be administered prior to the operation, but oftentimes it is unnecessary. Whiskey is a good sedative for elderly arteriosclerotic patients. . . . The two procedures that test the adequacy of refrigeration anesthesia are the cutting of the sciatic nerve at midthigh and the sawing of the femur. Following operation, it has been recommended by Allen that refrigeration of the stump be maintained by means of ice bags against a thin dressing, gradually reducing the refrigeration over a period of several days. . . . Wound healing is steady, although slower, with refrigeration. Stump sepsis is said to be lessened, presumably on the basis that postoperative wound drainage is usually more profuse, since the refrigeration inhibits the normal agglutination of the wound margins.” 38 references.

J. C. M. C.


“...In a study in which shock was produced in dogs by the release of tight leg tourniquets after a five hour period of constriction, it was observed that saline infusions and a single large plasma transfusion could prevent death in but a few of the cases. When, however, the same amount of plasma was divided into five equal doses, and given intermittently over the whole of the critical period, shock was prevented in all cases. These results led us to make a comparative study of the effectiveness of plasma, gelatin and saline in preventing shock following leg tourniquet release, and also that following leg muscle trauma. Both the single infusion and intermittent injections were employed for the administration of the plasma and plasma substitutes. . . . Twenty-five cubic centimeters per kilogram of 5 per cent gelatin in physiological salt solution given intermittently over a 7 hour period at the rate of 5 cc. per kgm. prevented shock in all of 14 dogs following release of leg tourniquets. The intermittent method of transfusing small amounts of plasma is much more effective in preventing shock following leg muscle trauma, than is a single large transfusion. Ten of 13 dogs did not show symptoms of shock after trauma when given plasma intermittently whereas but 2 of 10 dogs survived when a single large transfusion was employed. Both 5 per cent gelatin in physiological salt solution and salt alone either in isotonic or hypertonic solution given as a single injection or intermittently over 7 hours led to survival of approximately 50 per cent of the traumatized animals. Saline infusions are relatively ineffective in preventing shock induced by leg muscle trauma when such infusions are started when the arterial pressure is low and shock well advanced. However, they are apparently highly beneficial when administered before shock symptoms have appeared.” 16 references.

J. C. M. C.


Dr. Richards presents two interesting cases representing the effects of refrigeration on the tissues of the affected limbs; in one, no tourniquet was applied prior to femoral embolectomy and in the second, a tourniquet was applied prior to nerve section in the lower extremity for relief of pain. In the first case, the use of papaaverine and a lumbar sympathetic block had failed to reduce the pain. Eleven hours after onset, femoral embolectomy was
ABSTRACTS

done under local infiltration anesthesia. Postoperative treatment with heparin and dicoumarin by mouth was ineffectual in helping to restore circulation to the devitalized lower leg. On the 6th postoperative day, refrigeration of the leg was started, with maintenance of the thigh at a temperature of 18 C. and of the leg at 8 C.; no tourniquet was applied. True gangrene nor infection did not appear; but neither was any restoration of circulation to the lower leg evident. A guillotine amputation was carried out under refrigeration anesthesia; the patient died on the 23rd postoperative day, either from acute heart failure or a pulmonary embolus. Occlusion of the popliteal artery was discovered in the amputated member. There were no "gross necrotic changes in the avascular tissues." Injection of radiopaque material revealed patency of the popliteal vessel after removal of the thrombus and of the other vessels, including the smallest vessels of the foot. However, microscopic examination showed complete degeneration of the muscle tissue, with only sarcolemmal nuclei remaining; the nervous tissue showed "mild degenerative changes with infiltration of moderate numbers of polymorphonuclear cells."

... "The skin showed necrosis of the dermis and subcutaneous tissue with a few inflammatory cells and pigmented nuclei." It is the opinion of the author that cooling of the limb had not prevented the onset of gangrene, but had caused contraction of the available collateral channels and retardation of formation of new channels.

In the second case, section of the superficial peroneal and sural nerves was carried out under two and one-half hours' refrigeration anesthesia for relief of pain in a foot, in which the circulation was deficient, presumably on an arteriosclerotic basis, and on the medial aspect of the heel of which there was a small indolent ulcer. The foot was allowed to warm up slowly for four days postoperatively; but mid-thigh amputation was performed under gas anesthesia on the sixth postoperative day because of impending gangrene of the toes and marked increase in pain in the foot. Examination of the amputated member revealed occlusion of the popliteal artery by an organized thrombus; gross evidence of disintegration of tissues in the distal portion; beginning degeneration of muscle tissue and of nerve tissue; and subcutaneous edema with essentially normal epidermal and dermal layers.

This paper contains a fairly extensive review of the recent current literature on refrigeration anesthesia, shock from injury, and on clinical and experimental observations on the use of cold with and without the tourniquet, with presentation of the more important conclusions and observations of the various authors mentioned.

Dr. Richards's refrigeration technique stresses two important points: "(1) Tourniquet applied tight enough to completely obstruct all circulation to the distal parts; and (2) ice or another mechanism for maintaining the temperature of the ischemic limb between 2 C. and 8 C. until anesthesia is complete." The narrow tourniquet is used on the lower extremity, but Dr. Richards advises use of the pneumatic cuff on the arm. The low-thigh or mid-thigh amputation requires two and one-half to three hours of refrigeration; the upper leg, two to two and one-half hours; and the lower leg, one and one-half to two hours. The skin temperature is maintained at 2 C. to 8 C. The tourniquet may be placed three to six inches above the level of amputation "without fear of reducing the vitality of the tissues distally." Postoperatively, the stump is refrigerated over a period of forty-eight to seventy-two hours; the degree of heal-
ing, especially in infected cases, and the pain from edema can be controlled by this cooling. Pneumonia is a complication to be avoided after this procedure.

In summary, the conclusions of the author are: it is doubtful that refrigeration anesthesia can be used “in lengthy reconstruction operations upon normal limbs” or the repair of injured limbs; lack of care in use of the tourniquet in conjunction with cold may cause irreparable changes in muscle and nerve tissue; use of the tourniquet on an injured extremity adds the effect of tissue anoxia to trauma; cold tends to have a constricting effect on the present collateral circulation and may “retard the development of new collateral channels;” refrigeration anesthesia is of great advantage “in control of shock, hemorrhage, and infection if sacrifice of the limb has been decided upon”; . . . “the dangers of spreading thrombosis or embolism are obviated”; . . . “pneumonia postoperatively, must be cautiously avoided.”

C. S. H.


“During the last three and a half years, an attempt has been made at the Boston City Hospital to evaluate the role of reduced temperatures in the treatment of various types of peripheral vascular disease. Particular interest has been directed toward the employment of refrigeration as an anesthetic agent in amputations of the extremities for gangrene due to primary arterial disease. In addition, the effects of localized chilling of tissues in states of impending ischemia, due to sudden arterial occlusion, sepsis and venous thrombosis, have been observed. . . . It appears that the use of ice as an anesthetic agent might be of particular value in a group of poor-risk patients, in whom mortality in major amputations has always been appallingly high. . . . On the other hand, it is probable that, except in rare cases, the method of refrigeration has little to offer in groups of selected patients watched carefully by organized groups of physicians and surgeons. . . . In the ten-year period from 1930–1939, there were at the Boston City Hospital 162 cases of major gangrene of the extremities from different causes that were deemed inoperable, either because of the spread of the disease itself or because of other factors, such as old age and cardiorenal, cerebral or other complications. The mortality rate was 100 per cent. . . . In addition, the mortality rate on 270 cases of major gangrene operated on at this hospital between 1930 and 1939 was 53 per cent. . . . Fifty-four patients were refrigerated. Of these, 50 came to amputation and 4 died before operation. The latter were moribund on entry. . . .

“The immediate salutary effect of chilling of tissues on the more prominent signs and symptoms was most striking. Relief of pain was observed in every case and without the aid of the customary medication. . . . Shock has always been an outstanding and disturbing feature of thigh amputations, both during and after operation. In addition to operative trauma, general and spinal anesthesia, particularly the latter with its frequent attendant fall in blood pressure, contribute greatly to secondary surgical shock. This phenomenon is not observed in refrigeration operations. . . . The progress of gangrene and sepsis was notably inhibited in 48 cases by the application of cold. . . . In 50 cases of amputation, there were 16 deaths, a mortality of 32 per cent, and a salvage, in terms of 1930–1939 figures for unoperated cases, of 68 per cent. In addition, by this method there has been a