arterial solution should be sectionally injected. If necessary, undiluted cavity fluid can be injected hypodermically, or compresses of undiluted cavity fluid or autopsy gel can be applied to the surface to ensure preservation.

The embalming complications associated with chronic renal failure can be summarized:

1. Decomposition occurs rapidly.
2. Acidosis alters the reaction between proteins and the preservative.
3. The body appears sallow because urochrome is present in the tissues.
4. Sites of gastrointestinal bleeding may be sites of arterial fluid loss and sources of purge.
5. Edema dilutes the arterial fluid.
6. Uremic wastes in the blood and tissues neutralize preservatives.
7. Skin infections may be caused by uremic pruritis.

See Table 21–2 for a summary of edema.

▶ CONCEPTS FOR STUDY AND DISCUSSION

1. Explain how a supplemental edema reducing chemical works.
2. Discuss what treatments can be employed to help restore moisture to a body that is badly dehydrated during embalming.
3. List some of the conditions, both antemortem and postmortem, that cause dehydration.
4. Discuss some of the complications created by the presence of skeletal edema.
5. Discuss the arterial solutions and embalming techniques that can be used to remove edema from the skeletal tissues.
6. Discuss the complications that arise in the preparation of a body dead from renal failure.

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CHAPTER 22

VASCULAR CONSIDERATIONS

CHAPTER OBJECTIVES

- Intravascular conditions
- Extravascular conditions
- Vascular coagula
- Diabetes

The blood vascular system is the distribution route for the embalming solution. Any pathological or traumatic change that obstructs or breaks open this delivery system either completely blocks or reduces flow of arterial solution to a body region.

As people age, many degenerative changes can occur in the circulatory system. Although heart or blood vessel disease may not be the immediate cause of death, such a condition can greatly influence the embalming procedure. Likewise, drugs given for the treatment of heart or vascular diseases may have more influence on the embalming procedure than the condition of the diseased vessels. Intravascular conditions, diseases, or tissue changes in the walls of or within the blood vessels is of concern to the embalmer. The arteries are the vessels that carry the embalming solution to the capillaries. At the capillaries, some of the arterial solution will leave the vascular system to enter the interstitial spaces, where it will come into contact with the body cells and cellular proteins. The solution remaining in the vascular system travels into the veins and helps push the blood from the body in the form of drainage. Arteries have three layers:

- *Intima.* The inner lining of endothelial cells, which continue to form the walls of the capillaries and then the inner walls of the veins and arteries (this endothelial layer of cells lines the entire blood vascular system).
- *Media.* The middle layer, composed of muscle cells and elastic tissue.
- *Adventitia.* The outer layer, composed mostly of connective tissue.

The cavity of the vessel is called the **lumen.** Narrowing or obstruction of the lumen can decrease or stop flow of arterial solution to a body area. Intravascular problems can also result in breaks or tears in vessels. These can be very small ruptures such as petechiae or major ruptures such as aortic aneurysms.

Table 22–1 lists intravascular arterial conditions that can limit the distribution of arterial solution to various body areas. Arteriosclerosis and arterial coagula are the problems most frequently encountered by the embalmer.

Preinjection fluid should not be used when it is thought it will be difficult to establish arterial solution distribution. If the system is filled with the preinjection solution, swelling could result when the preservative solution is injected. Preinjection fluid should be used only if circulation is thought to be good; in such cases it maintains the good distribution and drainage. Many persons who had vascular diseases were given blood thinners and anticoagulants. These bodies generally exhibit good arterial solution distribution and few or no clots in the drainage.

▶ ARTERIOSCLEROSIS

Almost anyone older than 30 years may exhibit arteriosclerosis. Most people think of this degenerative condition as occurring in old age. Many persons who die from heart disease in their mid-fifties exhibit more

TABLE 22–1. CONDITIONS RESULTING FROM INTRAVASCULAR DISEASE PROCESSES

Vascular Condition or Injury	Description	Embalming Concern
Advanced decomposition	Breakdown of the body tissues	Arteries are one of the last "organs" to decompose. Some circulation may be possible. Expect a large number of intravascular clots. Distribution is very poor. Capillary decomposition causes rapid swelling of the tissues.
Aneurysm	Localized dilation of an artery	If aneurysm ruptures, fluid cannot distribute.
Arteriosclerosis	Hardening of the arteries	Vessel may not be suitable as an injection site. Narrowed arteries may easily trap arterial coagula.
Arteritis	Inflammation of an artery	Artery may narrow, resulting in poor distribution of arterial solution. Artery may also weaken and rupture from pressure of injection.
Asphyxiation	Insufficient oxygen supply	Right side of heart is congested (poor drainage). Purging can result as blood flows back into lungs instead of draining. Tissue is cyanotic. Intense livor mortis is present in neck and facial tissues. Blood may remain liquid. Capillary permeability is increased. Swelling could easily occur.
Atheroma, atherosclerosis	Patchy or nodular thickening of the intima of an artery	Flow of arterial solution may be restricted or occluded. Arterial coagula may be easily trapped during injection. Vessel is poor injection site.
Burns	Local or general damage to tissue from heat	Capillaries constrict resulting in extensive coagulation. Distribution of arterial solution may be reduced. Large burns can result in kidney failure, with retention of nitrogenous wastes, thus increasing the preservative demand of the tissues.
Cerebrovascular accident	"Stroke" caused by a clot or the rupture of a small artery in the brain.	Vasoconstriction may occur on one side of the body, reducing the distribution of arterial solution.
Clots or coagula	Antemortem or postmortem clumping of blood elements	Arterial clots can block or reduce fluid flow to a body region, and may not be removed through drainage. Venous clots may often be removed; if clots are unmovable, swelling and discoloration can result.
Congestive heart failure	Decreased heart function	Venous congestion and clotting and cyanosis occur. Legs and feet are edematous. Capillary permeability increases. Tissues can easily swell.
Corrosive poisons	Toxic and corrosive chemicals	If poisons are swallowed, purge can usually be expected. Corrosive action may destroy blood vessels causing loss of solution or blood into the gastrointestinal tract.
Diabetes	An endocrine disease affecting the control of blood glucose levels	Poor peripheral circulation can reduce solution distribution. Gangrenous areas require surface and/or hypodermic embalming treatments. Dehydration frequently occurs. Breakdown of protein results in poor firming of tissues.
Emboli	Detached blood clot	Blockage of a small artery interrupts solution distribution. Venous emboli can block drainage.
Esophageal varices	Swollen, tortuous veins caused by a stagnation of blood and generally seen in the superficial veins	Drainage may be difficult to establish. Rupture and massive purge may occur.
Extracerebral clot (stroke)	A clot, usually in the carotid artery, that stops blood supply to the brain	The clot can occlude the artery, making it impossible for arterial solution to flow to one side of the face. Blockage may occlude the carotid so it cannot be used as an injection site. Resulting stroke may cause vasoconstriction on one side of the body, reducing arterial solution distribution.
Febrile disease	A disease or condition accompanied by an elevation of body temperature	Decomposition may be speeded. Dehydration is possible. Blood coagulates and causes congestion. Distribution and drainage may be hard to establish.
Freezing (postmortem)	*Cooling of the body to the point where ice crystals form in body tissues*	Small vessels and tissues easily swell on injection of solution.
Gangrene (dry)	Poor arterial circulation into an area of the body, causing death of body cells	Distribution of arterial solution into the affected area is impossible to establish. Surface and hypodermic treatment is needed.
Gangrene (moist)	Occlusion of veins draining a body area that becomes the site of bacterial infection	Very strong fluid must be injected into the general area arterially. The affected necrotic tissues require hypodermic and surface treatments.
Gunshot wounds	Entry of a foreign missile into the body	Arterial system may rupture. Multisite injection may be needed. Conditions vary depending on location of wound. Blood loss may result in very little drainage. Bodies are usually autopsied.
Hanging	Asphyxiation resulting from exertion of pressure against the large vessels of the neck	Livor mortis is intense or absent in facial tissues. Vessels may be damaged or severed. Restricted cervical injection and jugular drainage are recommended.
Hemorrhage	Loss of blood caused by a break in the vascular system	Blood volume may be quite low so there is little drainage. Livor mortis may be minimal. If hemorrhage is the result of a ruptured artery, arterial solution may be lost to body cavities. Multisite injection may be necessary. If a vein has ruptured, much of the drainage may collect in the body cavity where the hemorrhage occurred. If the stomach or esophageal veins are affected, stomach purge can be expected.
Ischemia	Lack of blood supply to an area, frequently resulting in tissue necrosis	Arterial solution cannot reach the affected tissues. Hypodermic and surface embalming treatments are needed.
Leukemia	Cancer of the tissues that form white blood cells	Purpura are observed over the thorax, arms, and abdomen. Edema may be present. Circulation of arterial solution and drainage may be difficult to establish.
Mutilation	Traumatic tissue injuries	Several arteries may result in difficulty in establishing distribution. Multipoint injections may be needed.
Phlebitis	Inflammation of a vein	Edema may be present in the area. Blood does not easily drain from the area and discolorations may result.
Pneumonia	Acute inflammation of the lung	Broken lung capillaries can result in lung purge. Fever speeds the onset of rigor and decomposition. Congestion may lead to hydrothorax. Distension of the neck can easily occur. Body should be aspirated immediately after arterial injection.
Shock	Sudden vital depression, reduced blood return to the heart	Vasodilation may be present, which can cause swelling. In other types of shock, capillaries constrict and blood congestion occurs in the large veins, making drainage difficult to establish. Capillary congestion may interfere with the distribution and diffusion of arterial solution.
Syphilis	Venereal disease caused by the spirochete *Treponema pallidum*	Aneurysms may occur in arteries. Rupture can make distribution of arterial solution impossible.
Thrombosis	Blood clots attached to the inner wall of a blood vessel	Arterial solution distribution may be difficult. If occurring in a vein, drainage may be hard to establish from the affected tissues.
Tuberculosis	Infection of the lungs by *Mycobacterium tuberculosis* that may spread to other organs (e.g., bone, brain, kidney)	When the lungs are affected, cavitation may result; this causes small vessels and capillaries to rupture. There may be a great loss of arterial solution through purging. Purge can be expected. Untreated dehydration and emaciation may be observed.
Tumor	Benign or malignant growth of cells	Pressure may be exerted on the outside of an artery or a vein. Distribution to and drainage from an area may be difficult to establish.
Vasoconstriction	Narrowing of a blood vessel	When arteries are affected, as in a "stroke," it may be difficult to supply sufficient arterial solution to the affected side of the body. Multipoint injection may be necessary.

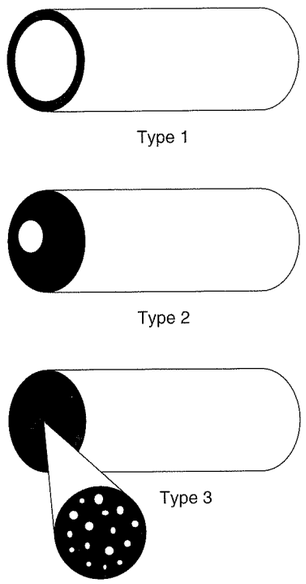

Figure 22–1. Types of arteriosclerosis seen in arteries used for arterial injection.

sclerosis than a 90-year-old person. Of the vessels used for embalming, the femoral artery is the most likely to be affected by arteriosclerosis. Thus, use of the common carotid artery as the primary site for injection is recommended.

The embalmer encounters three types of arteriosclerosis (Fig. 22–1):

- *Type 1.* The inner wall of the artery is hardened and thickened but the lumen is well defined and large. These vessels can usually be used for arterial injection. This condition is frequently observed in the autopsied body when the common iliac arteries are exposed.
- *Type 2.* The lumen is quite reduced in size and pushed to one side of the artery. The lumen can usually be identified and a small arterial tube can be used for injection.
- *Type 3.* The artery is completely occluded. If ischemia or gangrene is **not** present in the area supplied (e.g., the leg), the collateral circulation may have increased to supply blood to the limb **or** there may be minute paths in the occluded artery through which the blood can pass. The formation of these paths or canals is called **canalization**. These arteries **cannot** be used for injection.

In the presence of sclerosis, the strength of the arterial solution can be increased if distribution is poor or slow. Use of a stronger solution ensures that sufficient preservative reaches the tissues even if a large amount of solution cannot be injected. Coinjection chemicals may be used to help distribute the preservative solution. Dye can be added to the solution; it will help to indicate what tissues are receiving the arterial solution.

Lowering the hands over the sides of the table and gently but firmly massaging the limbs helps to distribute fluid in sclerotic bodies. Begin injection using a very slow rate of flow. After the vascular system is filled, rate of flow can be increased. When multisite injection is used, higher pressures and pulsation can be used to establish local distribution. Once circulation is established, the pressure and the rate of flow can be reduced.

When vascular problems are anticipated, the use of the common carotid artery is advised for injection. This vessel rarely exhibits arteriosclerosis. In those instances, when sclerosis is present, the size of the lumen of the carotid generally allows for easy insertion of arterial tubes. The accompanying internal jugular vein is large; the superior portion directly drains the head. The inferior portion of this vein leads directly into the right atrium of the heart. This chamber serves as the center of blood drainage during embalming. The use of angular spring forceps as an aid to drainage will help to remove venous coagula.

If a femoral vessel must be used, avoid cutting into the artery where an atheroma can be felt. Make the incision a little larger at a point where the vessel is softest. Avoid raising these sclerotic arteries to the surface. Work with them from within the incision. Ligate the arterial tubes in place with an arterial hemostat or a thick cotton ligature. Thin linen ligatures may separate and tear the vessel. Use an arterial tube small enough that it easily slips into the lumen.

A large arterial tube can damage the lumen of the artery and possibly make it unusable as an injection point (Fig. 22–2).

▶ AORTIC ANEURYSM

A ruptured aortic aneurysm can seriously affect fluid distribution in the unautopsied body. If surgical repair of the vessel was performed, extreme facial edema can often accompany this surgical repair. In the unautopsied body, determine whether fluid can be distributed from a single-site injection. Inject from the right common carotid artery or use restricted cervical injection. Usually, the femoral vessels in these bodies are sclerotic.

Use a strong arterial solution with additional fluid dye as a tracer. Inject slowly. If **drainage** is established, continue to inject. **If there is no drainage and the abdomen begins to swell, stop the injection** and institute a multipoint injection to embalm the various body areas. No drainage indicates a loss of the embalming solution into the thoracic or abdominal cavity. The trunk walls may have to be injected by use of an infant trocar with

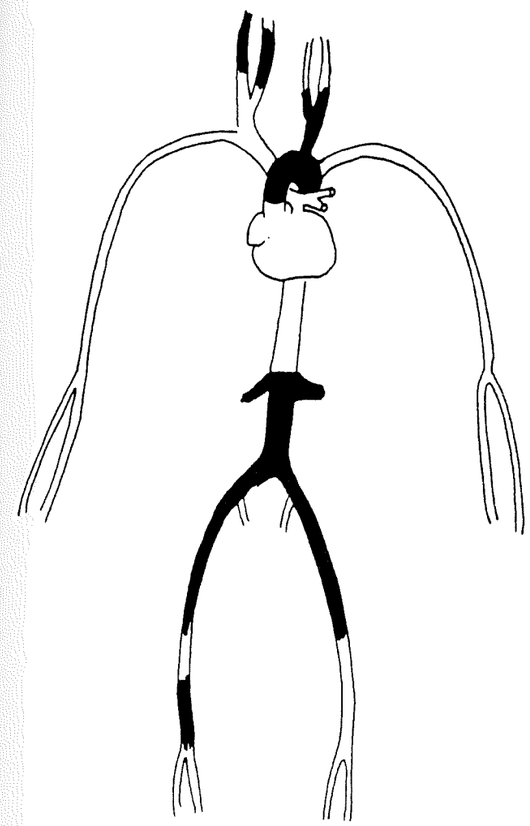

Figure 22–2. Common sites of arteriosclerosis. (*Courtesy of HE Kazmier.*)

cavity fluid. Often, when the death certificate cites the immediate cause of death as a ruptured aortic aneurysm, it may be possible to embalm the entire body from one injection site.

▶ VALVULAR HEART DISEASES

The following extract from the article, "Damage to aorta may bring embalming problems," written by Murray M. Shor, describes how disease or malformation may prevent the aorta from being the center of arterial solution circulation.

> Because of the position of the aortic semilunar valve, embalmers generally consider the aorta as the center of arterial fluid circulation. In most cases, this seems to be true. In the absence of damage to the circulatory system or the heart, it is only after the aorta is filled with fluid that its branches can be expected to receive fluid under any appreciable pressure.
>
> Were it not for the position and construction of the aortic valve, fluid would pass from the ascending portion of the aorta into the left ventricle. Under those conditions, the aorta would not be considered the center of embalming fluid circulation. If because of disease or malformation of the aortic semilunar valve fluid did pass into the left ventricle and was confined there by the proper functioning of the mitral valve, the problem would be merely academic. It is when other heart valves are impaired concurrently that embalming problems are created.

Anatomy of the Heart

Let us pause here for a brief review of the anatomy of the heart. The functioning valves are the left atrioventricular or mitral, which allows blood to pass from the left atrium to the left ventricle; the right atrioventricular or tricuspid, which opens from the right atrium into the right ventricle; the pulmonary semilunar, a tricuspid valve which opens to allow blood to flow from the right ventricle into the lungs via the pulmonary artery; and the aforementioned aortic semilunar, a tricuspid valve that opens into the aorta from the left ventricle.

During life, any one or any combination of these valves can be affected by the same degenerative diseases that affect the arteries. They can also be attacked by bacteria and damaged irreparably or suffer a congenital malformation. In all of these conditions, the circulation of blood during life and of the preservative during embalming is substantially altered.

The great strides made by the medical profession in the fields of infant mortality and infectious diseases leave an older population; one more likely to die of degenerative diseases. Also, because of better medical care, some of the infectious diseases that damage the heart, such as diphtheria and rheumatic fever, have been controlled to such an extent that victims of these diseases survive the infectious stage and live many years afterward, often with a damaged heart valve or valves.

In the United States, we have reached a point where one in every two deaths is attributable to cardiovascular disease. Therefore, it behooves the embalmer to become thoroughly familiar with embalming problems associated with these diseases.

In situations where the mitral and the aortic semilunar valves are damaged, embalming fluid under pressure will pass from the aorta into the left ventricle and from there into the left atrium. The left atrium receives the pulmonary veins from the lungs. These veins have no valves. Therefore, a fluid in the atrium, under pressure, would pass back into the capillaries of the lung.

Lung Purge

During most embalming procedures, the pulmonary capillaries also receive fluid from the bronchial arteries, coming from the descending thoracic aorta. When

the two fluid masses, one from the bronchial arteries and the other from the pulmonary veins, meet, their collective volume and pressure create a lung purge by virtually squeezing the contents of the hollow portions of the lung out through the trachea.

This event should not cause too much apprehension. The matter thus emanating from the mouth or the nostrils is the material the embalmer seeks to remove during routine cavity work.

▶ CONGESTIVE HEART FAILURE

Frequently, death certificates cite congestive heart failure as the primary cause of death. Some complications of the end stage of congestive heart failure are of particular interest to the embalmer:

1. Blood is congested in the right side of the heart.
2. The neck veins are engorged with blood; the facial tissues are dark because of the congestion of blood in the right side of the heart and the veins of the neck.
3. Lips, ears, and fingers are cyanotic.
4. Generalized pitting edema may be present. Edema of the legs and feet is pronounced in most bodies. Ascites may be present.
5. Blood may be more viscous because of an increase in red blood cells (polycythemia).
6. Salt is retained in the body fluids.

The carotid artery is used for injection and the right internal jugular vein for drainage, or restricted cervical injection is employed. This helps to ensure good drainage from the head and the right atrium of the heart. The first gallon of arterial solution is made mild to clear the blood congestion and discolorations. If edema is present, the subsequent gallons should be stronger to meet the preservative demand of the body. If the ascites (and intestinal gases) is severe, enough pressure can be placed on the inferior vena cava to diminish drainage from the lower areas of the body. Some of the fluid can be drained with a trocar or drain tube inserted into the abdominal cavity. Keep the trocar or drain tube in the ventral portion of the abdominal cavity so as not to puncture any of the major vessels.

Lowering the arms over the table at the start of arterial injection helps to establish good distribution so the discolorations of the hands and fingers can be cleared. The facial tissues may need to be massaged to clear the blood discolorations. It may be necessary to inject both common carotid arteries. When there is extensive discoloration of the face, some embalmers prefer to drain from both the right and left internal jugular veins.

Begin injection at a high enough pressure and rapid enough rate of flow to establish good distribution. Continuous drainage should be used to clear the congested blood. Pressure and rate of flow may be increased as the embalming progresses; the pressure and the rate of flow should be sufficient to move arterial solution through the entire body. In the presence of generalized edema, distribution and drainage can be expected to be good.

The liver may be enlarged and its functions decreased. This should improve drainage, as the level of clotting factor in the blood will be low.

Pulmonary edema, often observed in cases of congestive heart failure, may cause lung purge. The purge should be allowed to continue during the embalming process. Cavity treatment and repacking of the nasal cavity with cotton after embalming should correct this condition.

Thorough aspiration is necessary to remove distension in the neck tissues resulting from the engorgement with blood. Remove (as much as possible) the edema that led to the ascites. This edema dilutes cavity fluid. It is best to reaspirate and, if necessary, reinject the cavities several hours after the first treatment. Bodies dead from congestive heart failure should be aspirated immediately after arterial injection to help reduce distension in the neck and the facial tissues.

▶ VASODILATION AND VASOCONSTRICTION

Sometimes, the dye used to trace the distribution of arterial solution indicates that one side of the body has received a large amount of solution and the other side a small amount. This difference is often evident down the midline of the body. This unequal distribution of arterial solution frequently occurs after death from cerebrovascular accident. The vessels on one side of the body have undergone vasoconstriction. In an effort to supply more oxygen to the tissues in life, the vessels on the opposite side of the body have undergone vasodilation. Multisite injection may be necessary, but in most bodies injection of a sufficient quantity of solution should overcome the problem. This condition may be seen when the deceased has suffered a stroke.

▶ ARTERIAL COAGULA

At death, some blood remains in the arteries, especially in the large aorta. During the postmortem period, this blood can congeal (Fig. 22–3). Injection of the arterial solution may loosen and push coagula into the smaller arteries. By injecting the common carotid arteries, these coagula would be moved toward the legs.

If the femoral artery is used as the primary injection point, coagula can be moved into the common carotid arteries and stop the flow of arterial solution into the facial tissues. When the femoral artery is injected upward arterial coagula, most frequently, flow into the left subclavian artery, and it becomes necessary to raise and

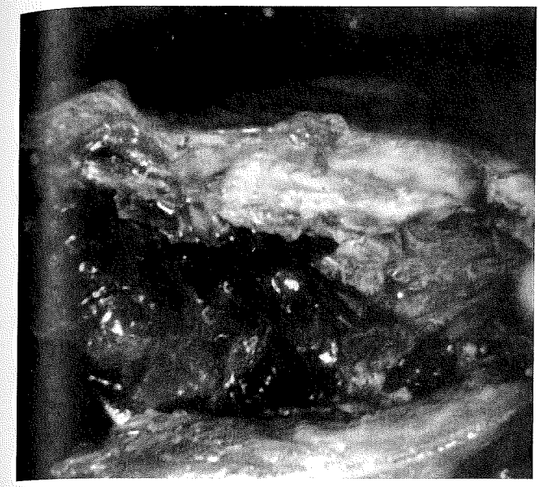

Figure 22–3. Dark areas are large dots in this sclerotic segment of the aorta.

inject the axillary or brachial artery of the left arm. When the common carotid is used as the primary injection site, arterial coagula are moved into the iliac and femoral arteries. The femoral arteries can be raised to embalm the legs; should this prove unsuccessful, the legs can be treated by hypodermic or surface embalming, or both.

If embalming is begun at a slower rate of flow and the use of preinjection fluids (which may loosen arterial coagula) is avoided, the arterial solution can pass **over** but not loosen coagula.

▶ VENOUS COAGULA

As veins enlarge toward the drainage site, venous coagula do not pose as serious a problem as arterial coagula. Failure to move the coagula, however, can block a vein, and this blockage can lead to tissue distension and discoloration. Massage from distal points toward the heart. Use the right internal jugular vein for drainage, as coagula in the right atrium can be easily reached with angular spring forceps and removed. Intermittent drainage helps to increase venous pressure and loosen coagula from the veins. Multisite injection and drainage may be warranted. When this condition is encountered in a localized area, use a stronger arterial solution to ensure that a minimum amount of arterial fluid delivers the maximum preservative.

▶ DIABETES

Various problems arise in the embalming of a person with diabetes. Of primary concern to the embalmer is

Figure 22–4. Discolored fingertips of an individual with diabetes. Poor peripheral circulation is often seen in the person with diabetes.

the establishment of good fluid distribution. Individuals with diabetes tend to develop arteriosclerosis, especially in the smaller vessels, and poor peripheral circulation can be anticipated (Fig. 22–4). These persons are also subject to increased bacterial and mycotic infections; all these conditions require use of a strong arterial solution. The first gallon can be slightly milder than subsequent gallons. To assist in establishing distribution and clearing of blood discolorations, the first gallon of arterial solution can be milder than subsequent injections. Some embalmers prefer to use a coinjection fluid to assist in the clearing of discolorations. Restricted cervical injection is suggested, and the embalmer should use moderate to high pressure to help distribute the solution. Massaging the extremities and using intermittent drainage also facilitate fluid distribution. High pressure and pulsation promote flow to the peripheral tissues (fingers, toes, ears, nose, and lips). Fluid dye can be used to trace the distribution of solution in the tissues.

The tissues of the diabetic may exhibit abnormal pH values. This may result in difficult tissue firming. Use of a moderate to a strong solution accompanied by a coinjection fluid and dye should meet the preservative demands.

Many individuals with obesity are diabetic. Restricted cervical injection and drainage from the right internal jugular vein ensure tissue saturation. A large volume of solution can be injected without concern that

the face may be overembalmed. The large volume of solution also promotes better fluid distribution.

Cavity embalming should be thorough. Mycotic infections are often found in the lungs of persons with diabetes. A minimum of 16 oz of cavity fluid should be used for each major body cavity. Abscesses, necrosis, and gangrene may be present in the pancreas and the liver. Arterial solution may not have reached these tissues. The cavity fluid is the only preservative that will be available to halt the decomposition that occurs in the tissues of these diseased organs.

Gangrene may also be present in distal tissues such as the fingers and the toes. These areas will **not** receive arterial solution when the body is injected. Cavity fluid should be injected into these areas by hypodermic injection or injection with an infant trocar. The surface of feet affected by gangrene should be painted with autopsy gel or cavity fluid compresses should be applied and the leg clothed in a plastic stocking.

Persons with diabetes are also subject to decubitus ulcers. These lesions should be disinfected topically and the tissue around them injected hypodermically with cavity fluid or a phenol cautery solution. Surface compresses of autopsy gel, cavity fluid, or phenol cautery solution should be applied to the necrotic surface tissues.

Restricted cervical injection allows the injection of a milder arterial solution into emaciated and dehydrated facial tissues. Coinjection chemicals and humectants may be used to help restore some moisture. After arterial preparation, tissue builder can be used to restore emaciated and sunken facial tissues.

▶ EXTRAVASCULAR RESISTANCE

Pressure on the outside of an artery or a vein is referred to as **extravascular resistance**, and may restrict the flow of arterial solution into a body region or may restrict drainage through a vein.

A slightly stronger, well-coordinated arterial solution should be used as distribution may be limited. Multisite injection may be necessary if extravascular resistance is present. Use of higher embalming pressures may promote distribution. Stopping the injection and allowing time for drainage may help to prevent blood discolorations: inject—drain without injecting—inject. Use concurrent drainage throughout the entire operation. Massage and manipulate the tissues to promote both fluid distribution and blood drainage.

Sources of extravascular resistance and suggestions on how to overcome the resulting problems are listed here:

- *Rigor mortis.* Relieve as much rigor as possible by manipulation prior to arterial injection.
- *Ascites.* Relieve the abdominal pressure by draining prior to or during arterial injection.
- *Gas in cavities.* Puncture the abdomen and relieve gases prior to or during arterial injection.
- *Bandages.* Remove tight bandages prior to injection.
- *Contact pressure.* Massage these areas.
- *Tumors.* Excise, with permission, if absolutely necessary. Sectional injection may be necessary.
- *Swollen lymph nodes.* Sectional injection may be necessary.
- *Hydrothorax.* Drainage may be possible prior to injection but can be difficult.
- *Visceral weight.* Above- and below-heart injection and drainage points can be employed.

▶ CONCEPTS FOR STUDY AND DISCUSSION

1. Discuss, from an embalming standpoint, the differences between postmortem venous coagula and postmortem arterial coagula.
2. Describe the vascular problems created by diabetes.
3. Discuss the problems created by congestive heart failure.
4. The embalmer has raised the right common carotid artery, as a point for arterial injection, an arterial tube is inserted toward the heart but it is a long tube and it passes through the aortic semi-lunar valve. Trace the various routes that the arterial fluid might take because of the location of the arterial tube.
5. The embalmer is injecting and draining from the right common carotid artery and the right internal jugular vein. All areas of the body are receiving arterial solution with the exception of the buttocks, the genital area, and the legs. Explain the problem and what can be done to solve it.

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CHAPTER **23**

EFFECT OF DRUGS ON THE EMBALMING PROCESS

CHAPTER OBJECTIVES

- Preservative demand
- Effects of various drug types
- Chemotherapy effects
- Radiation effects

The contemporary professional embalmer practices this art and science in an age that has often been referred to as the **Chemotherapy era**. (**Chemotherapy is the treatment of disease with chemical agents and drugs**.) The aims of modern medicine are to cure disease and alleviate pain via the long-sought-for "magic bullet" of Dr. Paul Ehrlich. Today, there is not a single case on which the embalmer works that has not been injected or made to ingest some type of chemical substance or substances (pharmaceuticals) prior to death. In many cases, particularly those received from medical facilities and institutions, many different types of drugs were used prior to the patient's death. Although the chemotherapy era began with Ehrlich's "magic bullet" for the treatment of syphilis, today we live in an age of **multiple-agent** chemotherapy.

The way antibiotics are used today exemplifies the multiple-drug approach common to the medical profession. It is very unlikely nowadays that a single antibiotic is prescribed for the treatment of an infection. Usually, two or more antibiotics are administered. In cancer chemotherapy, the multiple-drug approach is also common. It is not unusual for an oncologist to administer both a **cytotoxic** drug (one that kills the cancer cell directly) and an **antimetabolite** (one that slowly "starves" the cancer cell by depriving it of a needed nutrient). One result of this multiple-agent approach has been an increase in the number and types of embalming problems.

Before the embalming problems caused by chemotherapeutic agents are discussed, "normal" embalming must be defined. There is **no** "ideal case." It is probably impossible to find a person who has not been treated by one or more doctors with one or more drugs prior to death. So, in addition to the problems caused by the pathological processes resulting in death, the chemotherapeutic agent or agents administered for various intervals prior to death have physiological effects. The longer the drug was taken before death, often the more intense are the embalming problems likely to be encountered.

Another problem may arise from the chemical reaction between the administered drugs and the components of the embalming fluid. For example, are there any components of arterial embalming fluid that form insoluble precipitates when they react with antibiotics? If so, the circulatory path may become blocked, thus preventing the preservative components of the arterial fluid from reaching the tissues for preservation.

▶ THE CHEMISTRY OF PROTEINS

To discuss the chemistry of embalming, it is essential to understand the chemistry of proteins. These materials form the physical structures of the body. They give the body form. **The professional embalmer must achieve the absolute preservation of these structures.** This means that the proteinaceous materials forming portions of the various tissues and organs of the human body must be rendered chemically inert. Essentially, these structures must be frozen in time and space!

Proteins are labile substances. The molecules break down quite rapidly even without bacterial action. There exist proteins that break down other proteins. These

EMBALMING

HISTORY, THEORY, AND PRACTICE

Fifth Edition

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