UNTOWARD REACTIONS AND COMPLICATIONS DURING TRANSFUSIONS
AND INFUSIONS

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O ne of the earliest transfusions was given to a man who had fallen into a "Phrensy . . . occasioned by a disgrace he received . . . in some Amours." It was hoped that the calf's blood used for the transfusion, "by its midness and freshness might possibly allay the heat and ebullition of his Blood." Even today, unfortunately, good judgment may be lacking when transfusions are requested for certain obviously hopeless situations. On the other hand, who are we to deny someone the opportunity to survive that may be afforded by a transfusion?

It is generally recognized that the patient's chances of surviving an operation or of experiencing a smoother postoperative period are measurably increased if the preoperative fluid and electrolyte balance is satisfactory, nutritional state is adequate, and blood volume is within normal limits. These conditions must be combined, of course, with optimal postoperative support.

Attention to these details has made possible successful operative procedures on many patients who ordinarily might be considered extremely poor risks.

The development of heart-lung oxygenators, chemotherapeutic regional perfusion of isolated malignant lesions, and other procedures requiring varying volumes of blood has added further causes for concern for the patient's welfare during the postoperative period.

Blood transfusion services today have much to offer. Work is progressing toward a longer storage period for blood. By such techniques blood banks could perhaps accumulate rare types of blood for future demands and so reduce to a large extent some of the loss from outdating of blood. This progress again makes possible operative procedures that necessitate special patient care.

From the anesthesiologist's standpoint, the three principal indications for transfusion of whole blood or components are: (1) to increase the total circulating blood volume, (2) to increase the oxygen-carrying power of the blood, and (3) to increase the protein content of the blood. These three indications are specific, and when a blood transfusion is requested, one or more of them should be present to warrant the administration of blood.

No matter how well organized or how well supervised, a blood transfusion service is still operated by human beings. Consequently, errors in technical procedures, clerk or typist errors, mistaken identity of donors and patients, and many other situations are always possible. Therefore, one must be certain that a transfusion is justified before such a procedure is carried out. Many of the transfusions performed by anesthesiologists are done under the pressure of emergencies. Such situations are fraught with danger, because speed is conducive to human error. The education of the responsible physician in the more careful and thoughtful use of blood has great potential for lessening the untoward effects associated with this valuable therapeutic procedure.

UNTOWARD REACTIONS TO BLOOD TRANSFUSIONS

No matter how well a transfusion service supervises the laboratory work, and no matter how carefully the administration of the transfusion is carried out, a certain calculated risk of an untoward reaction always exists. In most institutions a reaction rate of 3 to 5 per cent is accepted. In certain instances transfusion reactions may be hard to recognize, particularly when the patient is under the effects of a general anesthetic. However, reactions do occur when the patient is anesthetized, and a careful observer should recognize them even then.

Untoward reactions are more likely to occur if the patient has certain complicating condi-
tions, such as a blood dyserythria or chronic ulcerative colitis, after multiple transfusions, or after one transfusion of several units of blood. Since more and more transfusions are being requested, the consensus is that the difficulties of finding compatible donors in certain instances and the possibility of untoward reactions may become increasingly evident.

At the Mayo Clinic we are conservative in the use of blood transfusion. In certain surgical situations, for example thoracic and cardiac surgery, we are careful not to overload the patients with blood. On the other hand, our experience has also led us to believe that certain other surgical procedures, such as operations on hips, extensive neck dissections, laryngectomies, and various other operations, warrant almost routine use of blood transfusion for supportive therapy.

Unless an extreme emergency intervenes, the first 100 ml. of blood should be administered slowly to see if any untoward reaction occurs. Every transfusion should be supervised in its entirety by a competent person.

If a reaction to a blood transfusion does occur, the person giving the transfusion and the responsible physician must make a real effort to determine the type of reaction it is and to institute the proper corrective and supportive therapy.

All too frequently the care of patients after untoward reactions is inadequately carried out because the attending physician (1) does not recognize the reaction, (2) recognizes the reaction but does not correctly classify it, or (3) recognizes the reaction but does not know the proper therapy.

A physician who has only occasionally seen a reaction to a transfusion may not be adequately prepared to look after the patient with such a reaction. In this regard, the personnel of a blood transfusion service and the clinical pathologic laboratory can offer valuable aid.

At the Mayo Clinic, reactions to blood transfusions are divided into five categories: hyperthermic or pyrogenic, allergic, circulatory, and hemolytic, with the fifth category comprising all those situations that do not fit into any other category.

Hyperthermic or Pyrogenic Reactions. These reactions are characterized by chills and fever, which appear during or shortly after the transfusion. Since the introduction of disposable equipment, the incidence of these reactions has decreased. In some instances the patient's disease seems to be responsible for minor or moderate febrile reactions. Payne* found that leuko-agglutinins were responsible for a number of these transfusion reactions. The leuko-agglutinins involved are in the recipient's plasma, as a rule, and they react with the donor's leukocytes. The antibodies have been shown to develop in the patient's blood only after many transfusions of blood have been received.

Symptoms accompanying hyperthermic reactions may vary from a slight chilliness with no fever to violent chills and a rise in temperature to 104 F. Complete recovery usually occurs within 24 hours.

These reactions must be differentiated from the febrile manifestations of the primary disease and from hemolytic reactions. A hyperthermic reaction can be differentiated from a hemolytic reaction by studying a sample of blood withdrawn from the recipient immediately after the reaction has occurred. The blood serum will show no free hemoglobin if the reaction is hyperthermic. Although the patient is uncomfortable, the reaction usually is not serious.

The treatment of hyperthermic reactions really begins with proper prophylaxis, including use of aseptic technique and of disposable equipment. Otherwise, treatment is symptomatic. Depending on the severity of the reaction, the transfusion may or may not need to be discontinued. Codeine, 30 to 60 mg. injected intravenously, makes the patient more comfortable. External application of heat is also in order.

Allergic Reactions. These reactions are characterized by hives, pruritus, and, occasionally, facial edema. The urticarial lesions may be local or widespread. The pruritus sometimes causes considerable discomfort. Angioneurotic edema, laryngeal edema, or bronchial asthma is a more serious accompaniment of this reaction.

Allergic reactions may arise in two ways: (1) Antigens may be present in the donor plasma for which the recipient's plasma contains equivalent reagins. This reaction depends
on the presence of an abnormality in the recipient rather than in the donor. The donor's blood may transfer circulating antibodies to the recipient so that later injections or inhalation of equivalent antigens by the recipient produces a reaction. At present it is impractical to test for, and thus prevent, this type of reaction.

The diagnosis can easily be made on the basis of skin manifestations. The symptoms of asthma must be differentiated from breath sounds that are caused by pulmonary edema resulting from overloading of the circulation.

If only a few, small, asymptomatic hives are present, no therapy is necessary. However, if there are large hives and pruritus, one of the antihistaminic agents administered intramuscularly, intravenously, or orally may be indicated. Benadryl, 25 to 50 mg. administered orally or intravenously, is usually the antihistaminic agent I would choose. If a still more alarming reaction occurs, such as bronchial asthma or laryngeal edema, emergency treatment with epinephrine, aminophylline, or corticosteroids may be necessary. For future transfusions to this patient or others with strong histories of allergic manifestations, administration of epinephrine, codeine, and an antihistaminic agent prior to the transfusion may be indicated.

Circulatory Reactions. When the blood volume is increased excessively, or, occasionally, when the increase is too rapid, the left side of the heart may dilate and fail; pulmonary congestion and edema then develop. This is a serious situation, particularly in patients with heart disease. Circulatory overload is perhaps the commonest cause of death from blood transfusions.

During the transfusion or shortly thereafter, the patient becomes dyspneic, orthopneic, and cyanotic. Frequently, a copious, blood-tinged, frothy fluid is coughed up. The cardiac rhythm may be normal, or auricular fibrillation or flutter may occur. The venous pressure is elevated, and the jugular veins are visibly engorged. If the patient survives, peripheral edema may appear.

This reaction must be distinguished from that of asthma, and the distinction must be made promptly. Death may follow quickly if treatment is not instituted early. Treatment includes placement of tourniquets on all extremities, without occluding the arterial pulse; this will pool 15 per cent of the circulating blood in the extremities. At least as much blood as has been administered should be withdrawn by phlebotomy. The patient should be in the sitting position, breathing oxygen under intermittent positive pressure. Drugs alone cannot be relied on for treatment. Future transfusions, which should be administered very slowly, should be small and perhaps limited to suspensions of red cells.

Hemolytic Reactions. Hemolytic reactions may result from one of three principal causes: (1) specific antigen-antibody reactions, such as those resulting from transfusion of incompatible blood, high-titered incompatible antibodies, or Rh-incompatible blood; (2) non-specific destruction of red cells caused by freezing, injudicious warming of cells, or improper storage; and (3) faulty administration, perhaps with addition of hypertonic or hypotonic solutions.

Whenever excessive amounts of hemolyzed blood are present in the circulation, serious changes occur in the body. The clinical picture of hemolytic reaction should be known to all physicians.

The early symptoms of a hemolytic reaction may occur after 50 to 100 ml. of blood has been administered. This is the best reason that the first 50 to 100 ml. of blood in every transfusion should be administered slowly. Early symptoms include flushed skin, headache, intense lumbar pain, severe subternal constriction, nausea, vomiting, and severe rigors. Breathing becomes rapid and labored. Shock may follow quickly.

Patients under the effects of a general anesthetic cannot complain; many of the fatal hemolytic transfusion reactions occur in such patients. Some authors advocate that no transfusions be given to anesthetized patients, and they frown on a transfusion of a single unit of blood under such circumstances. Their consensus is that potentially anemic patients should be transfused before operation. Severe bleeding, necessitating several units of blood during operation, is, of course, another matter.

Purpura and generalized oozing will occur with this reaction whether or not general anes-
Thesis is in use. Therefore, if petechial hemorrhages or generalized pronounced oozing occurs during a transfusion in any anesthetized patient, the transfusion should be stopped immediately. The bleeding resulting from a hemolytic reaction is possibly initiated by the release of thrombolytic substances from the destroyed red cells. Intravascular clotting results in hypoprothrombinemia and hypofibrinogenemia, in addition to the thrombocytopenia that accompanies a hemolytic reaction. This type of reaction is most commonly brought about by ABO incompatibilities, particularly if the recipient has high titer of immune bodies.

When massive intravascular hemolysis occurs, the plasma hemoglobin level may exceed 300 mg. per 100 ml. At a plasma hemoglobin level of 150 mg. per 100 ml, free hemoglobin will appear in the urine, and it will continue to be present until the hemoglobin level of the plasma falls to about 75 mg. per 100 ml. Usually the hemoglobin will be excreted through the kidneys or cleared through the reticuloendothelial system in 8 to 12 hours.

One of the most important observations the physician can make in properly diagnosing a hemolytic transfusion reaction is to note immediately the color of the recipient’s plasma. If it is normal in color, there is little likelihood of significant intravascular hemolysis. If the plasma is yellow or pink, a hemolytic reaction should be suspected. The transfusion should be stopped and detailed investigation be carried out promptly. The blood remaining in the donor blood bottle should be returned to the blood grouping laboratory for study. The urine should be examined immediately for hemoglobin. If studies are being done as long as 18 hours later, the level of the serum bilirubin should be determined. Most authors agree that serious renal damage is usually not observed in adults with hemolysis of less than 200 ml of blood.

In the differential diagnosis, a severe pyrogenic reaction may be mistaken for a mild hemolytic reaction. The reverse also may occur. The demonstration of hemoglobinemia and hemoglobinuria is direct proof of the presence of hemolysis.

In the treatment of a hemolytic reaction, the shock, which is an early symptom, necessitates vigorous management. Transfusion with known compatible blood is in order. Massive exchange transfusion has been used; this procedure, however, has not been accepted by many. To support the blood pressure during shock therapy, the administration of vasopressor drugs may be advisable. These drugs may be administered intramuscularly or intravenously, depending on the speed of effect required. Epinephrine hydrochloride, 0.25 to 0.5 ml of 1:1,000 dilution, may be administered intramuscularly. Ephedrine hydrochloride, 25 mg., may be given intravenously. One to 2 ml of a 0.2 per cent solution of levartemol bitartrate (levophed bitartrate) in 1,000 ml of a 5 per cent solution of dextrose in distilled water may be administered intravenously, or 1 to 2 ml of a 1 per cent solution of phenylephrine hydrochloride (neosynephrine hydrochloride) in 1,000 ml of a 5 per cent solution of dextrose in distilled water may be given intravenously. The intravenous administration of these fluids must be carefully watched to prevent excessive rise of the systolic blood pressure.

An accurate record of the intake and output of fluids must be started immediately. The specific gravity of the specimens of urine must be determined. Early in the treatment, replacement of fluid and electrolytes should be made as required, but the total amount of fluid administered should not be more than 500 to 3,000 ml. If less than 500 ml of urine is excreted in the first 24 hours, the patient must be treated conservatively. The rationale for the use of a one-sixth molar sodium lactate solution or a 5 per cent solution of sodium bicarbonate to alkalize the urine may be questioned. Forcing diuresis with intravenous administration of sodium sulfate or large volumes of fluids is to be condemned. If renal failure should occur, these excess fluids and electrolytes would be disadvantageous to the patient.

If the patient becomes anuric or oliguric, the intake of fluids, whether parenteral or oral, should be restricted to only 500 to 600 ml more than the 1,000 ml that is given daily to replace fluid lost through the skin and lungs. If more than this quantity is lost through vomiting, fistulous drainage, or in other ways, the additional loss must also be replaced. At least 100 Gm. of carbohydrate
should be given daily to supply some calories, but protein, which produces nitrogen, should not be administered. The administration of excess sodium salts to these patients may produce alkalosis and tetany, and possibly also pulmonary edema and congestive heart failure.

The electrocardiographic status, concentration of hemoglobin, hematocrit reading, and levels of nonprotein nitrogen or urea, sodium, potassium, chloride, and carbon dioxide combining power should be determined regularly. High levels of nitrogen, lowered levels of sodium or chloride, and acidosis usually are tolerated, but if the level of sodium falls to a critical 120 mEq. per liter or less, with elevation of the level of potassium, administration of a 5 per cent solution of dextrose in isotonic sodium chloride or a 10 per cent solution of dextrose in isotonic sodium chloride, covered with insulin, may aid in combating the retention of potassium. If the carbon dioxide combining power falls below 15 mEq. of bicarbonate per liter of plasma, administration of 500 to 1,000 ml of sixth-molar sodium lactate solution or 25 to 500 ml of a 5 per cent solution of sodium bicarbonate may be necessary.

If the patient's fluid and electrolyte balance can be adequately maintained and if development of uremic symptoms can be forestalled for a sufficient time, reversal of the renal condition may occur. However, if at the end of 5 to 7 days there has been no indication of resumed urinary excretion, if the values for urea, sulfate, phosphate, and other metabolic waste products in the blood continue to rise, and if the symptoms and signs of clinical uremia develop in spite of conservative measures, extrarenal means may be necessary to relieve the uremia. Such methods include continuous lavage of the stomach and upper part of the small bowel, peritoneal lavage, and extracorporeal dialysis (artificial kidney).

The recent literature contains many clinical reports concerning patients with acute renal failure treated by one of the means mentioned. Because of the rather elaborate setups required, the relatively high percentage of failures, and the numerous technical difficulties involved in carrying out methods of extrarenal excretion, the value of attempting a conservative program of treatment for as long as possible cannot be emphasized too strongly. However, if conservative measures fail and death appears likely, then one of the methods of extrarenal excretion should be considered as a lifesaving measure. At present hemodialysis by means of one of the several methods described in the literature seems to show promise.

When formation of urine is resumed and the onset of diuresis occurs, a second distinct hazard arises. With large volumes of urine passing through the kidneys, excessive quantities of sodium chloride are lost, resulting in depletion of the serum sodium or plasma chloride to critical levels. If, and when, the kidney assumes its role of excretion of urine again, the fluid intake of the patient still must be carefully regulated according to the output of urine. Frequent determination of the levels of plasma chloride, carbon dioxide combining power, and serum sodium must be made. If the concentrations of the electrolytes appear to be decreasing, it may be necessary to replace these ions. Consequently, the intake of sodium chloride must be increased. The intake of protein should also be increased as the uremia lessens. Many patients have died during this period of diuresis because of inadequate treatment, even though the underlying renal disease has improved.

Acute suppression of urine is extremely serious, and the prognosis must always be guarded.

**Bacterial Contamination**

Accidental contamination of donor blood can occur in several ways: through the equipment used, in improper cleansing of the donor's skin, and in improper storage of the donor blood. The use of disposable equipment has decreased the incidence of contamination. Gram-negative coliform, Pseudomonas, and Aerobacter-like organisms are most dangerous since they have the ability to grow at low temperatures and form potent endotoxins. Fever, hypotension, and severe muscular pains are typical clinical symptoms.

Irreversible shock and renal failure may develop. These reactions might be considered more dangerous than incompatibility of blood
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groups because much smaller quantities of donor blood are needed to initiate them. Prognosis in these cases must be guarded. Final diagnosis is made in the laboratory.

HEMORRHAGIC DIATHESIS

Massive transfusions may be followed by a bleeding tendency. Causes of this reaction include thrombocytopenia and abnormalities of coagulation factors.

CITRATE INTOXICATION

Bunker and associates have shown that in adults with normal liver function in whom citrate was infused at the rate of less than 0.5 mg. per kg. of body weight per minute the serum concentration of citrate ion remained below 9 mg. per 100 ml. (0.5 mM per liter), and the calculated ionized calcium remained above 0.85 mM per liter, which is within normal limits. Increasing the rate of infusion in adults with normal liver function may cause a moderate further rise in the serum citrate level and a slight fall in the level of ionized calcium, but the changes will usually not be sufficient to cause any untoward reactions.

Administration of calcium is specific therapy if citrate intoxication is apparent. It is accepted, however, that 2 liters of citrated blood can be given in 20 minutes to otherwise healthy adults. If more than this amount is given, some writers advocate use of 10 ml. of 10 per cent calcium gluconate for each liter of citrated blood administered.

Calcium is present in blood serum in two forms. Half the calcium is bound to protein and is not readily available for body needs. The remaining calcium is present in serum as ionized calcium and is available for body needs, such as maintenance of neuromuscular function, promotion of blood clotting (only minute amounts are necessary), and maintenance of circulatory integrity (principally through the influence of calcium ion on myocardial contraction).

Of all body calcium, more than 99 per cent is in bone, and of this bone calcium, fairly large quantities are in the form of so-called diffusible calcium. The diffusible bone calcium is readily available for migration into extracellular fluid or serum should the need arise. There may be present as diffusible calcium in bone as much as 100 times the total amount of serum calcium. In addition, work on experimental animals has demonstrated the difficulty of depleting serum calcium either by rapid infusion of citrate solution or by exchange transfusion with decalcified blood. This is evidence against the calcium depletion theory of "citrate intoxication."

On the other hand, numerous authors have reported electrocardiographic evidence of calcium depletion in human beings and in experimental animals during rapid infusion of large quantities of citrated blood or citrate solutions. In addition, Bunker and associates determined the values for total serum calcium and serum ionized calcium in a considerable number of patients receiving large quantities of citrated blood. Citrate levels were elevated in these patients, particularly in those with liver disease, and ionized calcium was frequently decreased. This evidence supports the theory of calcium depletion.

Both calcium gluconate and calcium chloride have been used during massive blood transfusion. Calcium gluconate contains 90 mg. of calcium per gram and calcium chloride about 270 mg. of calcium per gram. Calcium chloride is almost completely ionized when injected, and therefore it is immediately available to replace lost calcium. In large quantities it may induce metabolic acidosis (chloride ion). It must be given slowly and cautiously. Calcium gluconate apparently releases its calcium only as the gluconate radical is metabolized. The speed of this breakdown is unknown. In my experience calcium gluconate rarely, if ever, is needed in supportive therapy for blood transfusions. Howland and associates and Watkins expressed the belief that citrate intoxication per se does not exist. Were I to use calcium with massive transfusion, I would give empirically 0.5 Gm. of calcium gluconate for each unit of blood. However, had I replaced all blood lost and were I still faced with severe hypotension, which I might reasonably expect to be due to calcium depletion, I would give, slowly, 0.5 to 1.0 Gm. of calcium chloride and continue giving 0.5 Gm. for each unit of blood.
Potassium Intoxication

During storage of blood the potassium content of the red cell decreases, and the potassium content of the plasma increases. In adults with good renal function, potassium toxicity from relatively slow infusion of blood probably presents no problem. It has been suggested that rapid infusion of massive quantities of stored blood may result in interference with myocardial function due to high concentration of potassium in the circulation. If oliguric or anuric patients are to be transfused, blood stored for less than 2 to 3 days should be used.

Air Embolism

When air is injected into a vein, it finds its way into the pulmonary artery, resulting in a rapid fall in systolic blood pressure. Sixty to 80 ml. of air can produce alarming symptoms.12 Even smaller amounts may be fatal.

The administration of transfusions by direct air pressure within the donor bottle necessitates extreme care and constant attention by a responsible person. Some authors condemn the method. On the other hand, I am sure lives have been saved that might have been lost had rapid replacement of blood not been carried out by this method.13-15 Commercially available equipment for carrying out pressure transfusions seems to provide effective aid in the rapid administration of blood.

It is easy to introduce air into the patient's veins at the beginning of a transfusion or when changing from one bottle of blood to another. This can be avoided by making sure that the tubing is always full of blood before commencing the transfusion and, when changing bottles, by always leaving a little blood in the bottle before changing to the next bottle. If air does get into the tubing, it can be removed by disconnecting the tubing from the intravenous needle and running some blood through the tubing to expel air and fill the tubing with blood again.

The "Y" administration sets, the extra needle left inserted into the administration set to add medicaments, and other pieces of apparatus are potential sources of air emboli.

A fatality has been reported from air embolism produced by a combination of positive pressure and a blocked filter.14 A blocked filter alone can cause an air embolism. Bubbles of air are likely to be mixed with the blood only when the level of blood in the filter chamber is getting low and when the same filter has been used for blood containing considerable fibrin, which clogs the filter. It is good practice not to allow the level of blood to fall lower than the top of the filter (fig. 1).

Transmission of Disease

The transmission of syphilis, bacterial infections, and, in most cases, malaria can be con-
trolled by careful screening of donors. Transmission of viral hepatitis (homologous serum jaundice) is not so easily controlled. The precaution of rejecting donors with a history of jaundice cannot be expected to decrease significantly the occurrence of homologous serum hepatitis, since donors may be asymptomatic during the incubation period of hepatitis or may be infected with a subclinical or anicteric form of the disease. It is estimated that 0.5 to 6 per cent of the general public may be hepatitis carriers.

Bang and associates presented some interesting information on the detection of hepatitis carriers by study of the serum glutamic oxaloacetic transaminase activity.

**Infusion Therapy**

The responsibility of the anesthesiologist should not begin in the operating room. He should visit the patient preoperatively. This preliminary visit has many facets and is most helpful in determining the need for fluids and blood.

The medical record plus the physical examination of the patient will reveal much information about the status of hydration and the blood electrolytes of the patient before operation. That this is important is shown, for instance, in the recent report of Keating and Tang on neostigmine-resistant apnea in the presence of hypokalemia and the report of Foster who presented evidence for a possible central action of curare in the presence of low levels of serum potassium.

Vomiting, protracted diarrhea, gastric or intestinal suction, gastrointestinal fistulas, unusual sweating, and burns are frequently accompanied by disturbances in the volume of the body fluids and changes in the ion composition of the blood. Cardiac failure, cirrhosis of the liver with ascites, and renal insufficiency also often cause imbalances of the body fluids and blood electrolytes. Diseases of the endocrine glands are especially associated with disturbances of body fluids and electrolytes. Diabetes mellitus and adrenal insufficiency are of major importance. All these conditions demand appropriate treatment. This discussion will be restricted, however, to complications and hazards.

**Contamination.** With the commercially available fluids and administration sets in present use, the danger of contaminated solutions is almost nonexistent. However, the introduction of contaminating material by personnel administering these fluids is an ever-present source of danger. The accidental introduction of contaminating material by personnel adding extra medications to the intravenous solutions, the habit of keeping bottles of fluid, already opened, at room temperature for several days, and the use of the same bottle of fluid for different patients are real sources of danger.

**Local Trauma.** Repeated traumatic attempts to get needles into veins provide many opportunities for local introduction of skin contaminants. Local thrombophlebitis and cellulitis are not infrequently seen as a result of the use of poor techniques in the introduction of steel needles, plastic needles, or plastic catheters.

The addition of vasopressor drugs to intravenous fluids may be extremely beneficial to the patient. However, if certain vasopressor substances are accidentally injected extravascularly, bad sloughing may result (Fig. 2), necessitating surgical care and even skin grafting. The increasing awareness of this problem by physicians and nurses has resulted in more attention being paid to the areas into which

![Fig. 2. Slough resulting from accidental extravascular injection of solution containing a vasopressor drug.](http://anesthesiology.pubs.asahq.org/pdfaccess.ashx?url=/data/journals/jasa/931649/0)
needles have been inserted for the continuous intravenous introduction of solutions containing certain vasopressor drugs. Accumulated evidence now indicates that the injection of 5 to 10 ml of saline solution containing 2.5 to 5 mg. of phentolamine (Regitine) into the extravasated area may be successful in preventing such sloughs.

**Unfavorable Reactions.** Fluids containing vitamins, protein, fat, and carbohydrates should be given slowly and the patient should be carefully observed for allergic or hyperthermic reactions.

**Overloading of the Circulation.** All too frequently insufficient care is exercised in keeping the total volume of fluids administered within physiologic bounds. Overloading is particularly dangerous in patients suffering from cardiac or renal damage. The amount of fluid to be administered to an anuric or oliguric patient must be determined daily with great care.

**COMMENT**

We, as physicians and anesthesiologists, must be ever mindful of our responsibility to the patient, not only during the operation but also during the patient's convalescence. We must constantly be aware of what types of fluids and drugs we are using. We must carry out sterile techniques that are above all possible criticism. The prevention of local complications depends on the application of careful techniques as well as on the avoidance of the use of agents or solutions that are potentially dangerous.

**REFERENCES**


