Trace Metals Analysis Specimen Collection and Transport

Introduction

Trace metals exist in our environment at concentrations many-fold greater than their concentrations in blood, urine, or tissues. Analyses for trace metals at the Mayo Clinic Metals Laboratory are performed in an ultra-clean laboratory environment with a positive-pressure filtered air system to prevent specimen contamination. This allows for detection of many metals at the sub-parts-per-billion concentration range. Preanalytical steps are the steps most likely to affect the quality of trace metals analysis in clinical samples. Specimens must be collected and processed using the instructions outlined below to ensure contamination does not occur during these steps.

Serum, plasma, or whole blood samples received in most tubes or vials will not be rejected and will be analyzed. However, if a sample is received in a nonmetal-free container, abnormal results will be reported with a disclaimer that the sample was not received in a metal-free container. These results must be interpreted with caution.

General Instructions for All Specimens

Do not collect specimens for trace metal testing from patients who have received gadolinium-, iodine-, or barium- containing contrast material within the past 96 hours. These metal-based contrast agents are known to interfere with laboratory techniques commonly used for trace metals analysis.

Because of the technology used for testing, the laboratory may observe a significantly abnormal result for a metal that was not ordered. In such event, the laboratory will note the findings on the ordered metal's report, but only if the sample was submitted in a metal-free container. If the ordering physician deems that the metal is of clinical significance, the ordering physician may elect to submit an order for that metal so it can be reported.

Tips to Control Contamination of Specimens for Metals Testing

1. Keep the specimen handling area clean and free of dust.
2. Clean the venipuncture site with alcohol. **Do not use** povidone-iodine swabs or pads.
3. Use only the supplies listed in this document.
4. **Do not** ream a serum or plasma sample with a wooden stick to remove clots.
5. **Do not** insert any utensil or pipet into the specimen. Transfer sample by pouring from one tube to another.

Blood Collection General Instructions

The Mayo Clinic Metals Laboratory has tested numerous blood collection tubes and found that many of them introduce contamination when used for trace metals specimen collection. Contamination from blood collection tubes and specimen vials has also been noted in numerous publications.[1-3] To ensure that specimens are not contaminated by the collection tubes, specimen vials, or other supplies, only use the supplies listed in these instructions.

Order of Draw

When multiple blood specimens are scheduled for collection from a patient, the royal blue tube should be drawn first within its additive group.

Blood Collection Supplies

- BD Vacutainer Plus with K_2 EDTA Royal Blue Stopper 6 mL Blood Collection Tube. Product number 368381 (Supply T183 Metal Free B-D Tube [EDTA]-6 mL) for whole blood tests
- BD Vacutainer with Clot Activator Plus Royal Blue Stopper, 6 mL Blood Collection Tube. Product number 368380 (Supply T184 Metal Free B-D Tube [No Additive]-6 mL) for serum tests **except aluminum**
- Covidien Monoject with No Additive Royal Blue Stopper, 7 mL Blood Collection Tube., Product number 8881307006 (Supply T713 Metal Free Monoject Serum Tube [Aluminum Only]-7 mL) for aluminum serum tests
- BD Vacutainer Plus with K_2 EDTA Tan Stopper, 3 mL Blood Collection Tube. Product number 367855 (Supply T615 Metal Free [Lead only] EDTA Tube-3 mL) for lead blood only
- BD Microtainer with K_2 EDTA. Product number 363706 (Supply T174 Microtainer [EDTA] Tube-0.5 mL) for capillary collection of lead blood specimens only.
- Regular sodium heparin blood collection tube for fluoride test only
- Regular phlebotomy needle or butterfly needle
- Mayo Metal-Free Specimen Vial (Supply T173)
- Alcohol prep pads or wipes

If a syringe is required for collection, the HSW Norm-Ject disposable syringe is recommended. Immediately transfer the entire blood specimen to the appropriate royal blue stopper tube for processing.

Venous Whole Blood Collection

1. Prepare the patient for phlebotomy, following your normal protocol, using alcohol to disinfect the collection site. **Do not** use iodine-containing products.
2. Draw blood in a BD Royal Blue with K_2 EDTA Vacutainer tube (Supply T183).
   Note: Lead blood specimens may also be drawn in a BD Tan with K_2 EDTA, lead only (EDTA) Vacutainer tube (Supply T615).
3. Mix blood and anticoagulant by shaking the sample vigorously. Cell rupture will not affect metals testing, but any clots will make the specimen unacceptable.
4. Leave the specimen in the tube, attach a specimen identification label, and send the specimen to the laboratory at refrigerated (preferred), ambient, or frozen temperature. Specimens to be stored more than 48 hours should be stored at 4° C and sent refrigerated.

Capillary Blood Collection for Lead Testing

Use the BD Microtainer with K_2 EDTA (Supply T174) supplied by Mayo Medical Laboratories. Follow the instructions from the Centers for Disease Control (CDC) for collecting capillary blood specimens for lead testing.[4,5]

Note: If the lead result from a capillary sample is ≥5 mcg/dL, the comment "Capillary blood levels >5 mcg/dL may be due to contamination from the finger surface and should be confirmed with venous blood." will be added to the report.

Serum Collection

1. Prepare the patient for phlebotomy, following your normal protocol, using alcohol to disinfect the collection site. **Do not** use iodine-containing products.
2. Draw blood in a BD Royal Blue with Clot Activator Vacutainer tube (Supply T184).
   Note: Use a Covidien Monoject Royal Blue tube (Supply T713) if the sample is for aluminum testing.
3. Allow the specimen to clot for at least 30 minutes, but no more than 4 hours.
4. Centrifuge the specimen to separate serum from cellular fraction.
5. Attach a specimen identification label to a Mayo Metal-Free Specimen Vial (Supply T173).
6. Remove the collection tube stopper. Carefully pour the serum into the vial, avoiding transfer of the cellular components of blood.
   - **Do not** insert a pipette into the serum to accomplish transfer.
   - **Do not** ream the specimen with a wooden stick to assist with serum transfer.
   - Blood from a dialysis patient on heparin may produce an uncoagulated serum that forms a fibrin clot after centrifugation. Pour off serum as soon as possible, and repeat centrifugation step if more serum is needed.
7. Place the cap on the vial tightly and send the specimen to the laboratory at the temperature indicated in the test's transport instructions.

Plasma Collection (Fluoride Test Only)

1. Draw blood in a sodium heparin blood collection tube.
2. Centrifuge the specimen to separate plasma from the cellular fraction.
3. Attach a specimen identification label to a plastic vial. **Do not** use a glass vial to store or transport the plasma.
4. Remove the collection tube stopper. Carefully pour or pipette the plasma into the plastic vial, avoiding transfer of the cellular components of blood.
5. Place the cap on the vial tightly and send the plasma specimen to the laboratory at refrigerated (preferred), frozen, or ambient temperature.

Urine Collection General Instructions

- **Do not** collect urine specimens in an environment in which exposure is most likely to occur. It is important that dust from clothing not contribute to the specimen contents.
- **Do not** collect urine in metal-based containers such as metal urinals or pans.
- **Do not** collect or transport urine in colored containers or caps unless they are provided by Mayo Medical Laboratories. These containers have been evaluated and found to be clear of contamination.

Urine Collection

1. Collect urine in a clean, all-plastic container without a glued cap insert (Supply T309 Urine 24 Hour Container).
2. Mix urine well before aliquoting.
3. Attach a specimen identification label to a plastic 6-mL (Supply T465) or 10-mL (Supply T068) urine aliquot tube.
4. Pour urine into the aliquot tube.
5. Place the cap on the tube tightly and send to the laboratory at the temperature indicated in the test's transport instructions.

Kidney Stones

See Kidney Stone Analysis Packaging Instructions in Special Instructions.

1. Record the source of the specimen (eg, left kidney, bladder, right ureter).
2. Clean any blood or foreign material from the stone with distilled water.
3. Dry stone at room temperature.
4. Send entire stone in the container provided in the Stone Analysis Collection Kit (Supply T550) or a urine aliquot tube (Supply T465: 6-mL or T068: 10-mL).
   - **Do not** tape specimen to anything; tape interferes with the analytical procedure.
   - **Do not** send stone in formalin or any other liquid.
   - **Do not** send filters or other collection devices.
5. If multiple stones are being sent and separate testing is wanted on each stone, place each stone in its own container.
6. Testing must be ordered on each stone, and each test will be charged separately. Send the specimen at ambient temperature.

Tissue Testing

The Mayo Clinic Metals Laboratory provides validated testing of liver tissue for iron and copper, dermal biopsies for gadolinium, and hair and nail testing for arsenic, lead, and mercury. See tissue collection instructions on individual test pages for specimen requirements. No other tissue testing is offered.

Hair and Nails Collection General Instructions

- See Hair and Nails Instruction Sheet for Metals Testing in Special Instructions.
- Do not place nails in same container as hair. If both hair and nail testing is wanted, each must be placed under a separate order and sent in a separate container.

Hair Collection

1. At the back of the head, gather a lock of hair the width of a pencil.
2. Cut hair near scalp (metal scissors are acceptable).
   - **Do not** cut scalp or pull hair from scalp.
   - If hair is short, cut enough hair to equal at least 3 inches in length (0.5 grams minimum).

   Note: Head hair is the preferred specimen. Pubic, beard, mustache, or chest hair is acceptable if enough quantity can be obtained.
3. Place hair in container provided in Hair and Nails Collection Kit (Supply T565).
4. Indicate patient's name and source of hair on outside of container.
5. Send specimen at ambient temperature.

Cautions:

- **Do not** apply tape to hair.
- Patients that have used a Grecian Formula product cannot have lead testing performed on their hair. These products contain lead.

Fingernail or Toenail Collection

- Cut all 10 nails, either fingernails or toenails (using a metal clipper is acceptable). A minimum of 0.5 grams is required.
- Place nails in container provided in Hair and Nails Collection Kit (Supply T565).
- Indicate patient's name and source of nails on outside of container.
- Send specimen at ambient temperature.

References

1. Moyer TP, Mussmann GV, Nixon DE: Blood-collection device for trace metal and ultra-trace metals specimens evaluated. Clin Chem 1991;37:707-714
2. Boeynaems JM, De Leener A, Dessars B, et al: Evaluation of a new generation of plastic evacuated blood-collection tubes in clinical chemistry, therapeutic drug monitoring, hormone and trace metal analysis. Clin Chem Lab Med 2004;42:67-71
3. Rodushkin I, Odman F: Assessment of the contamination from devices used for sampling and storage of whole blood and serum for element analysis. J Trace Elem Med Biol 2001;14:40-45
4. CDC. June 1, 2009. Guidelines for Collecting and Handling Blood Lead Samples (video). Available from URL: http://www.cdc.gov/nceh/lead/training/blood_lead_samples.htm Retrieved May 29, 2012
5. CDC. Capillary blood sampling protocol. Atlanta, GA: U.S. Department of Health & Human Services, CDC; 1997