and requires secondary IV pump to infuse. Infusion rate determined by rate set on secondary IV pump.

Transfusion is administered post dialyzer and ideology is post-dialyzer administration helps prevent clotting of the dialyzer membrane fibers and circuit.

Action:

Beginning with access connection, does it really make a difference how the transfusion is infused? In dialysis, there is a wide variety of practices used for transfusing blood products during hemodialysis (D. Aston RN, 2014). Usually, the nurse's technique for infusing the blood varies from the experience and teaching they received during their career in dialysis. Due to lack of a clearly defined best practice for transfusing blood on dialysis, many variances in technique have developed.

Pre Filter

The majority of community nurses surveyed and those spoken to for expert opinion stated they prefer the pre-dialyzer transfusion method. Although it's possible the size of the dialyzer membrane may remove more waste as the filter increases in size, the transfused blood will only be passing through the membrane (dialyzer), once on the way to the patient, regardless of the filter size. As well, hemodialysis prescriptions are based on body volume and time as a means of removal of waste and potassium, so regardless of the size of the dialyzer, the important aspect of potassium correction is time. In fact, a common technique providers use if more waste or potassium removal is desired is to increase the patient's time on the machine and give the patient's blood more exposure to the dialyzer. So any potassium correction related to the pre-dialyzer argument would have to occur with one single pass through the filter membrane.

Post Filter

The important goal of giving an anemic patient a transfusion is to increase the red blood cell volume. Blood that has transfused to the patient is mixing with the patient's own blood and has been anticoagulated during storage, as well as a generally, many dialysis patients are anticoagulated during their treatments. If the patient and unit to be transfused are both anticoagulated, the post dialyzer argument in terms of clotting potential appears to be a non- issue. However, since it is imperative that the anemic patient receive the transfusion, a clotted dialyzer and inability to complete the needed transfusion due to clotting is an important thought to consider when making an argument for post-dialyzer infusion. In addition, in terms of

patient safety, the argument for an external IV pump to control the infusion rate also seems like an important action to consider.

Why Do Providers Prefer Transfusion on Dialysis?

Access

A dialysis patient has a larger gauge access than a non-dialysis patient for infusion purposes. Typically, a dialysis access is 14-15 gauge in diameter as opposed to 20 gauge for a non-dialysis patient with a peripheral IV. More volume can be infused quicker if necessary, and sometimes the patent's peripheral IV becomes non-patent or infiltrated and the transfusion needs to be stopped until another IV access can be obtained. A larger gauge dialysis access also allows providers the ability to dilute the hyperkalemic transfusion in the patient's own blood prior to systemic infusion and may reduce the severity of transfusion reactions, both due to ABO and hyperkalemic reactions if the initial test dose of the transfusion is given slowly. The larger access also allows the transfusion to be completed quickly and allows the provider more time to adjust the dialysis treatment goals to the patient.

Dialyzer

Although most nurses surveyed prefer pre-dialyzer administration for transfusion to allow the dialyzer to buffer the pH and potassium level of the stored blood there has been no research to prove this implication. In fact, the pre-dialyzer transfused blood would need to be corrected with one pass through the dialysis circuit for this to be all of the reason for pre-filter administration. As previously noted, time is a large aspect of how potassium correction occurs on dialysis, and one pass through the dialyzer regardless of filter size would have minimal affect. If the transfusion can be completed near the beginning of the treatment it gives the patient more exposure to the dialyzer and maximizes the ability for electrolyte correction.

Fluid Removal

Intradialytic transfusion gives the provider the ability to remove the volume of the transfusion in addition to the patient's fluid removal goal for the treatment. Fluid removal is an aspect of dialysis treatments and once the transfusion has been completed dialysis nurses may have an easier time removing not only the volume of the transfusion but excess fluids as well due to the increase in plasma proteins helping to pull extravascular fluid back into the vascular space. With this in mind, the argument can also be made for transfusions to be at the beginning of the treatment to help mobilize excess fluid to the blood stream and the ability for that excess fluid to be removed.

Stored Blood Mixing with Patient's Blood

As previously discussed, stored blood becomes hyperkalemic due to cold storage temperatures and temperature which inhibits membrane ATPase, allowing cations to leak unopposed into and out of the red blood cells. There is progressive increasing diffusion of potassium from human erythrocytes into the plasma during storage. This diffusion is rapid during the first 5 days and reaches a maximum level at about day 20 (DeGowin). Potassium levels may increase at a rate of 1.2 mmol per L per day (Wallas, March-April 1979). So the longer the blood has been stored, the more hyperkalemic it may have become. If the stored blood is more than a few days old this increase in potassium would seem to be fatal. So why don't dialysis patients have cardiac events when they receive transfusions so quickly on dialysis? The answer may be due to the reaction that occurs when the transfused blood mixes with the patient's blood.

Dr. Grace Chien, Anesthesiologist, and Transfusion Committee Chair at the Portland VA states that when blood is stored, the potassium leakage that occurs is corrected very quickly as the stored transfusion blood mixes with the patient's own blood. As the hyperkalemic transfusion comes in contact with the oxygenated blood of the patient, the Na+/K+ pump is reactivated and the extra potassium is reabsorbed into hypokalemic cells, thus preventing hyperkalemic cardiac events with transfusion on dialysis. The alteration in the distribution of sodium and potassium in the cell seems reversible in vivo following transfusion of the stored blood (Maizels & Paterson, 1940). This reaction happens very rapidly and as the transfusion is administered the patient's body help correct the additional potassium.

Red cells may be stored for up to 42days, allowing for efficient blood bank inventory management, but with prolonged storage comes an unwanted side-effect. Metabolic changes include a reduction in glycolysis and ATP production after the first week of storage. This leads to an accumulation of lactate and drop in pH, which leads to cation leakage (Flatt, June, 2014).

What does all this mean?

With the information that potassium levels may be high in stored blood, that the high potassium cells mix with the patient's cells and dilute the high potassium cells with the patient's blood in conjunction with the low potassium cells reabsorbing the potassium at a very rapid rate upon this mixing, this project would lean heavily on expert opinion. After discussing pathophysiology and hemodialysis machine operations, this evidence based project makes the following recommendations:

- Follow hospital policy in regard to pre-transfusion procedures.
- Connect the transfusion Pre-Dialyzer
- Use an external IV pump to control infusion rate
- Give a slow 15 ml volume of the transfused blood over 15 minutes to assure no reaction.
- Give the remaining volume of the transfusion over 20-30 minutes.

Changes / Things to consider:

- IV pump

Many dialysis nurses mistakenly believed the machines pump pressure would interfere

with external IV pump but during tests no problems identified. However, it would be

critical that the dialysis nurses had a good understanding of the external IV pump’s

features and troubleshooting in case of issues.

- Bolus volume defined

Dialysis nurses can use hospital infusion test bolus for transfusion but use an external IV

Pump.

- Verification of infusion speed on dialysis.

Through the confirmation of expert opinion more clarification that rate may be

increased on dialysis.

- Literature review on going and evolving