



By Cecil C. Cutting, MD  
Thomas McDonald, MD

## Perspective—Kaiser Permanente Medicine 50 Years Ago

**“*Omnia mutantur, nihil interit*” (all things change, nothing perishes). Ovid, *Metamorphoses***

Most Kaiser Permanente (KP) physicians of today had not yet been born during the World War II years, when our organization was forming. Therefore, most are probably unaware that a quarterly publication, the *Permanente Foundation Medical Bulletin*, existed for more than 10 years starting in 1943. Considering the small size of our organization at the time, this represents a considerable achievement. The *Bulletin* was decidedly clinical, with Review Articles, Clinical Series, and Case Reports dominating the pages. Dr. Morris Collen was the publication's editor and driving force. From recent conversation with Dr. Collen, it seemed evident to me that the *Bulletin* served important functions of boosting our organization's self-esteem and the respect we received from the general medical community.

I enjoyed perusing the *Bulletin*, not only because of its obvious historical interest but because some things had apparently changed little during the past 50 years. I thought it worthwhile to connect *Journal* readers with past KP authors, many of whom played major roles in establishing our organization. To this end, we conceived the idea of republishing some noteworthy *Bulletin* articles, adding brief commentaries by currently practicing physicians as appropriate. In this issue we present the lead *Bulletin* article from Vol. 1, No. 1 (published in July 1943). Written by one of our pioneering physicians, Cecil C. Cutting, the article is titled, “*The Treatment of Wounds, with Remarks on the Local Use of Sulfonamides*” and is followed by a brief commentary by Thomas McDonald.

—Arthur Klatsky, MD, Editor

Attachment: *Permanente Foundation Med Bull* 1943 (July);1(1):4-9.

### The Treatment of Wounds with Remarks on the Local Use of the Sulfonamides

**Cecil C. Cutting, MD**

IN ANIMAL TISSUES there are many factors which influence the process of wound repair. To enumerate, there are local factors which include: (1)

the amount of damaged tissue in the wound, (2) the adequacy of the vascular supply to the wound edges, (3) the amount and character of the exudate in the wound space, (4) the approximation of the wound surfaces, (5) the presence of foreign bodies within the wound, (6) the character and extent of infection.

To attain wound healing one must respect these factors and attempt to obtain a wound with the least possible amount of damaged tissue in it, an adequate blood and nutritional supply to the wound edge, hemostasis, approximation of all portions of the wound surfaces, minimal foreign reaction, and freedom from infection. Rough and excessive handling adds to trauma, strangulation and excessive tension of tissues decreases their blood and nutritional supply.

Adequate rest to the part must be provided. Imperfect suturing, inadequate control of the activity of the patient's straining and coughing, as well as allowing too early function or dependency of an extremity may delay wound healing.

There are systemic factors which exert influences of equal importance. We know that the fluid and protein levels in the blood and tissues and the adequacy of vitamin C are important. General toxicity retards tissue repair as do poor general circulatory states and anemia. Concurrent disease and malnutrition are frequent complications which must be recognized.

The present decade has seen many advances in the field of physiological chemistry as related to wound healing. The requirement of vitamin C for the formation of collagen in connective tissue is now recognized. Not only does the lack of intercellular cement substance result in hemorrhage into the wound space, but even partial vitamin C deficiency delays the development of tensile strength because of insufficient collagen fiber formation. Insufficient vitamin C results in abnormalities of all intercellular substances having collagen as a basis, including white fibrous tissue, bone, cartilage, and dentin. The importance of serum proteins and their effect upon fluid levels in blood and tissues are recognized. Ravdin and his associates demonstrated the disruption of abdominal

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left CECIL C. CUTTING, MD, one of the pioneering physicians of Kaiser Permanente, served as Chief Surgeon at Mason City Hospital on the construction site of Grand Coulee Dam. In 1942 he became the first Chief of Staff of the Permanente Foundation Hospital in Oakland; in 1947 he became a Director of The Permanente Medical Group. He served in both capacities until 1957, when he was elected Executive Director of The Permanente Medical Group, a position he held until retirement in 1976. Currently, he is a consultant at the Division of Research. He is a graduate of Stanford University and Stanford University Medical School, he completed internship and residency at Stanford Lane Hospital and San Francisco General Hospital.



right THOMAS MCDONALD, MD, is a graduate of the U.S. Army Military Academy at West Point and of Cornell University Medical School. He completed his residency training at Letterman Army Hospital and had a distinguished U.S. Army Medical Corps career, including the position of Chief of Surgery at Letterman for a number of years. He came to the Kaiser Permanente Medical Center as Chief of Surgery in 1987 and was appointed Physician-In-Chief in 1997.

wounds in over 70% of dogs operated on in the presence of hypoproteinemia. The wound edges were soggy with edema and the initial phase of healing was delayed one to two weeks. Protein is needed not only for maintenance of intercellular fluid balance but also for cellular nutrition. High protein diets tend to increase the rate of healing while high fat diets tend to delay it. Acidosis in dogs, developed by the administration of ammonium chloride, apparently shortens the period of wound healing.

### Sulfonamide Therapy

Sulfonamide therapy, a new chapter in the control of wound infection, began with the discovery of sulfanilamide. Since its discovery in Germany and its introduction into this country through England, the excellent results obtained by its use in controlling certain systemic infections have been widely recognized. It was early noted, however, that comparable results were not obtained in local suppurative lesions when the drug was administered orally or parenterally.

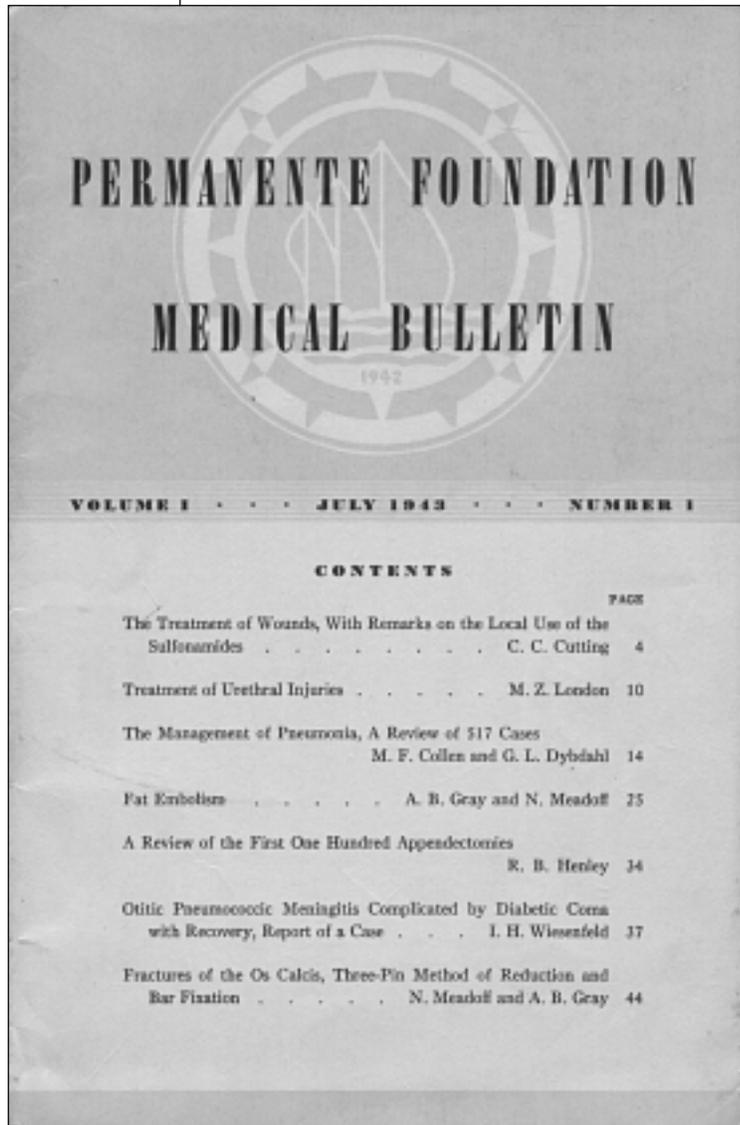
Local application of sulfanilamide was first reported in 1937 when it was used in dry sockets by the dental profession. In 1938<sup>1</sup> the excellent results following its use on chancroid lesions were reported. It was found that high concentrations were obtained in the surrounding tissues without either local or systemic toxic effects.

Although this lack of toxicity was true for the earlier small applications of sulfanilamide, it was soon found that its use in more extensive wounds might result in a blood concentration comparable to that obtained after oral administration, and the same systemic toxic manifestations might be seen. This is particularly noted in wounds whose surfaces are of considerable extent or are more than usually vascular.

The first conclusive evidence of the advantages of the local use of sulfanilamide was reported by Jensen<sup>2</sup> in 1939 in a series of compound fractures. After careful debridement of the wounds, sulfanilamide powder was inserted, and the skin was closed tightly. In this series of 39 cases, no infection developed as compared to the occurrence of infection in 27% of a control group.

Since that time it has found use in operative wounds, perforated appendicitis, perforated peptic ulcers, bowel surgery, osteomyelitis, mastoiditis, burns, leg ulcers, decubitus ulcers, conjunctivitis, and especially traumatic wounds.

In 1939, an inhibitory effect of sulfanilamide upon the healing of experimental stomach wounds in dogs was reported. However, the following year Taffel and Harvey<sup>3</sup> of Yale, on a large, carefully controlled series found no effect upon healing time or tensile strength of experimental wounds. These experiments were with sulfanilamide given orally, and they have been generally confirmed. When used locally, even with the much higher concentration of either sulfanilamide or sulfathiazole obtained in the proximate tissue, no effect upon the healing of the wound edges is demonstrable although the presence of packed clumps of powder in deeper tissues or separating skin edges may mechanically delay healing. Either drug may be placed into the peritoneal, pleural, or joint cavities with im-



***The cover of the inaugural issue of the "Permanente Foundation Medical Bulletin," as it appeared over 50 years ago.***



punity, except for the amount of absorption and systemic effects. The powder may be sprinkled beneath Tersch grafts or upon brain and nerve tissue. There is no demonstrable injury to any tissue cells.

Prolonged application of either sulfathiazole or sulfanilamide powder to a granulating area does appear to cause a grayish edema of the granulation tissue. Temporary discontinuance after several days, or the employment of Dakin's solution, rapidly freshens the granulations. Occasionally a sensitivity may be developed to continued use of either sulfanilamide or sulfathiazole. In these instances the wound edges become inflamed and vesicles develop on the surrounding skin. A systemic febrile reaction has been observed following the use of both drugs in sensitive individuals when the application of the powder was made on fairly large granulating areas. This is infrequently seen with sulfathiazole.

A combination of sulfanilamide and sulfathiazole powder may prove most desirable since the presence of one does not effect the solubility of the other in wounds, each being absorbed to its maximum extent. Sulfanilamide may questionably be more effective against streptococcus infection than sulfathiazole, but it is absorbed so rapidly that its blood concentration begins to fall within 12 hours. Sulfathiazole, on the other hand, is absorbed more slowly and its action persists four to five days. The systemic absorption is so small that, after implantation of four to five grams in the usual compound fracture wound, the concentration in the blood will be so slight that it is not measurable. Systemic toxic manifestations, therefore, with sulfathiazole implantations are seldom seen.

Small amounts of peptone reduce the effect of sulfanilamide and sulfathiazole, and small fragments of tissue interfere with their bacteriostatic effects in vitro. The extreme importance of adequate debridement of traumatized and necrotic tissue from wounds is immediately obvious. Present authors in military surgery are tending to discount the necessity of debridement, but they likewise sacrifice the possibility of primary closure of wounds.

The local use of sulfonamide derivatives in no way lessens the need to respect all of the cardinal principles required in obtaining wound healing which have been mentioned previously.

### Treatment of Wounds

There are four types of surgical wounds which are encountered. The treatment applicable to each type is briefly set forth in the following paragraphs.

1. *Clean operative wounds:* There are now reported in the literature large series of such wounds into which

sulfanilamide or sulfathiazole have been inserted and which have healed with no complication, no infection, and no delay. These drugs may be placed with impunity in all joint and body cavities. It is only when unnecessarily large amounts are used and clumps pack within the wound or separate skin edges that serum collects.

Sulfathiazole is slowly absorbed and unless large amounts are placed in the peritoneal or pleural cavities or on large granulating areas there will be no toxic absorption. Sulfanilamide is more rapidly absorbed and raises the blood concentration at a rate nearly paralleling oral administration.

In clean operative wounds there is always a possibility of a break in technic, especially in prolonged surgery with strenuous manipulation or retraction. There may be liquefaction of fatty tissues, trauma to muscles and fascia which predispose to infection.

It is not necessary to advocate its routine use in clean, non-traumatizing surgery, although many do. Its use must in no way temporize with necessary care and niceness in surgical technic or easy, careful handling of tissues.

2. *Contaminated traumatic wounds:* In this group are included lacerations and compound fractures which are treated early, that is, within 6 to 12 hours. Although circumstances of military surgery may demand compromised treatment, the aim of modern industrial and traumatic surgery is to attempt a careful and complete debridement and closure by primary suturing without drainage.

There is no question that the local use of sulfathiazole powder in these wounds allows them to be closed with good assurance of primary healing without infection. It admits the use of internal fixation in the treatment of compound fractures which has, heretofore, been definitely hazardous.

Systemic administration of sulfonamides are usually not necessary for this type of case.

3. *Acute pyogenic infections:* These may be divided into late, contaminated wounds, and into hematogenous pyogenic osteomyelitis and pyogenic arthritis: (a) The first of these late, contaminated wounds are those in which time has elapsed to permit development of infection. Almost no wound under six hours is so dirty or contaminated that it cannot be debrided and converted into a wound which may be closed tightly and without drainage. Possible exceptions to this are traumatic wounds of the rectum, and perhaps the bladder, and wounds of an extremity so extensive that the circulation to the area is seriously impaired.

After a delay of 12 hours, however, the infecting bacteria are not on the wound surface but

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*"Present authors in military surgery are tending to discount the necessity of debridement, but they likewise sacrifice the possibility of primary closure of wounds."*

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have penetrated into the tissue. These patients are ill with a systemic infection and need sulfonamide medication in full doses. Sulfadiazine is proving to be the drug of choice for oral and intravenous administration. In addition the wound should be adequately opened and drained, foreign bodies should be removed, and obviously devitalized tissues grossly excised. These wounds must be left open and generously dusted with sulfathiazole powder. Heat, rest, and elevation are indicated as may be gas gangrene polyvalent serum and other supportive measures. To date, sulfonamides do not replace tetanus or gas gangrene sera. (b) In the group of hematogenous pyogenic osteomyelitis or pyogenic arthritis the problem is somewhat similar except that the focus has not been drained. At the present time there is considerable difference of opinion as to whether or not this local abscess should be attacked surgically. Local infection with areas of necrosis should probably be drained as soon as it is safe to do so. Chemotherapeutic agents administered by mouth cannot be relied upon to sterilize an abscess cavity in the bone. The concentration of the drug in the abscess fluid is probably about 50% of that obtained in the blood, and is insufficient to kill staphylococci. This is equally true with soft-tissue abscesses, furuncles, etc.

In acute pyogenic arthritis the same is true. If the infection has progressed to cartilage necrosis, the joint should be opened widely and washed with normal saline followed by sulfathiazole implantation into the joint. In minimal and early infections, oral or intravenous sulfadiazine may be sufficient without surgical drainage of the joint. A far greater degree of residual joint function is now being obtained than was experienced prior to the use of the sulfonamides.

4. *Chronic osteomyelitis with sequestrae, draining sinuses, bone cavities, etc.* One of the most amazing examples of the efficacy of the use of sulfathiazole powder locally is in this type of wound. These sinuses need to be opened and cleaned out, necrotic tissue removed, and after the application of sulfathiazole powder to these wounds the skin edges and fascia may be brought together with through and through sutures and primary wound healing may be expected. This allows the approximation of freshened wound edges and the closure of dead spaces.

### Summary

There are both local and systemic factors which play important roles in wound healing. To attain wound healing one must attempt to obtain a wound with the least possible amount of damaged tissue in it, an adequate blood and nutritional supply to the

wound edges, hemostasis, approximation of all portions of the wound surfaces, minimum foreign body reaction and freedom from infection. Serum protein levels and vitamin C availability are important systemic factors which must be recognized.

As a rule, recent wounds may be debrided and closed tightly with the use of sulfathiazole powder in the wound. This allows more prompt healing, shortened disability and more complete function than is seen if wounds are left open and allowed to heal by granulation. Local and systemic requirements for wound care, however, must be recognized if the conversion of contaminated to clean wounds is attempted.

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3. Taffel, M., and Harvey, S.C.: Effect of Sulfanilamide on Wound Healing. Proc. Soc. Exp. Biol. and Med., 45:647 (November), 1940.

### Commentary by Thomas McDonald, MD

#### PIC at Oakland, Chief of Surgery from 1987-1997

Dr. Cutting's "The Treatment of Wounds," was published the month I was born, over half a century ago. As I reviewed his article, it was readily apparent that his stated principles of wound healing have stood the test of my lifetime. He identified the following six important local factors which affect wound healing: 1) amount of damaged tissue in the wound, 2) adequacy of the vascular supply to the wound edges, 3) amount and character of the exudate in the wound space, 4) approximation of the wound surfaces, 5) presence of foreign bodies within the wound, and 6) character and extent of infection.

Modern essayists might lump or split these six factors or give them other labels, but no one would claim that they are unimportant. Dr. Cutting also emphasized the major systemic value of good nutrition and essential vitamins and explained the differing characteristics of clean operative wounds, contaminated traumatic wounds, acutely infected wounds, and chronically infected wounds.

Dr. Cutting's main theme was wound treatment using local placement of sulfonamide powder as appropriate for various categories of wounds. This practice has, of course, been supplanted by use of systemic antibiotic treatment. However, some

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surgeons still cling to the belief that local antibiotic irrigation for selected wounds is still useful. Based on Dr. Cutting's and others' reports, I personally have used bacitracin solution irrigation during my entire surgical career and am reluctant to change a successful (albeit perhaps less than perfectly scientific) practice.

At a recent Permanente Medical Group dinner, I had the privilege to share a drink and a few minutes of talk with Dr. Cutting. As he spoke in a clear and thoughtful manner, I felt confident that, if the need arose, he could come to the emergency room, clean up my wound, carefully sprinkle sulfa powder into it, and I would be just fine. ❖

## Stewardship

"Many of us do not want that much information, but that is the part of us that still wants to be taken care of, that wants to be a child. We hear the cry that all that "business literacy" stuff is for administrators and bureaucrats, leave us alone so we can just do our jobs. Don't nibble that bait off that hook. Customer, financial, and systems responsibility is essential to everybody's job. Anyone who does not want to learn these things cares little for the well-being of the larger organization. Another form of self-interest. Organizations that allow anybody to get too distant from either their bankers or their marketplace will not survive. Learning what it takes to keep the ship afloat is the price we pay for our desire for more voice and more control."

*Peter Block, Stewardship: Choosing Service Over Self-Interest, Berrett-Boehler Publishers, 1993.*