

be viewed. Clotting may be suspected in bodies that have been dead for long periods, in deaths from systemic infections and febrile disease, and in bodies of persons who were bedfast for long periods.

When the embalmer suspects that the blood vascular system is heavily clotted or that distribution of arterial solution will be difficult, the best vessel to use in beginning the arterial injection is the common carotid artery, and drainage should be taken from the right internal jugular vein. An even better method is to raise both common carotid arteries at the beginning of the embalming (restricted cervical injection). As the head is thus separately embalmed, the embalmer maintains control over solution distribution into the facial tissues.

6. Facial tissue distension

The possibility of distension of the facial tissues during injection exists in (1) bodies dead for long periods of time; (2) bodies with facial trauma, and (3) bodies that have been frozen or in refrigeration for extended periods of time. Use of restricted cervical injection would best control the amount of arterial solution entering the facial tissues in the unautopsied body.

7. Facial discolorations

Intense livor mortis and possibly postmortem stain are frequently seen when bodies have died from congestive heart failure or pneumonia. Any postmortem condition, in which the head is dependent to the heart, can increase this discoloration. Obese bodies when the shoulders and head have not been elevated will exhibit intense livor mortis. Postmortem refrigeration and the antemortem use of blood thinners can contribute to facial livor mortis, when the head is in a dependent position.

In the preparation of these bodies, this intense discoloration necessitates elevation of the shoulders and head. The right internal jugular vein is the best choice for drainage. It may be necessary to open and drain both right and left internal jugular veins. Clearing of these tissues is also assisted by direct injection of arterial solution into the head, which is best achieved by raising and injecting the right and left common carotid arteries.

8. Volume and strength of arterial solution

In the unautopsied body, stronger solutions may be necessary if (1) there is a long delay between the death and the embalming, (2) the body shows evidence of decomposition, (3) death was due to uremic poisoning or burns, and (4) skeletal edema is present. To avoid running excessive

amounts of solution through the facial tissues, restricted cervical injection is recommended.

9. Medicolegal requirements

These examples illustrate specific requirements in selection of an injection site:

- An embalmer preparing a body under orders from the military services may be instructed to follow military standards for the choice of vessels for injection.
- Some hospitals allow arterial embalming prior to autopsy; in such situations, the hospital may have preference as to the vessels to use for injection of the body.
- Some medical schools may allow embalming and a funeral service before the body is taken by the medical school. Specific vessels may be necessitated by the medical school for the embalming of the body.

► MULTIPPOINT INJECTION SITES

When arterial embalming solution has failed to distribute to a particular area, or if the embalmer feels that an insufficient amount of arterial solution is present in a body area, the first consideration should be the direct arterial injection of that area. **The injections here all involve treatment of the head or appendages.** If there is insufficient arterial solution in any area of the **trunk portion** of the body, these areas are best treated by hypodermic injection of the area rather than by arterial treatment.

Three methods of embalming can be used to treat body areas that have not received enough arterial solution: (1) arterial embalming, (2) hypodermic embalming, and (3) surface embalming.

Multipoint injection of the head or limbs could include injection of one or more of the following arteries in the **head**, the right and left common carotid and the right and left facial arteries; in the **arms**, the left or right axillary, brachial, radial, or ulnar artery; and in the **legs**, the left or right external iliac, femoral, popliteal, anterior tibial, or posterior tibial artery. As part of the ongoing embalming analysis, the embalmer must determine what additional injections are necessary to properly arterially embalm the areas where additional solution is needed.

Example 1. Suppose the starting injection site was the right femoral artery. Assume that there is no arterial solution in the entire left arm. Methods to stimulate the flow of the arterial solution into the arm have been unsuccessful. It is presumed that a clot or coagulum that was present in the abdominal aorta has been freed and has moved into the left subclavian artery. Now, the embalmer must select a secondary injection site. It is almost

certain that the left axillary or brachial artery may be used. Injection from this point should establish distribution of solution down the arm and into the hand.

Example 2. Using the same set of circumstances as in Example 1, assume that arterial solution reaches only as far down the left arm as the elbow. Now, the embalmer must decide whether the radial or ulnar artery (or both) should be raised, the hand injected, and then the arterial tube reversed and some solution injected back toward the elbow.

Example 3. Assume that a body has been embalmed using the right common carotid artery for injection. Drainage was taken from the right internal jugular vein. After arterial embalming, it is felt that the right leg does not have enough arterial solution. The embalmer raises the right femoral artery to inject the leg. Drainage can be taken from (1) the right internal jugular vein, (2) the right femoral vein, or (3) the heart (during aspiration).

► ELEVATION OF VESSELS

After selecting an injection site, the embalmer elevates the vessels to the skin surface, places ligature under the vessels, and opens and inserts tubes into the artery for arterial solution injection and a drainage device into a selected vein for drainage.

After injection of the arterial solution, the embalmer evaluates the body to determine whether any further injection is necessary for regions that may have received an inadequate amount of preservative. If such areas are found, sectional injection sites are selected and an artery or arteries raised for direct injection into the areas needing additional solution.

This section of the chapter involves the general protocol for raising vessels. Later, the specific locations for incisions and the protocol for raising vessels with respect to the individual artery selected are examined.

- Select instruments and prepare ligatures for the vessels to be used. Be certain that arterial tubes, especially very small tubes, are clear and working before inserting them into an artery.
- Locate vessels and their respective sites for skin incision by the linear guide on the surface of the skin.
- Generally, make incisions where the vessels are nearest the skin surface.
- In the dissection for the vessels, remember that muscles do **not** have to be cut to locate arteries, veins, and nerves. These run in groups **between** the muscles. The only muscle that may have to be divided for locating vessels is the sternocleidomastoid muscle.

- Make an incision through the skin. Use blunt dissection through the superficial and deep fascia. Locate the vessels on the basis of their anatomical guides and surrounding structures. Raise each vessel to the surface of the incision and place ligatures loosely around each vessel raised.

Example. When the internal jugular vein and the common carotid artery are raised, the vein is the superficial vessel. After a ligature is placed around the vein, it is pulled laterally. The artery can easily be located on the medial side of the vein, a little deeper than the vein. The common carotid artery is described as being **medial** and **deep** in its relationship to the internal jugular vein.

- The order in which vessels are raised varies, depending on the relationship of the artery to the vein. Two general rules should be remembered:
 - When both the artery and the vein are to be used (as in a one-point injection), always raise the superficial vessel first.
 - When both the artery and the vein are to be used at the same location (as in a one-point injection), **always insert instruments** (arterial tube or drainage instrument) **into the deepest vessel first.**

Example. When raising the right internal jugular vein and the right common carotid artery, raise the vein **first**, because it is the most superficial. Pull the vein laterally, raise the **deeper** common carotid artery to the surface, open the artery, insert the arterial tubes, return to the vein, open the vein, and insert the drainage instrument.

- Make an incision into the artery, insert the arterial tube, and tighten the ligature to secure the tube into place.
- Always use arterial tubes slightly smaller than the lumen of the artery into which they are to be inserted. **Do not** force arterial tubes into arteries.
- If clotted material is present in an **artery**, especially in the common carotid artery, attempt to gently remove this material.
- Arteriosclerosis does not always mean that it cannot be used for injection. Starting from the incision, find the "softest" portion of the exposed artery. Some forms of arteriosclerosis actually form a "wall" around the lumen. Open the sclerotic artery—observe if there is a small lumen pushed to one side of the artery into which a small arterial tube can be inserted.
- If an artery is accidentally broken (arteries remain open and do not collapse), merely locate the two open ends and attach a hemostat to

each. Carefully apply new ligatures and insert arterial tubes.

► INSTRUMENTS AND LIGATURES

To raise an artery for injection and a vein for drainage, the following instruments may be used:

Instrument	Use
Scalpel	Making the incision; opening the artery or the vein
Double-point scissors	Making the incision; preparing ligatures; opening the artery or vein
Aneurysm needle	Dissecting fat and fascia; elevating vessels at surface
Bone separator	Elevating vessels at skin surface
Arterial tubes	For insertion into the artery for injection of fluid
Drainage tube	For insertion into the vein for drainage control
Angular spring forceps	For insertion into the vein for drainage control (in lieu of a drainage tube)
Straight spring forceps	Passing ligatures around the vessels
Grooved director	Assisting in expansion of the vein for insertion of the drainage device

This list represents the minimum number of instruments. Various other instruments can also be used. These include arterial hemostats (for holding the arterial tubes in place within the artery; this is of great help in autopsy preparation), ligature passers, arterial scissors, and retractors. Ligatures for securing the arterial and drain tubes are generally linen or cotton thread. The cotton is somewhat thicker and softer and many embalmers prefer it.

Cut ligatures long enough so that you can get a good grip on the string to make a very secure tie. A length of 8 to 12 inches is comfortable to work with.

► VESSELS USED FOR ARTERIAL EMBALMING

The arteries discussed in this chapter from the standpoint of injection site are the common carotid artery, femoral artery, external iliac artery, axillary artery, brachial artery, popliteal artery, radial artery, ulnar artery, facial artery, abdominal aorta, thoracic aorta, anterior tibial artery, and posterior tibial artery. With respect to these arteries, the area supplied, the considerations for their use, precautions, locations for incisions

for raising the vessels, and the protocol for raising the vessels and inserting instruments when both the artery and the vein are being used for an injection and drainage site are discussed.

Also discussed (along with the accompanying artery) is the use for drainage of the internal jugular vein, femoral vein, external iliac vein, axillary vein, and inferior vena cava. The location and use of the right atrium of the heart as a drainage point are included in the discussion. Because the incisions for the veins are the same as those for the arteries, the student is asked to refer to the artery incisions.

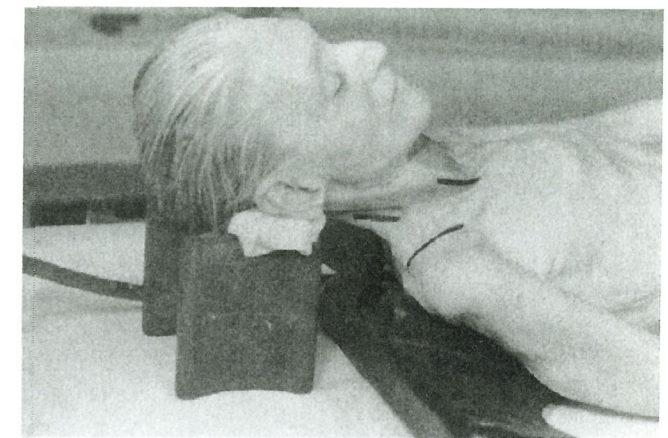
Common Carotid Artery

To be accurate in the discussion of this vessel, consideration is given to the use of a one-point injection, but there follows a discussion of **restricted cervical injection**, which employs both right and left common carotid arteries.

The common carotid artery is the largest vessel the embalmer can raise from a superficial point in a body region outside the trunk area. The incision is made in the inferior portion of the neck. This large artery is closely situated near the **arch of the aorta**, which is the central distribution point for arterial fluid. The common carotid artery can well be described as the "best choice" for injection of the body, especially if there has been any time delay between death and preparation or if vascular difficulties are anticipated.

- Regions supplied
 - If the injection is directed superiorly, the head and the face are embalmed.
 - If the injection is directed inferiorly, the opposite side of the face and the head are embalmed as are the trunk and appendages.
- Considerations
 - It is very large in diameter.
 - It has no branches except the terminal branches, so it is easily raised to the skin surface.
 - It is very elastic.
 - It is rarely found to be sclerotic.
 - It supplies fluid directly to the head.
 - It is situated close to the arch of the aorta.
 - It is accompanied by a very large vein that can be used for drainage.
 - Arterial coagula are pushed away from the head.
- Precautions
 - The head may be overinjected.
 - If leakage occurs, it may be seen.
 - Some types of instruments, if improperly used, may mark the side of the face or jaw line.
 - The incisions may be visible with some types of clothing.

- Incisions for the common carotid and the internal jugular vein
 - Supraclavicular* (anterior lateral): The incision is made on the clavicle (collar bone) from a point near the sternoclavicular articulation and is directed laterally.
 - Anterior vertical* (parallel): The incision is made from a point near the sternoclavicular articulation and is directed upward on the sternocleidomastoid muscle.
 - Posterior vertical* (parallel): The incision is made posterior to the sternocleidomastoid muscle, 2 inches below the lobe of the ear, and is directed downward toward the base of the neck.
 - Anterior horizontal*: The incision is made at the base of the neck from a point on the sternocleidomastoid muscle and is directed posteriorly.
 - Flap incision (semilunar)*: This incision is used by the operator when it is necessary to raise the vessels on both the right and left sides for injection or drainage. The incision extends from a point lateral and slightly superior to the sternoclavicular articulation and is directed downward on the upper chest wall, across and upward to a similar location on the opposite side. The pattern may be either a U or an inverted C in shape.
 - Strap line*: This incision is adaptable to the embalming of females. The incision is made approximately 2 inches lateral to the base of the neck on the line where the strap of the undergarments crosses the shoulder (Fig. 9-1).
- Suggested protocol for raising the common carotid artery and the accompanying internal jugular vein
 - Take a position **at the head of the embalming table**.
 - Turn the head of the body in the **direction opposite** that of the vessels being raised (i.e., if the right common carotid is being raised, turn the head to the left).
 - Place a shoulder block under the shoulders and lower the head of the body on the head block.
 - Make the incision. Dissect through (or cut through) the platysma muscle and the superficial fat and fascia.
 - The sternocleidomastoid muscle will exhibit an area where its fibers part at the clavicle (it looks like a triangle).
 - Raise the **internal jugular vein**: Put a ligature around the vein and pull it laterally.
 - Go **medial and deep** and locate the common carotid and bring it to the surface; put two



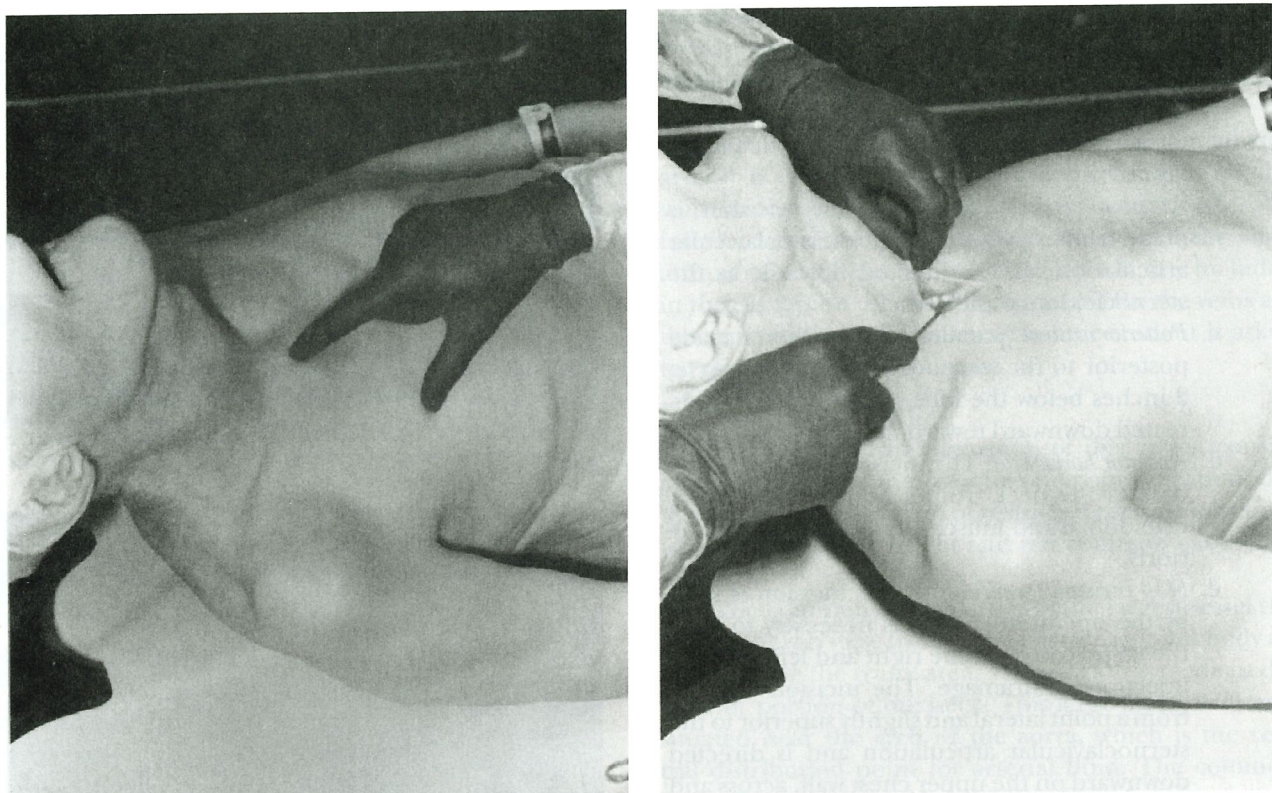
A



B

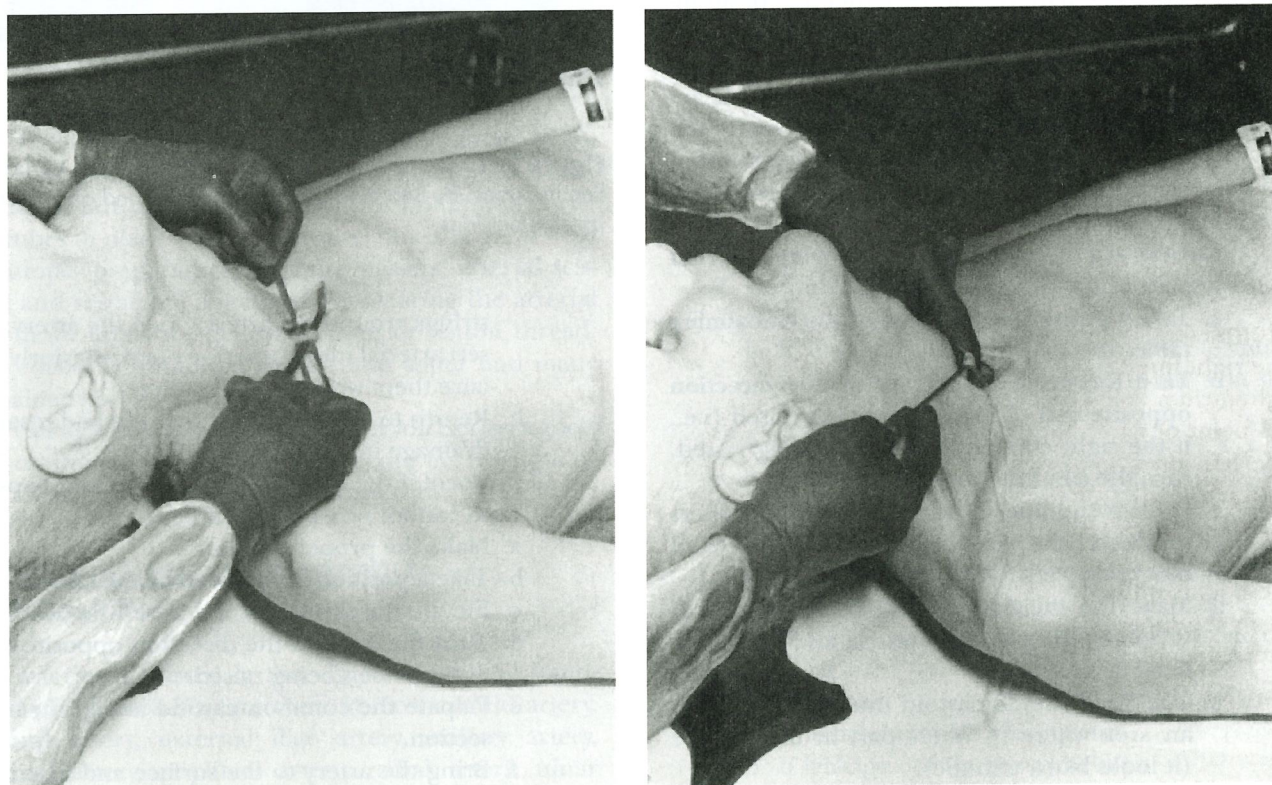
Figure 9-1. A. Anterior vertical, posterior vertical, and strap line incisions. B. Supraclavicular, semilunar, and anterior horizontal incisions.

- strings around the artery; open the artery; insert arterial tubes superiorly and inferiorly; secure them with a tight ligature.
 - Return to the vein; open the vein and insert a drainage instrument (Fig. 9-2).
- Protocol if the internal jugular vein is collapsed (and cannot be easily identified).
 - Make the proper incision.
 - Take a position at the **head of the table**.
 - Elevate the shoulders and lower the head.
 - Turn the head in the direction opposite that of the vessels being raised.
 - Palpate the common carotid artery after dissection.
 - Bring the artery to the surface and insert arterial tubes into the artery.
 - Begin arterial injection.
 - When vein becomes dilated, elevate it to the surface and ligate.



A

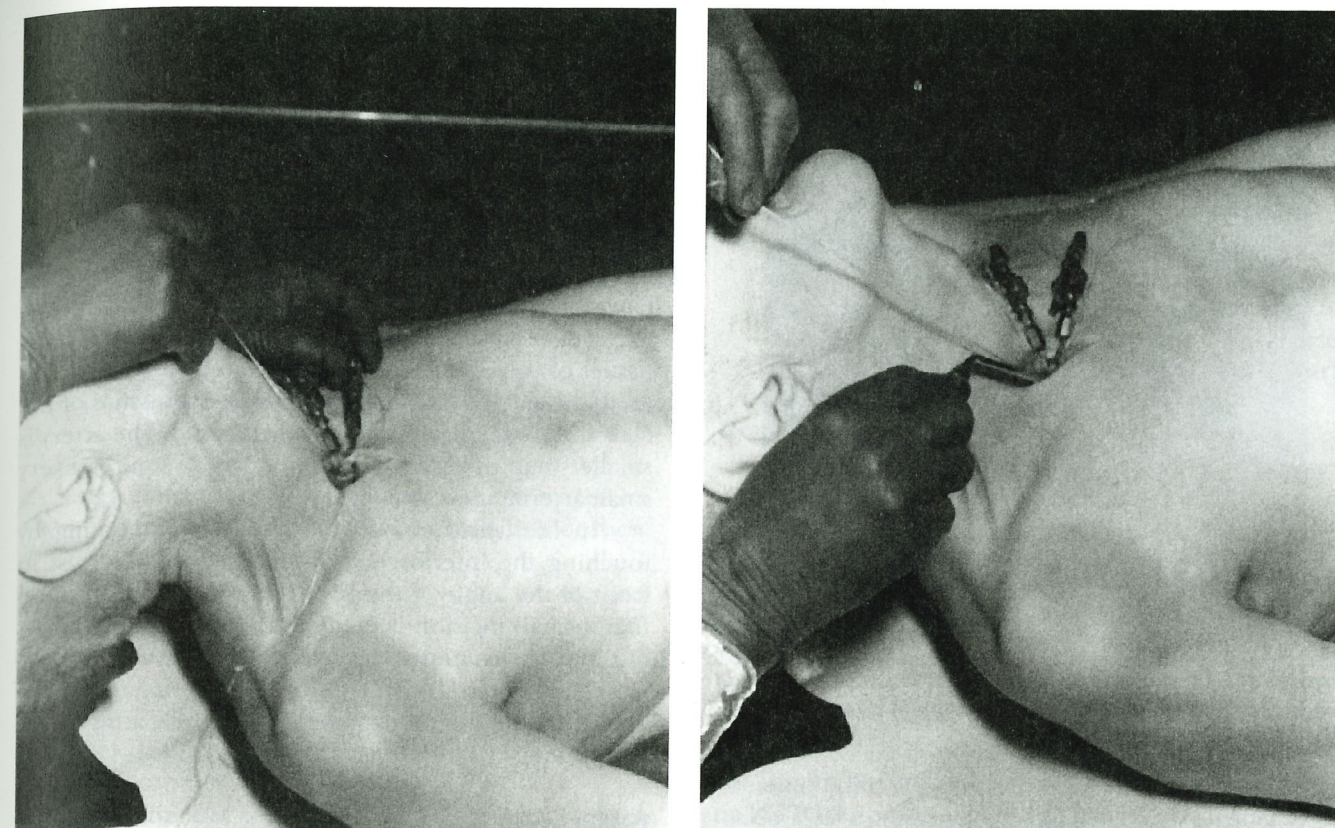
B



C

D

Figure 9-2. **A.** Point at which an anterior parallel incision is made. **B.** The (superficial) internal jugular vein is raised first. **C.** A ligature is placed around the vein and it is pulled laterally. **D.** With the vein pulled laterally, the artery, which is medial and deep to the vein, is raised.



E

F

Figure 9-2. (Continued) **E.** Arterial tubes are placed into the common carotid and secured with ligatures. **F.** The operator elevates the vein and inserts a drainage instrument toward the heart. Note the suggested position of the operator throughout this procedure.

Internal Jugular Vein

The right internal jugular vein is in direct line with the right atrium of the heart. The right atrium is the central point of blood drainage in the dead human body. The left internal jugular, although a very large vein, does not lead directly into the right atrium. Instead, it joins with the left subclavian vein to form the left brachiocephalic vein, which crosses to the right side of the chest, joins with the opposite brachiocephalic vein, and forms the superior vena cava. For this reason, the right internal jugular vein is preferred as a drainage site.

1. Considerations

- The vein is very large.
- There is direct drainage from the face and the head.
- It is accompanied by the common carotid artery, which can be used for injection.
- The right internal jugular vein leads directly through the right brachiocephalic and superior vena cava into the right atrium, allowing easy removal of clotted material that may be present.

2. Precautions

- Leakage may be visible.
- Drainage instruments, if improperly used, may mark the face.
- The incision may be visible with some clothing.

Because of its size, its location with respect to the right atrium of the heart, and its ability to directly drain the head, the right internal jugular vein certainly must be considered as one of the best possible sites for drainage during arterial injection.

An excellent method of embalming involves raising **both** the right and left common carotid arteries at the beginning of the embalming process. This method of embalming, **restricted cervical injection**, most effectively controls arterial solution entering the head and the face (Fig. 9-3). The procedures are as follows:

- Raise the right common carotid artery and the right internal jugular vein.
- Insert an arterial tube into the right common carotid artery directed toward the head. Insert a

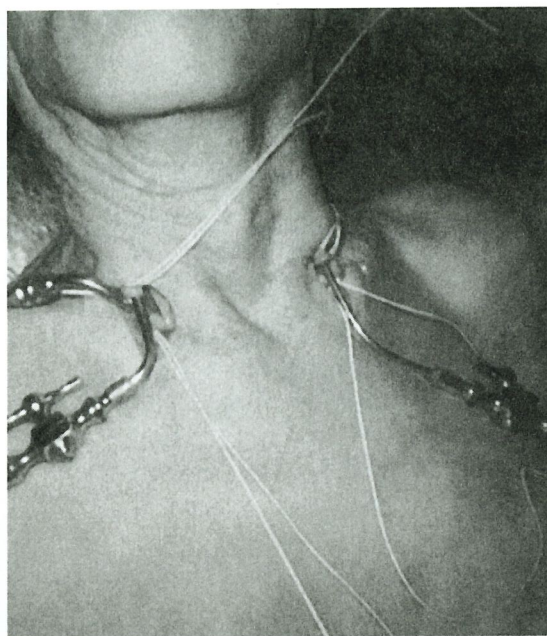


Figure 9-3. Restricted cervical injection affords control over the amount and strength of solution entering the facial tissues.

second tube into the artery directed toward the trunk. **Be certain to keep the stopcock OPEN on the tube directed toward the head.**

3. Insert a drainage device into the right internal jugular vein.
4. Raise the left common carotid artery only. **Insert a tube into the artery directed toward the head and leave the stopcock OPEN.** Tie off the lower portion of the artery.

The following are some advantages to use of the restricted cervical injection:

- The arteries are large.
- Carotids are very elastic and have no branches, so they are easy to elevate.
- The arteries are accompanied by the largest veins.
- The arteries are rarely sclerotic.
- Clots or coagula present in the arterial system will be pushed away from the head area.
- Solution is supplied directly to the head.
- This injection allows the best control over the amount of arterial solution entering the head.
- Two strengths of arterial solution can be used: one for the trunk and another for the head.
- Two rates of flow can be used: one for the trunk and a second for the head.
- Two pressures can be used: one for the head and another for the trunk.
- Large volumes of solution can be run through the trunk without overinjecting the head.

Features may be set after the trunk is embalmed and aspirated if purging took place during injection.

Facial Artery

The facial artery can be used in two situations: in bodies that have been autopsied and the common carotid and portions of the external carotid removed and in bodies with clotting or sclerosis of the carotid artery, most frequently found in persons who have suffered from an extracerebral stroke.

The facial artery supplies arterial solution to the soft tissues of the face, the upper and lower lips, the mouth area, the side of the nose, and the medial tissues of the face and some portions of the lower eyelid. The artery is smaller than the carotid or femoral and requires a very small arterial tube (see Fig. 8-2).

In life, the facial artery can be felt pulsating by touching the inferior margin of the mandible just in front of the angle of the jaw. It is in this same location that a small incision is made to raise the artery. Fibers of the platysma muscle have to be opened, and by moving the aneurysm needle along the inferior margin of the mandible, the embalmer can find the artery. This incision is best closed with super glue (Fig. 9-4).

Axillary Artery

The axillary artery is a continuation of the subclavian artery. It begins at the lateral border of the first rib after passing through the **cervicoaxillary canal**. (This canal is bounded by the first rib, clavicle, and scapula.) This vessel can be used to embalm the entire body.

During the early years of embalming, when much work was done at the residence of the deceased, this vessel was preferred. The head received a large amount of solution, and the incision itself was easily hidden from view. It was a very "clean" artery to employ for injection,



Figure 9-4. Left facial artery.

and drainage was generally taken directly from the right side of the heart by use of a trocar. Early arterial solutions were quite strong, so large volumes were not injected. The small volume would quickly clear the head when injection was from the axillary.

Today, the axillary artery is used principally as a secondary point of injection where there is insufficient arterial solution in the arm or hand. The axillary vein is relatively small and may not allow easy access for the passage of clotted materials.

1. Regions supplied
 - a. If the arterial tube is directed toward the hand, the axillary supplies fluid directly to the arm and hand.
 - b. If the tube is directed toward the body, the entire body can be embalmed from this location.
2. Considerations
 - a. Arterial solution flows directly into the arm and hand.
 - b. The artery is close to the face.
 - c. The vessels are superficial.
 - d. The artery is close to the center of arterial solution distribution.
3. Precautions
 - a. The arm must be extended, especially if the vein is to be used for drainage.
 - b. The artery is small for injection of the whole body.
 - c. The artery is accompanied by a vein that is small for drainage.
 - d. There exists the danger of overinjecting the facial tissues.
 - e. There are numerous branches and, often, anomalies.
4. Incision for the axillary artery and vein
 - a. The arm should be extended (abducted) a little less than 90 degrees from the body. The incision is made parallel to the linear guide. Many embalmers make this incision along the anterior margin of the hairline of the axilla.
5. Suggested protocol for raising the axillary artery and vein

When the arm is abducted, the artery will be found slightly anterior and deep to the axillary vein and the brachial plexus. The vein can be described as being located medial and superficial to the axillary artery (Fig. 9-5).

 - a. Abduct (extend) the arm and rest the distal portion of the arm on the hip of the embalmer. Try not to abduct the arm beyond 90 degrees, as this tends to compress the structures in the arm.
 - b. Make the incision along the anterior margin of the hairline.

- c. Begin the dissection and first locate the axillary vein. This will be a superficial vessel.
- d. Place a ligature around the vein and pull the vein away from the incision and downward.
- e. Go "above" and "behind" the vein to locate the artery.
- f. Pass two ligatures around the artery.
- g. Incise the artery and place arterial tubes into the vessel.
- h. Return to the vein, pass a second ligature around the vein, and open the vein and insert a drainage tube or forceps toward the heart.

Brachial Artery

The brachial artery supplies fluid directly to the arm and the hand. If the tube is directed toward the body, the artery is large enough that the entire body can be embalmed from this point, but because of the small size of the brachial artery, injection would be quite slow and it would be very difficult to build effective arterial pressure. Drainage from the accompanying basilic vein is difficult, as this vein is quite small.

The incision for the brachial artery may be made anywhere along the upper half of the linear guide. The proximal third is preferred. Many embalmers make this incision approximately 1 inch above and parallel to the linear guide. To raise the artery, the arm should be abducted.

Radial Artery

The radial artery supplies solution directly to the thumb side of the hand. It is quite superficial and may easily be palpated through the skin in the area of the wrist. The incision is made parallel to the artery directly on the linear guide, approximately 1 inch above the base of the thumb (Fig. 9-6).

Ulnar Artery

The ulnar artery supplies arterial solution directly to the medial side of the hand. The incision is made parallel to the vessel directly over the linear guide. Generally, the incision should terminate approximately 1 inch above the pisiform bone (Fig. 9-7).

There are times when injection of the axillary or brachial artery alone will establish adequate flow of solution into the arm and the hand. With heavy clotting, however, it is necessary to raise and inject both the radial and the ulnar arteries to adequately embalm the hand. Also, a tube may be directed toward the arm from the radial or ulnar artery in an attempt to inject more solution into the arm area.

If there is difficulty clearing the hand, the embalmer may try injecting only the radial artery. When this is done, digital pressure should be placed on the ulnar artery. By application of such pressure, short-circuiting

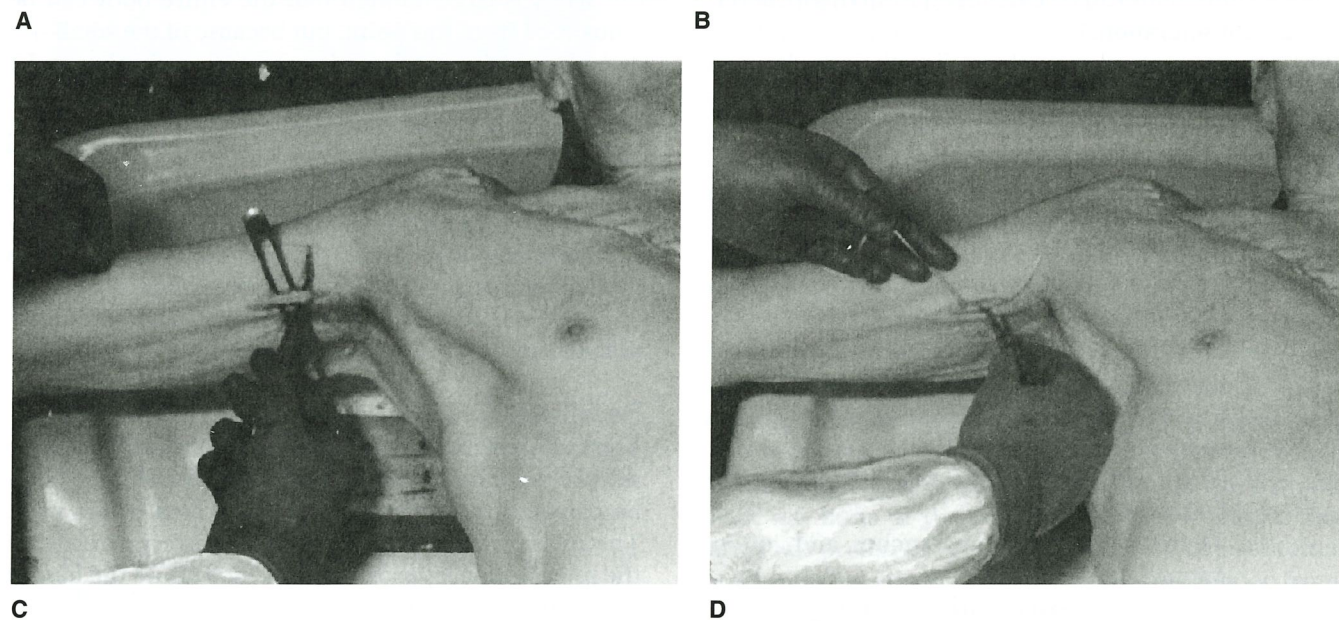
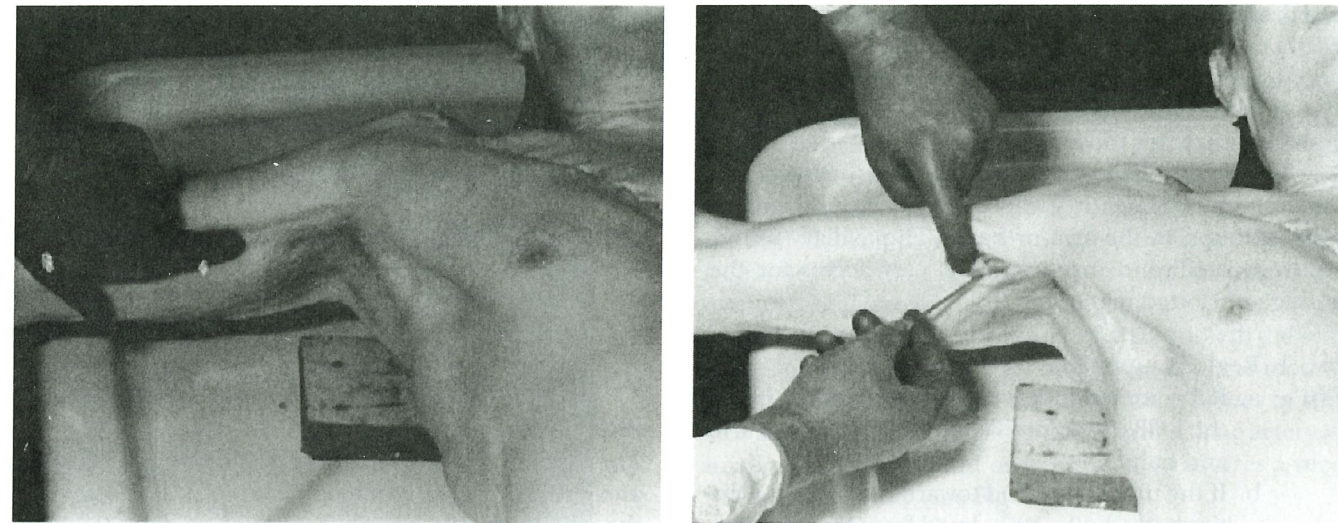


Figure 9-5. **A.** Location of incision used for raising the axillary artery. This particular incision raises the axillary artery where it becomes the brachial artery. **B.** The artery lies deep (behind) to the vein. **C.** Ligatures are passed around the artery. **D.** An arterial tube is inserted to demonstrate how the arm would be injected.

of the solution will not occur and more solution will flow into both sides of the hand.

Some embalmers also raise the brachial artery in the area of the antecubital fossa, where the artery divides into the radial and ulnar arteries. The arterial tube can be directed into each of these arteries from this point, avoiding an incision in the wrist area, which may be a difficult area to tightly suture, especially if edema is present.

Femoral Artery

The second, most frequently used set of vessels for arterial embalming comprises the femoral artery and the femoral vein. The artery is located superficial and lateral

to the femoral vein. Because it is a continuation of the external iliac artery and vein, this set of vessels is often referred to as the iliofemoral vessels.

1. Regions supplied

- When the injection is directed toward the foot, the artery directly supplies solution to the leg and the foot.
- When a tube is directed toward the head, the artery supplies arterial solution to the opposite leg as well as the remainder of the body.

2. Considerations

- The artery is large.
- The incision is not visible.

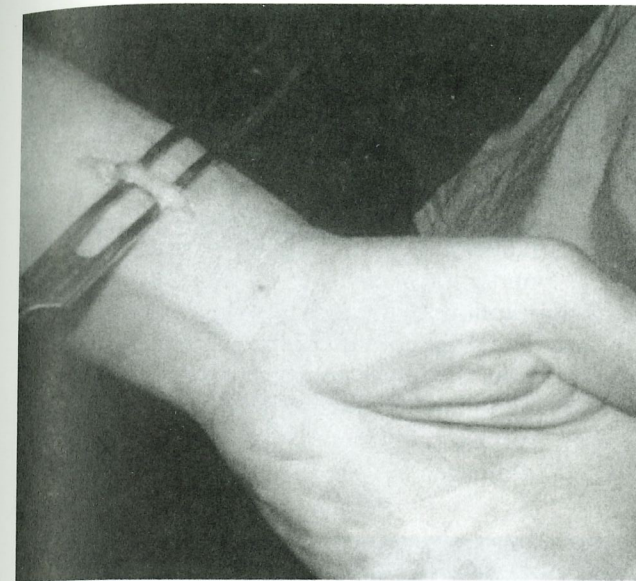


Figure 9-6. Left radial artery.

- Both sides of the head may receive an even distribution of solution (especially important if dyes are used with the arterial solution).
- The artery is accompanied by a large vein, which can be used for drainage.
- With the proper instruments, it can be a "clean" method of embalming; no solution or blood will pass under the body.
- The head and arms can be posed without having to be further manipulated after embalming.

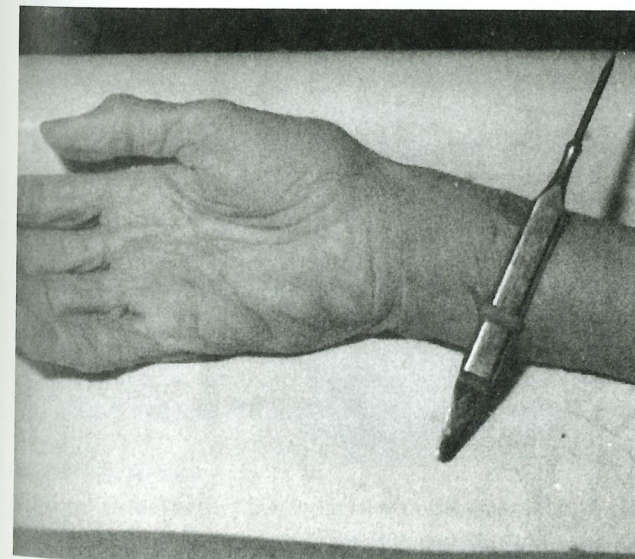


Figure 9-7. Right ulnar artery.

3. Precautions

- The most frequent reason for inability to use the femoral artery as an injection point is the presence of arteriosclerosis in the artery.
- In obese bodies, the vessels may be very deep.
- There is no control over the solution entering the head, especially when large volumes of solution must be injected or when strong solutions are used.
- Coagula in the arterial system can be pushed into the vessels that supply the arms or the head, areas that will be viewed.
- Large branches might be mistaken for the femoral artery.

4. Incision for the femoral artery and vein

- This incision is made over the linear guide for the artery beginning at a point slightly medial to the center of a line drawn between the anterior superior iliac spine and the pubic symphysis. Some embalmers prefer to make the incision directly over the inguinal ligament; others prefer to make the incision an inch or more inferior to the inguinal ligament. The external iliac vessels at the inguinal ligament become the femoral vessels. The external iliac artery lies lateral and slightly superficial to the external iliac vein at the inguinal ligament. The acronym VAN can be used: the Vein is the most medial structure, then comes the Artery, and the most lateral structure is the Nerve.

5. Suggested protocol for raising the femoral artery and vein

- Stand at the right or the left side of the table.
- Make the incision parallel to the vessels, on the linear guide through the skin and the superficial fascia.
- Dissect superficial fat and fascia bluntly. Observe the great saphenous vein, which is quite superficial.
- Locate the sartorius muscle. The vessels are found along the medial side of this muscle.
- Locate the femoral artery and dissect the artery free. Place a ligature around the superior and the inferior portions of the dissected artery.
- Pull the artery laterally (toward the embalmer) and dissect medially and deeper to free the femoral vein.
- Clean off the vein, being careful not to rupture it. Also, be careful around the tributaries, which may be full of blood. Bring the vein to the surface and pass one ligature around each end of the dissected portions of the vein.

- h. Make an incision into the vein and insert the drainage device, tube, or forceps toward the heart. Tie the tube into the vein. (Keep the vein ligatures on the medial side of the thigh and the artery ligatures on the lateral side of the thigh.)
- i. Bring the artery to the surface of the incision. Incise the artery and insert one arterial tube directed toward the head and a second tube directed down the leg. Secure both with the ligatures (Fig. 9-8).

Femoral Vein

The femoral vein may be used as a drainage point. The vein is large, and because of its location the incision will

not be seen. Because of its location, the femoral vein is assisted by gravity in draining blood from the body.

1. Considerations
 - a. The vein is large.
 - b. With tubing attached to a drain tube, it can be a very clean method of drainage; water and blood need not come down over the table and under the body.
2. Precautions
 - a. The weight of the viscera can restrict drainage from the upper portions of the body.
 - b. Abdominal pressure from gases or ascites can exert pressure on the vein and restrict drainage.



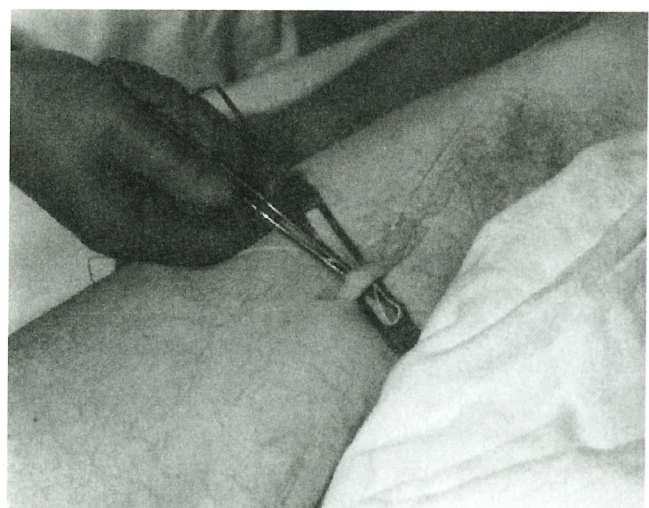
A



B



C

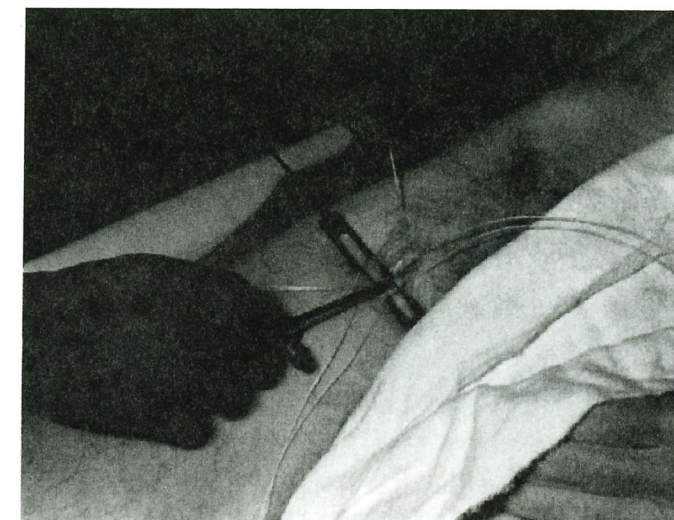


D

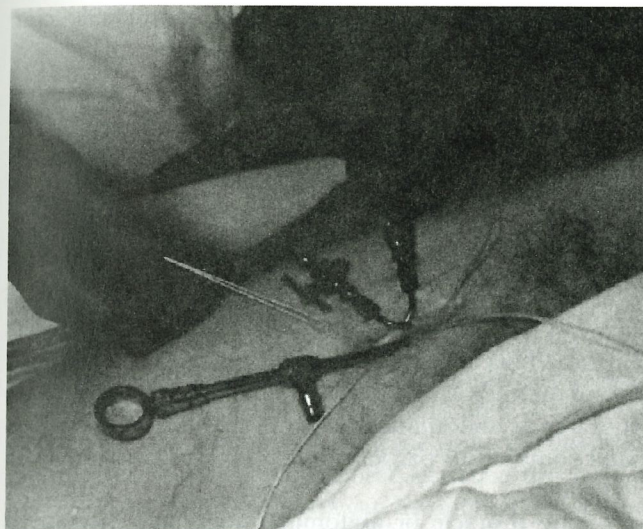
Figure 9-8. **A.** The femoral artery and veins are raised. **B.** The artery lies just lateral to the sartorius muscle. **C.** The femoral artery is superficial and slightly lateral to the vein. **D.** Ligatures are passed beneath the artery and it is pulled laterally, toward the embalmer.



E



F



G

Figure 9-8. (Continued) **E.** The femoral vein is raised; it is medial and deep to the artery. **F.** Ligatures are passed around the vein and a drain tube is inserted toward the heart. **G.** Arterial tubes are placed in the artery.

- c. In obese bodies, the vein is very deep.
- d. Many tributaries flow into the femoral vein, and care must be taken not to rupture any of them.
- e. Clots in the right atrium and the upper areas of the vascular system may be difficult to remove.
- f. Pressure on the heart from hydrothorax (as frequently seen in deaths from pneumonia) may make it difficult to establish good drainage from the right atrium and the large veins of the head and the arms.

Popliteal Artery

The popliteal artery is used as a secondary injection site when solution has not reached the area of the leg below the knee. Because of the inconvenient location of this artery, it is generally used only in special circumstances.

Examples include severance of arteries from traumatic mutilation of the leg or bone removal for transplant.

Most tissues of the body are best preserved and more uniformly preserved by arterial injection. As the legs will not be viewed, other methods of embalming can be used, including surface and hypodermic embalming. **FIRST**, attempt to inject the legs using the external iliac or the femoral artery.

As previously stated, the popliteal artery is generally used only when there has been an interruption of the arterial pathway, as in accidents or mutilations. The limbs of the arthritic body may be in such a position that the femoral vessels cannot be used, and, because of the "swayed" position of the legs, the popliteal artery may be easy to work with.

Two incisions can be used: (1) The body may be turned and the incision made down the center of the popliteal space, parallel to the artery. (2) If the body is



Figure 9-9. Incision location (optional) for the left popliteal artery.

not turned, the knee can be slightly flexed and a longitudinal incision made along the posterior-medial aspect of the lower third of the thigh, actually just superior to the popliteal space (Fig. 9-9). Because of the location of the artery and the size of the vessels, the accompanying vein is not used as a drainage site.

Anterior and Posterior Tibial Arteries

The anterior and tibial arteries supply arterial solution directly to the portion of the leg below the knee and into the foot. Unlike the superficial radial and ulnar arteries, which supply the distal portion of the arm and the hand, these arteries are deeper, making them more difficult to locate and to bring to the surface of the incisions. In addition, the skin covering the distal portion of the leg is very tight, making suture of the incisions very difficult. When suturing is difficult, leakage can become a problem.

With regard to arteriosclerosis, it would be most impractical to attempt to raise and inject the tibial arteries when the femoral artery is affected by arteriosclerosis, especially if gangrene or necrosis is present in the foot or in the distal portion of the leg. Treatment, when the latter conditions are present, is best accomplished by hypodermic treatment of the leg with cavity fluid; the leg should be painted with preservative autopsy gel and a plastic stocking containing embalming powder placed on the limb.

The incision for raising the anterior tibial artery is made along the lateral margin of the inferior third of the crest of the tibia. In the distal portion of the leg, it lies at the superficial margin of the tibia. By using the aneurysm needle to dissect down along the tibia, the embalmer can locate the artery (Fig. 9-10).

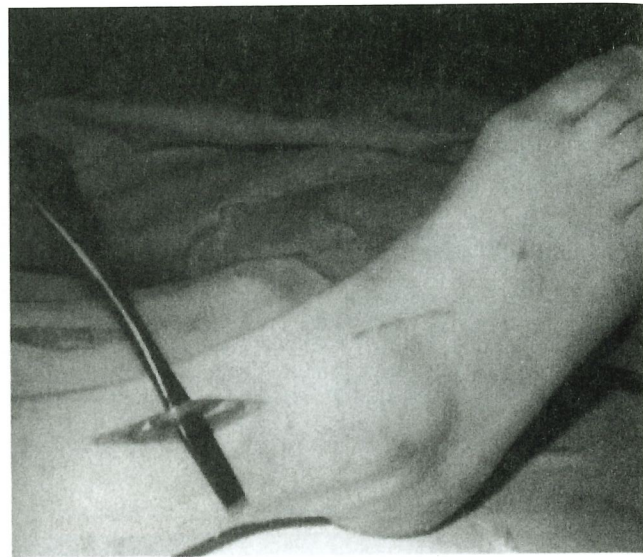


Figure 9-10. Right anterior tibial artery, lateral to the crest of the tibia.

The incision for the posterior tibial artery is made midway between the medial malleolus and the large calcaneus tendon.

Abdominal Aorta and Thoracic Aorta

The abdominal aorta and thoracic aorta are large vessels very deeply seated in the abdominal and thoracic cavities. They lie in the center of the body and can be found on the anterior surface of the spinal column. The thoracic or abdominal aorta may be used for injection after complete or partial autopsy or organ donation and in infants.

The thoracic or abdominal aorta may become a vessel for injection in certain bodies where an incision has been made from which the vessels can be dissected and identified. Such bodies might include those dying following recent surgery; bodies in which partial autopsies have been performed, or the bodies of organ donors. Drainage may be taken from a vein that the embalmer raises such as the femoral or internal jugular vein. Drainage may also be taken directly from the inferior or superior vena cava. Use of the aorta for injection and the vena cava for drainage is determined by the amount of exposure of these vessels created by the partial autopsy or organ removal.

In the unautopsied infant, the abdominal aorta can be exposed by making an incision to the left of the midline, beginning a few inches below the xiphoid process of the sternum and extending over the abdominal wall approximately 4 inches in length. The greater omentum is thus exposed. It can be reflected upward, and the small intestines can be pushed aside or lifted out of the abdominal cavity to expose the abdominal aorta

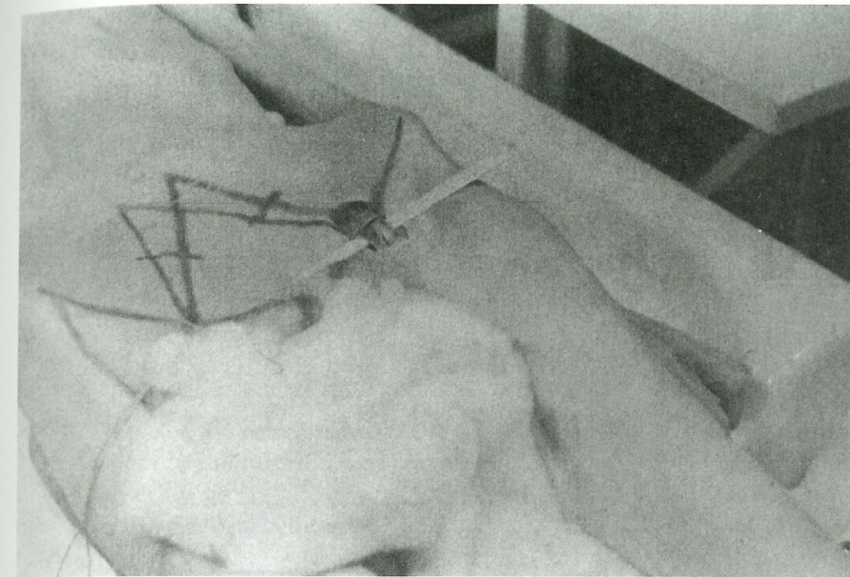


Figure 9-11. Linear guides and incision location for raising the left external iliac artery and vein. The artery is lateral to the vein at the inguinal ligament.

and the inferior vena cava resting on the spinal column in the midline of the abdomen.*

The thoracic aorta in the infant can be exposed by making a midline incision down the center of the sternum. Because the sternum is quite soft, a sharp scalpel can be used to divide it. The sternum is retracted and held in this opened position. The pericardium of the heart is now exposed and can be cut open with a pair of surgical scissors. After the pericardium is opened, the right auricle, the little ear-like appendage at the top right side of the heart, can be cut open and used as a site for drainage. If the heart is moved to the right, the descending thoracic aorta can be exposed as well as the arch of the aorta above it. The aorta can be opened and a tube inserted for injection (see Chapter 16).

External Iliac Artery

For considerations on the use of the external iliac artery, see section Femoral Artery, above. The incision is made over the inguinal ligament (Fig. 9-11). Because the external iliac artery passes beneath the inguinal ligament, it lies on the lateral side of the external iliac vein. If the leg is injected from this point, in the autopsied body, the artery supplies solution to the lower extremity and the anterior abdominal wall.

Internal Iliac Artery

The internal iliac artery is a branch of the common iliac artery that runs medially into the pelvic cavity. In the autopsied body, injection of this artery supplies

*These procedures should be used only when absolutely no other methods would produce satisfactory results, and when used, be certain that proper permission has been obtained.

embalming solution to the gluteal muscles and the peroneal regions.

Inferior Vena Cava

For completeness, at this point, the inferior vena cava is discussed as a drainage point. This site can be used for drainage when a partial autopsy has been performed. If the contents of the thorax have been removed, the abdominal viscera and lower extremities can be injected (1) through the abdominal aorta or (2) by clamping off the aorta and injecting the femoral artery. With either point of injection, drainage can be taken directly from the remnants of the inferior vena cava. The inferior vena cava is located to the right of the abdominal aorta at the posterior portion of the diaphragm.

If the contents of the abdominal cavity have been removed in a partial autopsy, the thoracic viscera, the head, and the arms can be injected from the descending thoracic aorta. Or, the aorta can be clamped closed and the upper portions of the body injected from the carotid or axillary vessels. Drainage can easily be taken directly from the remnants of the inferior vena cava.

When drainage is taken from the inferior vena cava, it is not necessary to place a drainage device in the vein. To create intermittent drainage, the inferior vena cava can be closed shut with a hemostat. A large piece of cotton can also be held over the vena cava with a gloved hand.

Right Atrium of the Heart

When drainage is difficult to establish, the right side of the heart may be pierced with a trocar for drainage. The trocar is inserted into the right side of the heart and should be placed in the right atrium. Piercing of the

heart should not begin until one-half to one full gallon of arterial solution has been injected.

To drain from the right side of the heart, the trocar is inserted through the abdominal wall at the standard point of entry (2 inches to the left and 2 inches above the umbilicus). The trocar is directed into the mediastinum area and intersects a line extending from the lobe of the **right** ear to the **left** anterior superior iliac spine. Actually, if the trocar is simply directed toward the right ear lobe, the point should pass into the right side of the heart. The aspirator can be stopped at this point and the drainage established by a gravity system.

It is wise to attach clear plastic tubing to the trocar so that further movement of the trocar can be **stopped** immediately after it enters the heart. This very old method for removing blood during arterial injection was used when bodies were embalmed at the residence of the deceased.

► MAKING THE INCISION INTO THE ARTERY AND VEIN

To open the artery or the vein, a scissors or scalpel may be used, depending on the preference of the embalmer. In the method most commonly employed to open the artery or the vein, the embalmer simply makes a **transverse** cut into the vessel from the edge of the vessel to the center or just slightly beyond the center. Cutting too far may weaken the vessel enough that it will break into two pieces.

Very elastic arteries such as the carotid and the axillary arteries can easily be stretched to the surface of the incision. With arteries such as the femoral, when some sclerosis is present, raising the vessel to the skin surface can create great tension on the artery. Care should be taken in opening sclerotic vessels to avoid breaking the vessel. As soon as you observe the lumen in this type of vessel, cut no further.

A longitudinal incision may also be used to open vessels. Most embalmers prefer to elevate these vessels on a bone separator. Using a scalpel, cut a longitudinal incision in the center of the vessel running parallel to the vessel. Most embalmers prefer to use a scalpel; however, double-point scissors can also be used. The longitudinal incision is not recommended for opening sclerotic arteries. Many embalmers use this incision for veins, for it provides a large opening for drainage instruments. Two arterial tubes may be placed into position using this incision for the artery.

A combination of transverse and longitudinal incision is preferred by many embalmers, especially for opening veins. It is also most helpful when a drainage tube is to be inserted, because it permits drainage from the opposite end of the vein. A wedge can also be cut

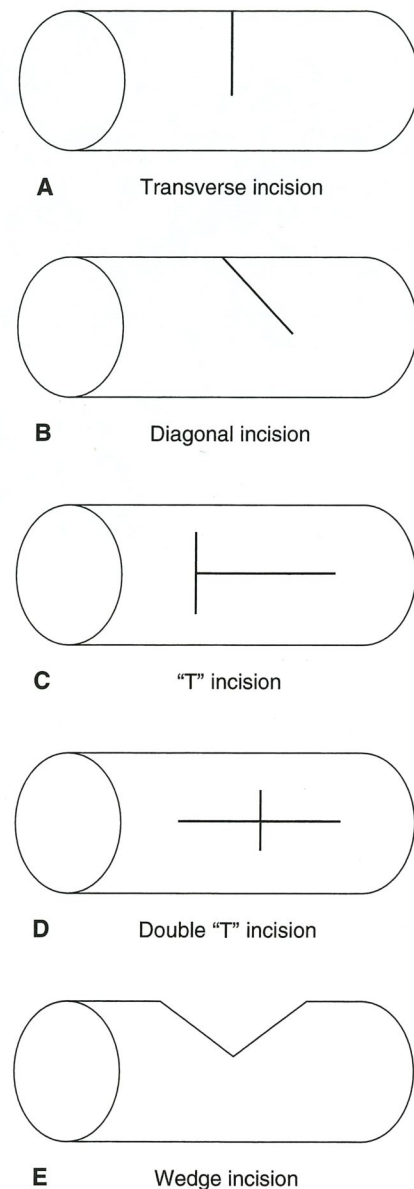


Figure 9-12. A. Transverse incision. B. Diagonal incision. C. "T" incision. D. Double "T" incision. E. Wedge incision.

into an artery or a vein with double-point scissors or a scalpel. This method is not recommended for sclerotic arteries (Fig. 9-12).

► CONCEPTS FOR STUDY AND DISCUSSION

1. Explain each of the following methods of injection:
 - a. Multipoint injection
 - b. Sectional embalming
 - c. Restricted cervical injection
 - d. One-point injection
 - e. Six-point injection
 - f. Split injection

2. Differentiate between arteries, veins, and nerves.
3. List the 12 major factors to consider in choosing an artery for injection and a vein for drainage.
4. List several advantages to use of the common carotid artery as a vessel for injection.
5. List the steps for raising and inserting instruments into the common carotid artery and the internal jugular vein.
6. List six incisions that can be used to raise the common carotid artery.
7. List the advantages to use of the restricted cervical method of injection.
8. Describe the relationship of the common carotid artery to the internal jugular vein.
9. Describe the relationship of the femoral artery to the femoral vein.

10. Describe the relationship of the axillary artery to the axillary vein.
11. Give the steps for raising and inserting instruments into the femoral artery and vein.
12. Describe where the incisions are made for raising the radial and ulnar arteries.
13. Describe several incisions that can be used to open an artery for insertion of the arterial tube.
14. List the incisions that can be used to raise and inject the popliteal artery.

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