

Shock

—— A Physiologic
Basis for Treatment

SHOCK

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35 EAST WACKER DRIVE • CHICAGO

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SHOCK

A Physiologic Basis for Treatment

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Foreword

THIS PAINSTAKING, informative and discerning monograph by Dr. Thal and his associates of the University of Kansas mirrors the complex technology and the expertise and sophistication of earnest modern-day students of the shock problem. It also reflects the increased awareness of today's clinicians of their dependence upon the basic biologic disciplines.

In World War I the Harvard physiologist, Walter B. Cannon, took his laboratory to the front lines to try to bring enlightenment and understanding into the shock problem. The work of Cannon and his associates did succeed in setting aside the thesis of a diffuse vasomotor paralysis in shock, which theory had long been current prior to that time, despite the work of Seelig and Lyon (1909, 1910) and of Mann (1914), which had shown very definitely that peripheral vasomotor constriction was in large measure responsible for the "lost blood" in traumatic shock. Alert surgeons of the third decade of this century gave saline solution and blood to increase the cardiac output, depending solely on reestablishment of functional equilibrium to correct peripheral vasomotor constriction. Shock which fails to respond to restoration of blood volume has come to be known as irreversible shock. Today's surgeon-physiologist has at his command a number of effective vasodilator agents, corticosteroids and antibiotics to hasten reestablishment of normal vasomotor tone in endotoxin shock and to combat existing sepsis, conditions that fail to respond to restoration of blood volume. Successes with this type of management characterize the progress that current-day studies are lending surgery's advance in an area previously surrounded by an aura of hopelessness.

In his lecture "The New Physiology" before the Harvey Society in New York City (1916) Haldane predicted that understanding the normal physiologic processes would come to make a great impact upon medicine, a theme already stressed by Claude Bernard (1865) half a century earlier. In 1952 (Proc. Staff Meet. Mayo Clinic, 27:537), this writer expressed the hope that the time would not be far off when physiologists would be as active on the wards as the pathologist. Dr. Thal and his associates have taken the laboratories of the physiologist and biochemist to the patient's bedside to recognize the physiologic and biochemical changes attending the shock syndrome, enabling physicians to keep a running account of necessary corrective measures to be invoked.

As a junior medical student in 1920 at the Minneapolis General Hospital, I observed one of my teachers, Dr. J. Frank Corbett, recently returned

from a period of military service in France and a student of shock and "adrenal exhaustion," treat a patient with avulsion of the shoulder girdle by repetitive injections of large doses of epinephrine. The patient's pallor increased despite momentary rise in blood pressure and within an hour he was dead. Corbett (1914, 1915) was persuaded that adrenal exhaustion dominated the picture. Less than a year later, I was a junior intern in the same hospital and was in the emergency admitting ward when a pulseless and cyanotic patient, with a crushing injury of neck and upper thorax sustained in the nearby railroad yard, was brought in during early hours of the morning. The overworked and tired resident was called and he examined the patient and remarked that the situation was hopeless and left. Not capitulating so readily to a sense of utter futility I performed my first tracheostomy, and with help from the nurse on duty administered two liters of saline solution. By the time the multiple wounds had been satisfactorily dealt with, the patient had become conscious and eventually left the hospital. I tell this story only to indicate that this episode terminated the treatment of shock by injections of epinephrine in this area.

It is to be remembered that whereas a few clinicians had advised intravenous infusions as early as the mid-1880s, a precept which Rudolph Matas early adopted, hypodermoclysis, save in emergencies, continued to be the standard manner of giving fluids postoperatively up into the mid-1920s. Blood transfusion had come into being, but the only available donors were patients on the wards known to have group O blood.

Today's surgical house officers, too often unfamiliar with the trials of their predecessors of the late nineteenth and early twentieth centuries in meeting the emergencies of traumatic shock, probably little appreciate how much they are beholden to the studies of George W. Crile, Walter B. Cannon, Alfred Blalock, and to a number of investigators who made blood transfusion a practical reality. Blood banks and accurate fluid and electrolyte replacement have done much to improve the surgeon's record in dealing with trauma and what surgeons of a century ago often alluded to as the "shock" of operation.

When Sir Frederick Treves wrote the second edition of his *Intestinal Obstructions* (1899), the only fluid administered to patients dehydrated from vomiting was an occasional enema, apart from small quantities of hot water or ingested tea. Paget (*Lancet* 1:148, 1863) recommended and employed subcutaneous injections of morphine after operation as an antidote to shock. One of Treves' distinguished countrymen, O'Shaughnessy, 60 years earlier (1831-32) had shown how the collapse from the diarrhea of cholera could be assuaged by the intravenous administration of fluids containing the electrolytes sodium and potassium in the same concentration as observed in diarrheal stools. We constantly need to be mindful of

the admonition of the Preacher in Ecclesiastes I:11 concerning "remembrance of former things."

As early as 1867, a *Practical Treatise on Shock*, a monograph of 88 pages, was authored by the London surgeon, Edwin Morris. He described shock as a "peculiar effect on the animal system, produced by violent injuries from any cause, or from violent mental emotions." Groeningen's (1885) monograph professed to be a critical study of the physiologic basis of shock. He advised rest, alcohol, strychnine, and digitalis as the best remedial agents and concluded with the hope that future studies, characterizing the nature of shock, would find a better name for the condition.

Prior to Cannon's studies (1923), a goodly segment of the blood lost from the circulation was presumed to be in the veins of the abdominal viscera, though the English surgeon Malcolm (Lancet 2:579, 1905) had pointed out that the intestines were pale in shock. As early as 1879 the Irish surgeon Mapother (Brit. M. J. 2:1023) had suggested that shock was owing to "contraction of arterioles"; the vasodilator nerves he postulated were paralyzed. Cannon believed the stagnant blood to be in the capillaries. Blalock (1930) stressed the loss of blood and plasma in the injured tissues in shock. Modern-day students of the problem cite the venules as an additional site of the trapped blood. Great military surgeons had long advised bleeding for gunshot wounds when bleeding was not prominent. Ambroise Paré (1634) stated that phlebotomy is "required in great wounds where there is fear of deflexion, paine, Delirium, Raving and unquietness" (1968 reprint, p. 326).

Le Dran (1743) spoke of "the shock* and agitation which commonly follows gun-shot wounds. . . . Bleeding is of prodigious advantage here; nay it is absolutely necessary, if no considerable haemorrhage has preceded."

The British surgeon Ranby (1776, p. 121) endorsed phlebotomy for gunshot wounds and wrote "where the wounded person has not suffered any great loss of blood it will be advisable to open a vein immediately, and take from the arm a very large quantity and to repeat bleeding, as circumstances may require."

John Hunter in his *Treatise on the Blood, Inflammation and Gunshot Wounds* (1796, vol. 2, p. 287) endorsed, though somewhat unenthusiastically, bleeding for gunshot wound if spontaneous hemorrhage had not accompanied the injury.

MacLeod (1862, p. 251), writing of the Crimean War, stated that in the management of compound fractures of thighs he followed the advice of

*Le Dran had used the word *secousse* or *saisissement* (*Traite . . . sur les playes d'armes a feu*, 1740, pp. 2, 74). His unnamed English translator (1743) interpreted it as "shock" (pp. 2, 48-50).

Ravaton (1768, p. 323) in such injuries, who recommended removal of fragments from wounds and early bleeding, none of which "could protect him against inevitable death." Larrey (1832, Rivinus translation, p. 38) recommended bleeding for gunshot wounds only when complications developed. In the first decade of the nineteenth century, Philip Syng Physick, usually referred to as the Father of American Surgery, introduced phlebotomy for the reduction of dislocations and fractures, bleeding the patient in the erect posture until limp, thus providing at least as effective relaxation as with inhalation of anesthesia. In the War of the Rebellion (1861-1865) Mitchell, Morehouse, and Keen (Surgeons Generals' Circular No. 6, 1864) described reflex paralysis of peripheral nerves as a result of severe trauma.

In reporting upon *Surgical Experience in the Boer War of 1899-1900*, George Makins (1901, p. 110) related that shock was treated by administration of stimulants, hypodermic injection of strychnine, and in severe cases, when operation was necessary, by the intravenous injection of saline solution and stimulants.

This brief recital serves to indicate that only when physiologic techniques were applied at the front by the physiologist Cannon was notable progress made in military circles in the solution of the shock problem. Three centuries of experience was not the equal of physiologic assessment in appraising the nature of traumatic shock.

In his Harvey Lecture of 1919 (vol. 15, p. 30, 1921) Henry Dale emphasized the importance of secondary wound shock as a very significant factor in mortality. A number of the case histories of patients related by Dr. Thal and his associates obviously fall into this category. The cause of the death is often a mystery. Is there a dialyzable toxic factor as suggested by Cannon in his shock monograph (1923, pp. 160-162), whether of tissue or bacterial origin? Is there still an unrecognized factor not adequately dealt with? Are lapses in therapy responsible for the mortality? Certainly in late deaths infection is often the significant factor.

The *why* still continues to be as important as the *how* in the baffling shock syndrome. The interdependence of organ function and systems is well brought out in this penetrating study by Dr. Thal and associates, which should find eager readers among house officers, surgeons, and physicians who deal with the complex problems of shock. Moreover, these scientific explorations and achievements, in the hands of the University of Kansas investigators, point the way to solution of other bewildering and knotty clinical problems.

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