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The Clinician's Role in the Measurement of Accurate Lab Values

The dialysis caregiver plays an integral role in the collection and preparation of lab specimens. If a specimen is improperly handled from the time of collection to the time of receipt at the lab, the results yielded may not be useful to the nephrologist, who must base care on those lab results. Improved patient care would result from staff taking the time to adequately prepare for and administer the laboratory blood draw procedures as recommended. Accurate results take an attention to all details, including draw techniques, handling, storage, and shipping of specimens. Different procedures should be followed when collecting blood from a central venous catheter vs. a fistula needle. It is the responsibility of every member of the dialysis team to ensure that correct techniques are used to handle lab specimens in order to ensure accurate results.

Over the years, most dialysis facilities have moved away from performing routine laboratory testing on-site except when absolutely necessary. Low staffing levels, increased risk of exposure to blood, inconsistent results, increased documentation requirements, and strict regulatory requirements have led physicians to rely on laboratories specializing in dialysis testing to provide accurate and timely results.

General Specimen Handling and Storage

All handling of specimens should be done using universal precautions, including the proper use of personal protective equipment. The processing of lab specimens should not place the staff member at any greater risk of blood exposure than performing routine dialysis procedures.

Blood products. Reasonable care should be exercised to ensure staff member safety when handling blood products. Clean gloves should be worn when collecting tubes from the patient care area, when inserting and removing tubes from the centrifuge, and when packaging specimens. A face shield, or goggles plus a mask, should be worn if opening a tube to transfer serum to another container. Lab coats or other protective attire should be worn to protect the clothing while working with specimens in the lab area.

Staff members should be monitored closely to be sure they adhere to facility protocol and safe procedures when handling and processing blood and body fluid specimens.

Refrigeration. The temperature of the refrigerator should be maintained at 36–46°F, or 2–8°C. The refrigerator should be checked and the temperature documented every day the refrigerator is used. Lab refrigerators should be disinfected and defrosted regularly as part of general housekeeping chores. If not defrosted regularly, the freezer compartments found in many small refrigerators become iced over, so that the freezer door will not close properly or will break off entirely. This allows the colder air from the freezer to escape into the refrigerator section, making it difficult to maintain a stable temperature in the refrigerator compartment. Samples stored in the upper compartment may then be exposed to freezing temperatures.

Likewise, if the samples are crowded into the refrigerator on the uppermost shelf directly under the freezer compartment, a collection of frost may rest directly on the tubes

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causing them to partially freeze. Freezing causes lysis of the red blood cells. Hemolyzed samples are unsatisfactory for any hematological analysis.

Blood sample tubes. Each blood sample tube should be inverted 5–10 times in order to mix the blood with the anticoagulant or clot activator in the tube. Hematology specimens collected in lavender and light-blue top tubes will clot if not mixed properly. Tubes that do not need to be spun should be refrigerated as soon as possible. Serum separator tubes (SSTs) that are to be spun should be left to clot for 30–60 minutes at room temperature and in an upright position, preferably in a test tube rack.

Specimen Collection: Venipuncture and Central Venous Catheters

Fistula needles. Most laboratory samples are obtained through the fistula needle, prior to initiating the dialysis treatment. The fistula needle line must be primed with blood before attaching a vacutainer holder with a multi-sample Luer™ adapter. Air in the fistula needle will decrease the amount of blood aspirated into the tube, resulting in an insufficient quantity (QNS) of sample needed to perform the ordered lab tests. An underfilled SST may result in a lower bicarbonate value.

Use of syringes should be avoided when collecting lab samples from the fistula needle due to the potential for hemolysis when transferring blood to the vacutainer tubes, as well as the risk of needlestick injury and blood exposure.

Under no circumstances should the rubber or plastic top be removed from the tube when filling it. This breaks the vacuum seal and causes underfilled or overfilled tubes, and may cause clotted lavender tubes. In addition, air allowed to enter the tube or blood coming into contact with air will alter bicarbonate and CO_2 levels. Vacutainer holders and multi-sample Luer adapters are provided by the laboratory for safe specimen collection and should be utilized.

Multi-sample Luer adapters and vacutainer needles can be easily removed from the vacutainer holder by utilizing a special hole in the top of a sharps container specifically designed for this purpose. The hole is graduated so that the needle or holder can be inserted into the wide side of the hole and then wedged into the narrow end, which grips the needle hub and allows the holder to be unscrewed with a one-handed motion. The used needle falls into the sharps container when released from the holder.

Recapping the needles should either be avoided or accomplished with the one-handed method to prevent needlestick injury. Safety needles are available for use with vacutainer holders to provide user protection against accidental needlesticks. The vacutainer holders can be disinfected with bleach and reused many times—until the thread on the plastic holder becomes worn and will no longer accept a needle. (Some states require one-time use of the vacutainer adapter holders).

Central venous catheters. If a sample is collected from a central venous catheter (CVC), then the heparin or heparinized saline instilled in the line after it was used last should be withdrawn and discarded.

Several factors must be considered when deciding how much blood should be withdrawn from a CVC and discarded prior to sample collection. These include the length and internal diameter of the catheter, the amount and concentration of heparin used, and the patient's normal level of activity. In the course of daily activity, some of the heparin instilled in the catheter is displaced and mixed with the blood lying proximal to the catheter in the subclavian vein.

If 1.5 cc of 1:10,000 heparin is injected in each port of the catheter to maintain patency, more than 1.5 cc should be withdrawn and discarded before collecting a lab sample from the CVC. Some facilities have policies dictating the removal of 5 cc of heparin solution/blood from each port before initiation of the next treatment. However, on monthly lab day as much as 25 cc of blood from the sampling port may be withdrawn to ensure that the specimen collected is free of heparin contamination.[1] The NKF-DOQI Clinical Practice Guidelines recommend aseptically drawing an additional 10 ml of blood, then reinfusing it after specimen collection. The importance of a heparin-free sample cannot be overemphasized. Heparin-contaminated samples produce compromised lab results.

Ideally, the number of patients with CVCs would be low enough so that discarding this blood would not occur with enough frequency to cause widespread concern. According to the NKF-DOQI guidelines, less than 10% of the patients at any given time should have a central line as their primary vascular access.[2] In reality, however, the numbers seen in most facilities tend to be much higher. This is a separate and complex issue to address.

Hopefully, physicians will strongly advocate for the placement of a permanent fistula or graft, and this will become a less pressing issue in the future. In the meantime, facility policies should specifically address the preferred technique for blood specimen collection from a CVC.

The performance of continuous quality improvement (CQI) methods can be used to study whether the patients with central venous catheters have a higher incidence of delayed clotting, or whether their

results include more comments indicating "incomplete separation of serum" or "hemolyzed sample." If such a problem exists in a given facility, it would be in the patient's best interest to address the issue at the source—which is not necessarily how much blood to discard, but why so many patients have CVCs.

Hematology Specimens

When physicians first began prescribing Epogen® years ago, doses were often adjusted at each treatment, or weekly, based on the results of the spun hematocrit (Hct). It was not unusual for nurses and technicians within the dialysis clinic to collect and measure their patient's spun Hcts frequently throughout the month. Performing these tests was time consuming as well as risky for the staff member, who had to contend with potential broken glass, spattered blood, and the creation of biohazardous aerosols.

Additionally, results of spun Hcts performed in the facility were frequently inconsistent because they were dependent on the technique of the clinician performing the test, as well as on uniform interpretation of the results, quality and maintenance of the testing equipment, and several other factors. Because the anticipated rise in Hct following an Epogen adjustment is not apparent for several weeks, in recent years clinicians have moved away from frequent dosage changes.

Nevertheless, many facilities continue to perform weekly determinations of Hct or hemoglobin (Hgb) in order to monitor the effectiveness of the Epogen therapy. However, a lack of correlation was noted when comparing these weekly spun Hcts to the monthly calculated Hct result reported by the laboratory. Often, the spun Hcts were higher than the automated Hct. If results were rechecked at a local laboratory, they were often different from the results obtained by both the dialysis laboratory and via the spun Hct at the facility. Confusion reigned as physicians attempted to regulate Epogen doses based on all these disparate Hct values.

For the sake of consistency, many facilities elected to send all weekly Hcts to the dialysis laboratory, where all tests would be uniformly processed by an automated system. Since Epogen doses were no longer being adjusted on a weekly basis, many physicians eventually decided to monitor trends by tracking biweekly or monthly Hct/Hgb rather than weekly Hcts. Nephrologists were also understandably reluctant to draw 3–5 cc of blood weekly from a patient who was already anemic, when the result was not going to change the immediate treatment regimen. For many clinics, testing has now evolved into a monthly routine only, unless clinical symptoms warrant additional studies. In addition, many physicians are opting to use Hgb rather than Hct to base decisions made about Epogen dose changes.

While most staff are relieved to be free of the burden of performing spun Hct testing at the facility, they still have to collect weekly, biweekly, or monthly lavender tubes to send to the lab for testing. It is imperative that the collection, storage, and transport of these specimens are carried out properly in order to ensure accurate results.

Lavender tubes should be refrigerated within 30 minutes of the blood draw. If left at room temperature for longer period of times, the red blood cells (RBCs) swell, causing a false elevation in the Hct value; Hgb values are not as likely to be affected by temperature variations. White blood cells (WBCs) are also temperature sensitive. Higher temperatures can cause them to deteriorate and lyse, resulting in a lower WBC count.

One of the worst places to store a lab specimen, even on a short-term basis, is on top of the dialysis machine! The heat generated by the dialysis equipment will cause rapid degradation of the specimen. Additionally, avoid placing the test tube rack on a sunny windowsill or next to the centrifuge while it is operating, since the specimens will be exposed to hot air from the vents. The safest place to store tubes is in the refrigerator.

Refrigerated tubes should be positioned upright in a test tube rack, or stored in the plastic trays provided by the lab for shipping. Foam rubber shipping racks should not be used in the refrigerator. If freshly drawn samples are stored in a foam rubber rack, they do not cool properly due to the insulating property of the foam.

Chemistry Specimens

All serum separator tubes should be allowed to clot at room temperature for at least 30 minutes, but not longer than 60 minutes. If the serum is allowed to "sit on the clot" for longer periods of time, certain constituents with higher concentration in the red cells leak out and falsely elevate the serum concentration. Cellular-based metabolism can adversely affect glucose, LDH, and uric acid values. Both pre- and post-samples must be spun before shipping.

To obtain the highest quality serum specimen, it is important to allow blood collected in the SSTs to clot thoroughly before centrifugation. Incomplete clotting allows latent fibrin formation and inhibits the flow of gel during the spinning process, resulting in poorly separated samples or "incomplete separation." Incomplete clotting also promotes hemolysis of red cells, producing samples with spuriously higher potassium and phosphorus values.

Clotting of the sample may be delayed if a patient is on systemic anticoagulants (e.g., Coumadin, aspirin). If a tube drawn pre-dialysis takes longer than 60 to 90 minutes to clot, the physician should be made

aware so that the dosage of the medication can be adjusted as necessary. For a patient who is not taking anticoagulants, it is even more important to notify the physician of delayed clotting times.

Sufficiently clotted blood spun for the proper amount of time at the appropriate speed should separate completely. If a problem is noted (i.e., many reports of "incomplete separation"), check the speed of the centrifuge and ensure that enough time is being allotted for spinning. Also, review with staff the proper procedure for specimen collection from CVCs. Finally, report any continuing problems to the lab. Only a very small number of tubes, if any, should have to be manually poured off into plastic transport tubes in order to prevent hemolyzed results.

Packaging and Shipping

Dialysis laboratories work very hard to provide their clients with all of the supplies necessary to collect and ship their samples correctly and safely. Notify your laboratory customer service representative if you are receiving too few or too many supplies for your needs. Rotate your stock to avoid wasting tubes that pass their expiration date. Tubes that have expired may lose their vacuum or compromise accuracy with additives that may no longer be effective.

Courier services are contracted through nationwide agencies to arrange for lab specimen pickup at the facility and delivery to the lab within 24 hours of collection. Facility staff can assist the lab by making sure the specimens are kept refrigerated until the courier arrives, and that the package is ready for immediate pickup. Only the approved packaging should be used to ship blood specimens. It is against OSHA regulations for a courier to carry a diagnostic specimen that is not labeled as such, or that is shipped in incorrect packaging.

The tubes should be packed in special racks (foam rubber, Styrofoam, or plastic) to prevent breakage. Some type of absorbent material is included in the package in case a tube should break or leak. Ice packs should be completely frozen prior to use in order to provide proper temperature during transport. Place the entire shipment in the large Ziploc™ plastic bags provided before sealing the package.

Every effort should be made to be sure the lab has the corresponding orders or requisitions on file in order to avoid phone calls and reporting delays later. A separate airbill is recommended for each package shipped, and the airbills or boxes should be marked "1 of 2" and "2 of 2" if more than one package is sent. A copy of the airbill should be kept on file at the facility for tracking lost shipments. These can be discarded after the lab results are sent to the facility indicating safe receipt of the package.

Conclusion

The entire healthcare team is involved in assuring quality laboratory testing for its dialysis patients. The physician who orders the lab tests, the patient, and the nurse or patient care technician who draws and processes the specimens are all important members of the team. Charge nurses remind staff to remember that it is "lab day." Chief techs are often the people who make sure the supplies are ordered and received in stock to perform the lab draw. The dietitian is closely involved with counseling the patient and interpreting the results. The courier who transports the samples must be reliable. And last, but certainly not least, the laboratory staff performing the actual testing are also very crucial members of the team.

Due to the importance of the lab results in the plan of care for the patient, many facility administrators and nurse managers are designating one key person to be responsible for laboratory specimen handling on monthly and biweekly lab draw days. This works especially well in large facilities. Often, it is easier to make one dedicated person accountable and responsible for ensuring that the proper specimen handling procedures are being followed than to have "many hands in the pot" and, thus, no accountability when samples need to be tracked. A great sense of accomplishment can be obtained from performing a monthly lab draw flawlessly, with no need to repeat tests or reschedule labs that were inadvertently overlooked.

There are many factors that adversely affect lab values: specimen collection and handling procedures, uncontrolled temperatures, and inadequate packaging and shipping. Patient caregivers must remain vigilant in their efforts to follow the prescribed techniques for specimen handling in order to ensure quality and timely lab results—and, thus, the most appropriate treatment for their patients.

References

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