Appendix
SPECIMEN COLLECTION PROCEDURES

BLOOD, ARTERIAL: RADIAL ARTERY

Equipment

The necessary equipment for an arterial puncture is usually available as a packaged, sterilized set.

Antiseptic—povidone-iodine
Local anesthetic—lidocaine hydrochloride
Sodium heparin solution
Sterile cotton gauze pads
Sterile syringes and plungers
Disposable needles—a 25-gauge needle is used when administering the anesthetic. A medium bore needle (e.g., 21-gauge) is usually used for the actual puncture
Specimen containers—almost always the syringe itself will serve as the specimen container

Procedure

1. Identify the artery by its pulsations.
2. Cleanse the skin over the puncture site using the antiseptic. Allow it to air dry.
3. The use of local anesthesia is not required but is encouraged. Infiltrate the skin and soft tissue at the puncture site with the anesthetic.
4. Draw 1 ml of sodium heparin solution into the syringe and with it thoroughly lubricate the barrel. Test the plunger to assure easy mobility, then expel the heparin, leaving the dead space filled with residual heparin.
5. Change the needle on the syringe. For puncture, the needle gauge should be appropriate to the caliber of the artery to be entered.
6. Position the arm so that it is well supported and comfortable. Dorsiflexion of the wrist is useful and may be achieved by placing a rolled towel under the patients vein.
7. Hold the needle parallel to the artery at an angle of 45-60 degrees, bevel up.
8. Puncture the skin and underlying artery, using a steady, moderately fast movement. The needle should be advanced no further than the estimated distance needed to enter the lumen of the artery. A slight give can usually be felt when the artery is entered.
9. Arterial blood usually fills the syringe under its own pressure but slight negative pressure generated by gentle retraction of the syringe plunger may be needed. Once the specimen has been collected withdraw the needle and immediately compress the puncture site for at least 5 min using a sterile gauze.
10. If air has been aspirated into the syringe, expel it.
11. Remove the needle, place an airtight cap over the tip of the syringe, and place the syringe into ice.
12. Transport the specimen immediately.

Sources of Variability

1. Contract with air, even as air bubbles within the syringe, will result in substantial alterations in the partial pressure of oxygen (pO_2) in the specimen. Because the pO_2 of arterial blood is always subatmospheric in patients who are not receiving oxygen therapy, exposure to air for even short periods will cause the pO_2 to increase. Air bubbles should be expelled from the syringe, and the tip of the syringe should be capped securely.
2. Because carbon dioxide is readily absorbed into heparin solution, a large volume of heparin in the collection syringe (as can happen in small syringes with large dead spaces) will cause a decrease in the partial pressure of carbon dioxide in the specimen. Minimize the residual heparin in the syringe prior to obtaining the specimen.
3. Cellular respiration in a blood specimen leads to a decrease in its pO_2. Cooling the specimen by immersing it in ice water effectively slows this process. Immediate delivery and processing of the specimen further reduces the likelihood of significant oxygen consumption.

Medical Considerations

1. Local anesthesia can greatly reduce the discomfort experienced by the patient so its use is encouraged.
2. Local trauma from an arterial puncture is usually minimal when arm arteries are used. In adults, femoral arteries are frequently atherosclerotic. Consequently, puncture of these arteries can lead

to disruption of atherosclerotic material, with downstream embolism. In addition, hemostasis is much more difficult to achieve with an atherosclerotic vessel. This is especially problematic for the femoral arteries, which lie deep in the soft tissues of the groin where direct pressure cannot be applied effectively. Massive blood loss can occur. In consideration of these concerns, femoral artery punctures are discouraged.

3. At the end of the procedure, direct pressure must be applied to the puncture site until the bleeding has stopped. This takes at least 5 min. A much longer time will be required for patients who are anticoagulated or who have a bleeding disorder.
4. Thrombosis is an uncommon complication of arterial puncture. Collateral circulation to the hand via the ulnar artery can be confirmed using the Allen test.
5. When the brachial artery is used as a puncture site care must be taken to avoid the underlying brachial nerve.

BLOOD, VENOUS: ANTECUBITAL VEIN

Equipment

Antiseptic—70% isopropanol (disposable gauze wipes soaked in isopropanol are available)
Sterile cotton gauze pads
Sterile syringe or vacuum tube holder
Disposable needle—the gauge of the needle should be appropriate to the size of the vessel to be entered. A "butterfly" needle (a short needle attached to a flexible plastic tube that ends in a syringe hub) may be used. Two-sided needles are required when vacuum tube containers are used.
Tourniquet
Specimen tubes

Procedure

1. Have the patient sit or lie down.
2. Prepare the specimen tubes and the syringe assembly and place them beside the patient.
3. Select the arm to be used for the procedure. Position the arm so that it is straight, well supported, and comfortable. Position yourself so that you are comfortable and have ready access to the puncture site.
4. Place the tourniquet 6-10 cm above the elbow to distend the veins. By palpation, identify a vein in the antecubital area that is of adequate size, pliant, and well seated (visual inspection alone will not detect many excellent deeper veins). If the veins are difficult to palpate, blood flow to the arm may be accentuated by wrapping the arm in a warm towel for 10 min prior to the procedure. Also, limited forearm exercise (for example, making a fist) can be used in an effort to "bring out" a vein. Do not massage or slap the arm.
5. Release the tourniquet before proceeding.
6. Cleanse the puncture site with antiseptic and allow it to air dry or wipe it dry with a sterile gauze pad.
7. Reapply the tourniquet.
8. Hold the skin taut over the puncture site by applying downward tension on the forearm with the thumb of the free hand. The free hand may provide additional support for the patient's arm.
9. Hold the syringe assembly in the line of the vein to be punctured at an angle approximately 30ş with the arm. The bevel of the needle should be up, the cutting tip down.
10. Puncture the skin and underlying vein, using a steady, moderately fast movement. The needle should be advanced no deeper than the estimated distance needed to enter the lumen of the vein. A slight give can usually be felt when the vein is entered. Also blood can often be seen at the needle hub.
11. Apply negative pressure by puncturing the vacuum tube or by gently retracting the syringe plunger. Blood should flow freely into the tube or syringe. If the flow is irregular, rotate the needle to reposition the bevel. Sometimes the needle tip has passed through the vein - the lumen can be reentered by pulling the needle backward slightly.
12. Remove the tourniquet once blood is flowing into the tube or syringe to prevent venous stasis at the puncture site.
13. Once the specimen has been collected, remove the needle and immediately apply pressure to the site, using a sterile gauze pad until the bleeding stops. The patient may apply the pressure with his or her free hand. Do not allow the patient to bend his or her arm as this reopens the incision in the vein.
14. Specimen tubes containing anticoagulants must be mixed promptly and may be inverted with one hand while applying pressure to the venipuncture site with the other.
15. Apply a sterile adhesive bandage.

Sources of Variability

1. Increased capillary hydrostatic pressure causes water to shift from the intravascular into the interstitial space. Blood cells, plasma proteins, and protein-bound constituents will be present in increased concentrations in this setting because they will be distributed in a reduced volume of plasma water. It can result from a systemic increase in capillary pressure such as is seen with prolonged standing, or from local effects, most notably a prolonged time of application of

the tourniquet during venipuncture. Both the time of standing prior to venipuncture and the time of tourniquet application should be kept to a minimum.

2. Rapid flow of blood through small-bore needles and exposures to large negative pressures lead to hemolysis with its accompanying contamination of the plasma portion of the blood specimen with red cell cytoplasmic constituents. Hemolysis is minimized by the use of large-bore needles, moderate flow rates, and moderate negative pressures. Invert specimen tubes gently to mix the blood with additives.
3. Blood specimen contamination with intravenous fluids is not uncommon. Blood should not be drawn from a site above as intravenous infusion, but must be obtained from a site on the patient's other arm or, if necessary, below the infusion site.

Medical Considerations

1. Local trauma from a venipuncture is usually minimal. If bleeding into the soft tissues or from the skin puncture site is noted during the procedure, the tourniquet should be removed immediately and direct pressure applied.
2. At the end of the venipuncture, direct pressure should always be applied to the puncture site until bleeding has ceased. This may take a long time in patients who are anticoagulated or who have a bleeding disorder.
3. Thrombosis and thrombophlebitis are rare complications.
4. Some patients become faint during venipuncture. The procedure should be terminated immediately and the patient should lie flat until he or she recovers.

BONE MARROW: POSTERIOR ILIAC CREST ASPIRATION AND BIOPSY

Equipment and reagents

The necessary equipment for obtaining bone marrow is usually available as a packaged, sterilized set.

Antiseptic—povidone-iodine solution
Local anesthetic—lidocaine hydrochloride
Sterile cotton gauze pads
Sterile syringes and plungers—a 10 ml syringe is used to administer the anesthetic. A 5 or 10 ml syringe is used to collect the specimen.
Sterile surgical blade
Disposable needles—25 and 20 gauge needles are usually used when administering the anesthetic.
Aspiration needle and stylet or biopsy needle, stylet, and probe
Sterile adhesive bandage or butterfly closure

Procedure

1. Place the patient in the prone position with his or her head resting on his or her folded arms.
2. Identify by palpation the posterior superior iliac spine of the iliac crest.
3. Cleanse the skin over the puncture site using the antiseptic. The remainder of the procedure is performed using sterilized equipment and sterile technique.
4. Local anesthesia is achieved by infiltrating the skin, soft tissue and periosteum at the puncture site with 2-3 ml of lidocaine hydrochloride. Use the 25-gauge needle for the skin and the 20-gauge needle for the soft tissue. Wait 4-5 minutes for the full anesthetic effect.
5. If a biopsy is to be obtained, make a 3 mm skin incision using the surgical blade to allow the biopsy needle to pass through the skin easily.
6. Insert the needle with stylet in place holding the needle perpendicular to the plane of the back.
7. Advance the needle through the bony cortex using firm pressure and an alternating twisting motion. Penetration into the marrow space is usually accompanied by a sudden increase in the ease of advancing the needle.
8. Remove the stylet and attach the specimen syringe.
9. Aspirate marrow by withdrawing the plunger. If no marrow enters the specimen syringe, remove the syringe, replace the stylet and advance the needle a few millimeters. Again remove the stylet, attach the specimen syringe, and attempt the aspiration. If this fails, remove the syringe, replace the stylet, and withdraw the needle until the tip is in the subcutaneous tissue. Redirect the needle into a nearby site.
10. Aspirate about 0.5 ml of marrow. The patient will usually experience a few seconds of suction pain during the aspiration.
11. Remove the syringe from the aspirating needle and hand it to the assistant or technician who will process the specimen.
12. If only an aspirate is to be obtained, replace the stylet and withdraw the needle. Apply firm pressure to the incision site using a sterile gauze pad.
13. If a biopsy specimen is to be obtained, replace the stylet, withdraw the needle from the bone, and reinsert the needle into nearby bone.
14. When the needle is firmly fixed in bone, remove the stylet and then slowly advance the needle 2-3 cm into the medullary cavity using an alternating twisting motion.
15. Replace the stylet. The length of the core specimen will be shown by the distance the end of the stylet projects from the needle hub.
16. Break off the specimen by rotating the needle through several turns in one direction then in the other or by rocking the needle from side to side.
17. Withdraw the needle and apply firm pressure to the incision site using a sterile gauze pad.
18. Remove the biopsy specimen by inserting the probe into the needle from the cutting end and pushing the core out through the hub. The assistant or technician will process the specimen.
19. Apply a butterfly closure to the skin incision and cover the site with an adhesive bandage.
20. Examine the incision site periodically for bleeding in patients who are thrombocytopenic.

Sources of variability

1. Failure to aspirate marrow (a "dry tap") may occur in a patient with a condition resulting in excessive collagen disposition in the marrow. A biopsy specimen must be obtain in such a circumstance.
2. Rapid processing of the specimens is essential. This is extremely difficult to do if the procedure and the processing must be performed by the same individual. It is desirable to have an assistant or laboratory technician present to process the specimens.
3. Correct technique in the processing of the specimens is essential. It is usually best to have a trained laboratory technician present to process the specimens.

Medical Considerations

1. Reassurance of the patient is often necessary prior to and during performance of the procedure.
2. In elderly individuals and in patients with myeloma the bone may be soft. Take care not to penetrate too deeply into bone.
3. At the end of the procedure, direct pressure should be applied to the incision site until bleeding has stopped. This may take a long time in thrombocytopenic patients.

CEREBROSPINAL FLUID: LUMBAR SUBARACHNOID SPACE

Equipment

The necessary equipment for a lumbar puncture is usually available as a packaged, sterilized set.

Antiseptic—povidone-iodine
Local anesthetic—lidocaine hydrochloride
Sterile syringe and plunger—a 10-ml syringe is used to administer the anesthetic.
Disposable needles—25- and 20-gauge needles are usually used when administering the anesthetic
Spinal needle and stylet - 20-gauge or smaller; a 26-gauge needle is best
Three-way stopcock
Manometer
Specimen containers
Sterile adhesive bandage

Procedure

1. Monitor the patient's cardiorespiratory status during and following the procedure.
2. Place the patient in the lateral recumbent position with the craniospinal axis parallel to the floor and the flat of the back perpendicular to the procedure table.
3. Have the patient assume the flexed knee-chest position with the back at the edge of the procedure table. An assistant is often needed to aid the patient in maintaining this position.
4. Identify by the palpation the spinal processes and interspaces. The line connecting the tops of the two iliac crests usually crosses the L3-L4 interspace. Use interspace L3-L4, L4-L5, or L5-S1.
5. Cleanse the skin over the puncture site using the antiseptic. Allow it to air dry. The remainder of the procedure is performed using sterilized equipment and sterile technique.
6. Local anesthesia is usually employed. Infiltrate the skin and soft tissue at the puncture site with 2-3 ml of the anesthetic. Use the 25-gauge needle for the skin and the 20-gauge needle for the soft tissue.
7. Insert the spinal needle with stylet in the midsagittal line of the prepared interspace. Hold the needle perpendicular to the plane of the back. Advance the needle through the longitudinal ligament into the subarachnoid space. A slight give is usually felt when the needle penetrates the dura.
8. Remove the stylet. If cerebrospinal fluid (CSF) appears, the space has been entered. If no fluid appears, replace the stylet and rotate the needle 90°. Again remove the stylet and check for CSF. If there is still no fluid, replace the stylet and advance the needle a few more millimeters. Feel for the give of the dura and check for fluid. If this fails, replace the stylet and withdraw the needle until the tip is subcutaneous, then redirect it along a new midline path.
9. When fluid appears at the needle hub, quickly attach the three-way stopcock and manometer. Orient the manometer in the true vertical. CSF should flow freely into the manometer. If the CSF flow is sluggish, rotate the needle or, if necessary, reposition it.
10. Record the "opening pressure" (mm CSF) once it has become steady. The patient should be relaxed with legs extended during the measurement.
11. If the "opening pressure" is elevated (greater than 200 mm CSF) or if the pressure quickly falls, only 1-2 ml of CSF should be removed. If the opening pressure is less than 200 mm CSF, withdraw adequate fluid to perform the desired studies. (If more than 20-30 ml is removed rapidly, a mild transient postural headache is likely.)
12. After the CSF sample has been removed, record the volume of CSF obtained and the "closing pressure" (mm CSF).
13. Replace the stylet and remove the needle.
14. Apply a sterile adhesive bandage.

Sources of Variability

1. The CSF pressure is raised in patients who are straining. The patient should be relaxed and quiet during the determination of the opening pressure.
2. Incision of a vessel in the ventral vertebral venous plexus can lead to contamination of the CSF specimen with blood. This is referred to as a traumatic tap. In order to distinguish a

traumatic tap from a valid finding of bloody CSF, centrifuge the first and last specimen tubes collected. If the fractional volume of blood in the last tube collected is much less than that in the first, the blood probably comes from a traumatic tap. A xanthochromic supernatant following CSF centrifugation indicates that blood was present in the CSF prior to puncture.

3. Adequate fluid should be withdrawn to perform the requisite laboratory studies. It is not the volume of fluid removed at the time of puncture but the subsequent leakage of CSF through the dural defect that is usually responsible for the complications of the procedure related to CSF volume depletion.

Medical Considerations

1. There are three settings in which the performance of a lumbar puncture entails a significant risk of a life-threatening complication. These are: a) the patient with increased intracranial pressure; b) the patient who has a hemorrhagic diathesis; and c) the patient with an infection at the proposed site of the lumbar puncture. Each of these settings is a relative contraindication for a lumbar puncture. The need for a CSF specimen must outweigh the risk involved if a lumbar puncture is performed in such cases.
2. Respiratory compromise, which can mimic ventilation failure from brain herniation, can develop in weak patients or patients with pulmonary disease who are held in a highly flexed position. Be certain that the patient can breathe comfortably while positioned for the procedure.
3. The most common complication of lumbar puncture is postural headache, which is often accompanied by backache. The incidence of headache depends upon the technique and can be as high as 20 percent. Headache is uncommon when small-bore spinal needles are used and when the number of punctures is minimized.
4. Radicular symptoms following a lumbar puncture suggest spinal nerve root trauma. Incorrect technique is the most frequent explanation for this complication. Spinal nerves are displaced and stretched when the CSF specimen is obtained using plunger action or when the spinal needle stylet is not replaced prior to withdrawal of the needle.

PERITONEAL FLUID

Equipment

The necessary equipment for an abdominal paracentesis is usually available as a packed, sterilized set.

Antiseptic—povidone-iodine solution
Local anesthetic—lidocaine hydrochloride
Sterile syringes and plungers—a 10-ml syringe is used to administer the anesthetic. A 30 or 50-ml syringe is used to collect the specimen
Disposable needles—25- and 22-gauge needles are usually used when administering the anesthetic
Intravenous catheter—a 20- or 22-gauge catheter with trocar is preferred
Three-way stopcock
Sterile tubing—two 30-50 cm lengths tubing may be needed
Specimen containers
Sterile adhesive bandage

Procedure

1. Have the patient empty his and her bladder.
2. Place the patient in the semirecumbent position.
3. Identify the puncture site - the avascular midline caudad to the umbilicus and caudad to the level of percussible dullness. Avoid surgical scars. If a midline scar is present, use a site in the lower abdomen 1-2 cm lateral to the margin of the rectus sheath. Use the side which is more dull to percussion. If the volume of peritoneal fluid is small, such that dullness to percussion can be demonstrated only when the patient is in the hands-knee position, the patient should undergo the procedure in that position. If the patient is too weak to maintain the position, place the patient in the prone position spanning two beds, and perform the procedure sitting on the floor.
4. Cleanse the skin over the puncture site using the antiseptic. Allow it to air dry. The remainder of the procedure is performed using sterilized equipment and sterile technique.
5. Infiltrate the skin and soft tissue at the puncture site with 5 ml of the anesthetic. Use the 25-gauge needle for the skin and the 22-gauge needle for the soft issue.
6. Retract the skin at the puncture site toward the symphysis and insert the trocar with catheter. Hold the trocar perpendicular to the abdominal wall. Advance the trocar into the peritoneal cavity. When fluid appears in the catheter tubing remove the trocar while keeping the catheter in place. Attach a length of tubing to the catheter hub and the large syringe to the free end of the tubing.
7. Withdraw adequate fluid to perform the desired studies.
8. If a large volume of fluid is to be removed, insert the stopcock into the free end of the tubing. Attach the large syringe and the other length of tubing to the stopcock. Aspirate fluid into the syringe then expel it through the open tubing.
9. Remove the catheter. Apply direct pressure to the puncture site.
10. Apply a sterile adhesive bandage.

Sources of Variability

1. Incision of a vessel can lead to contamination of the peritoneal fluid specimen with blood. The volume of fluid is usually so large that such contamination has little effect upon the laboratory studies. However, this possibility must be kept in mind if the study values are at variance with the clinical impression.

Medical Considerations

1. The performance of an abdominal paracentesis in a patient with a hemorrhagic diathesis is associated with a significant risk of serious abdominal wall or intraperitoneal hemorrhage. Because of this risk, this setting is a relative contraindication for a paracentesis. The procedure can be made much safer by therapeutic correction of the bleeding disorder, if possible.
2. Perforation of bowel is unusual if the bowel is mobile. Even if punctured, the bowel usually does not leak its contents. Peritonitis can develop, however, so closely monitor any patient who suffers a bowel perforation during paracentesis. The chance of puncturing the bowel is minimized by not selecting a puncture

site near a surgical scar (intraperitoneal adhesions can tack the bowel to the anterior abdominal wall) and awaiting decompression of the bowel in patients with bowel distention.

3. Puncture of the bladder is avoided by making certain that the patient's bladder is empty.
4. Peritoneal fluid may leak from the puncture site and may infiltrate along the puncture track into the abdominal wall.

PLEURAL FLUID

Equipment

The necessary equipment for a thoracentesis is usually available as a packaged, sterilized set.

Antiseptic—povidone-iodine
Local anesthetic—lidocaine hydrochloride
Sterile syringes and plungers—a 10-ml syringe is used to administer the anesthetic. A 30 or 50-ml syringe is used to collect the specimen
Disposable needles—25- and 20-gauge needles are usually used when administering the anesthetic
Intravenous catheter—a 16- or 14-gauge catheter with trocar is preferred
Three-way stopcock
Sterile tubing—two 30-50 cm lengths of tubing may be needed
Specimen containers
Sterile adhesive bandage

Procedure

1. Place the patient in the sitting position, preferably with his or her legs over the side of the procedure table. Support the patient's feet and rest his or her arms on a pillow on a bedside stand.
2. Identify the puncture site - the intercostal space at the location of maximum dullness to percussion, usually in its posterolateral aspect. Posteriorly the site should be above the ninth rib, and laterally, above the seventh rib.
3. Cleanse the skin over the puncture site using the antiseptic. Allow it to air dry. An area incorporating three interspaces should be cleansed. The remainder of the procedure is performed with sterilized equipment and sterile technique.
4. Infiltrate the skin and soft tissue at the puncture site with 5 ml of the anesthetic. Use the 25-gauge needle for the skin and the 20-gauge needle for the soft tissues. Always advance the needle perpendicular to the chest surface and above the lower rib. The intercostal nerve and blood vessels located at the lower margin of the upper rib are thereby avoided. Advance the needle in 1-2 mm increments injecting a small portion of the anesthetic at each step. Negative pressure is applied to the syringe prior to each injection to assure that the anesthetic is not injected into a blood vessel. The patient will usually complain of pain when the parietal pleura is reached. Inject a generous amount of anesthetic there. Continue to advance the needle in steps until pleural fluid is aspirated. If the needle is inserted all the way to its hub without obtaining fluid, withdraw it slowly while applying constant negative pressure. Puncture at a site one interspace inferior or superior to the original site may then be considered.
5. When pleural fluid is aspirated, withdraw the needle, insert the trocar with catheter into the prepared site, and advance it on through the parietal pleura, always staying just above the lower rib. When fluid appears in the catheter tubing remove the trocar while keeping the catheter in place. Attach a length of tubing to the catheter hub and the large syringe to the free end of the tubing.
6. Withdraw an adequate amount of fluid.
7. If a large volume of fluid is to be removed, insert the stopcock into the free end of the tubing. Attach the large syringe and the other length of tubing to the stopcock. Aspirate fluid into the syringe then expel it through the open tubing.
8. Remove the catheter. Apply direct pressure to the puncture site to seal the puncture track and prevent aspiration of air.
9. Apply a sterile adhesive bandage.
10. Monitor the patient's respiratory status.

Sources of Variability

1. Incision of a vessel can lead to contamination of the pleural fluid specimen with blood. The volume of fluid is usually so large that such contamination has little effect upon the laboratory studies. However, this possibility must be kept in mind if the study results are at variance with the clinical impression.

Medical Considerations

1. The most common complication of thoracentesis is pneumothorax due to puncture of the visceral

pleura. This is usually small and does not produce symptoms. Larger pneumothoraces require prompt therapy. The risk of puncturing the visceral pleura is minimized by avoiding those portions of the chest where pleural adhesions are known to exist and by advancing the needle and the trocar less than 1 cm beyond the parietal pleura.

2. Subcutaneous emphysema caused by the needle track is avoided by sealing the puncture site immediately after withdrawing the needle.
3. Hemorrhage into the intercostal space and the pleural cavity will occur if the intercostal vessels, especially the artery, are punctured. Significant acute blood loss and hemothorax can result. This complication is rare if the needle and the trocar are kept just above the lower rib as they are advanced through the intercostal space.
4. Puncture of the diaphragm and subdiaphragmatic organs is avoided by selecting the puncture site carefully. The site should not be below the ninth rib posteriorly or the seventh rib laterally.

URINE: TIMED COLLECTION

Equipment

Specimen container—disposable plastic containers are preferred. The container should be large, usually 4 L. The appropriate preservative should be placed into the container prior to the start of the collection. Preservatives are usually added by the laboratory. If the analyte to be assayed is light sensitive, a dark container is necessary.

Procedure

1. Patient cooperation is imperative for a successful timed urine collection so instruct the patient carefully in the procedure and encourage his or her cooperation.
2. Warn the patient if the urine preservative is caustic.
3. Instruct the patient to discard a voiding and record the time. For 24 h collections, it is usual to discard the first morning voiding.
4. Have the patient collect every voiding for the duration of the timed collection. The urine may be collected in a wide-mouthed, chemically clean container and then poured into the specimen container.
5. The specimen container should be kept refrigerated throughout the collection period.
6. The last urine collection should be a complete, forced voiding at the exact end of the timed period.
7. Seal the container tightly and submit the specimen immediately.

Sources of Variability

1. The specimen container should be chemically clean.
2. The analyte of interest must be preserved during the storage of the urine while the collection is in progress. Light-sensitive analytes should be shielded in dark bottles. Refrigeration is used to retard bacterial growth as well as to stabilize certain analytes. Acidification of the urine is necessary to assure stability of a large number of analytes.
3. Since the timed urine collection is used to calculate an excretory rate, i.e. amount of analyte excreted per unit time, it is imperative that the collection be complete and properly timed. Unfortunately, timed collections very frequently are incomplete, usually because of the forgetful discarding of a voiding during the collection. Over-collection does happen but is much less common. Variability in the completeness of the collection is by far the most important variable in timed collections. Consequently, care must be taken to instruct the patient or nursing staff in the importance of a complete collection.

URINE: RANDOM COLLECTION

Equipment

Specimen container—disposable plastic cups are preferred

Procedure

1. Random specimens may be collected at any time.
2. Instruct the patient to urinate into the specimen container.
3. Seal the container tightly and transport the specimen immediately.

Sources of Variability

1. The specimen container should be chemically clean.
2. Perform the examination of the urine immediately, that is, on fresh, warm urine. Delay will result in the disappearance of leukocytes, casts, and bilirubin; the appearance of crystals and crystal aggregates; and the proliferation of bacteria with resultant pH changes.

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Sweet is the melody, so hard to come by
It's so hard to make every note bend just right
You lay down the hours and leave not one trace
But a tune for the dancing is there in its place.

Iris DeMent