# FIBRIN AS A HÆMOSTATIC IN CEREBRAL SURGERY

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THE purpose of this paper is to suggest the use of fibrin for controlling hæmorrhage in certain types of intracranial surgery. Fibrin possesses all of the hæmostatic qualities of cotton wet with salt solution and has the advantage that it is absorbed with comparatively slight reaction on the part of the surrounding tissues. Fibrin is easily procured, it is inexpensive, and it may be kept sterile with the other operating room supplies.

During the extirpation of cerebral tumors there is occasionally more or less difficulty in controlling hæmorrhage. Troublesome bleeding is particularly liable to occur with new-growths which have deep, vascular pedicles or which have attachments to the walls of inacessible dural sinuses. In an emergency of this sort the cavity is usually packed with some foreign substance, such as cotton, and moderate pressure made over the wound. When bleeding is started afresh by the removal of the cotton it is the custom of some operators to insert small pieces of muscle or fascia against the bleeding points and hold them in place until the oozing ceases. Cushing (2) and Horsley (5) have found fragments of raw muscle very helpful for this purpose and have noted no ill results to follow their use.

Various kinds of tissues are now recommended for hæmostasis. Hilse (4), Stuckey (8), Chessin (1), Philipowicz (7), and many others have reported successful autoplastic hæmostasis in hæmorrhage from the abdominal viscera with slices of subcutaneous fat, pieces of omentum, and strips of fascia. Philipowicz asserts that this autoplastic method has never failed to arrest hæmorrhage either in the clinic or in experiments, when properly done. In abdominal work Ohkohchi (6) found disturbing adhesions to develop most frequently with slices of muscle. On the other hand, proliferation of connective tissue was most pronounced with pedunculated omental flaps. All of the advantages of these tissues, he believes, can be secured, with none of their disadvantages, by using a slice of sea sponge. It arrests the bleeding mechanically; it is gradually absorbed; and it does not seem to irritate the surrounding tissues—minimal adhesions form later and the parenchyma of the organ does not degenerate. In intracranial surgery Wendel (9) has shown that comparatively large pieces of fascia and subcutaneous fat may safely be transplanted into cerebral defects.

While the methods which employ cotton, muscle, or fascia are usually successful in securing hæmostasis they possess certain obvious disadvantages. In the first place it is often difficult to procure a sufficient amount of fascia or muscle. Though other portions of the patient's body—the thigh for example—may afford an abundant supply of either tissue, the preparation of the leg and the excision of the muscle necessitate a certain delay. This procedure, furthermore, always contributes a slight additional chance for infection. In the second place, it occasionally happens that an inaccessible bleeding area can be controlled only by using a bulky packing material such as cotton. In the subsequent removal of this tampon it is often difficult to withdraw all of the cotton without stirring up fresh hæmorrhage. No operator, however, cares to leave an unabsorbable substance of this nature in the wound, in spite of the fact that animal experiments have shown a good tolerance of the cerebral tissues for cotton.

At the suggestion of Dr. Cushing the writer attempted to find an absorbable material which might be used for this purpose in place of cotton or muscle. The fibrin from sheep's blood ultimately proved to answer most of the requirements. Sheep's fibrin was used because it was readily procured from the Wassermann laboratory.

Serologists usually shake the freshly drawn

blood in a flask containing glass beads until the fibrin formation has been completed. The fibrin collects about the beads in a stringy, spongy mass. In this form it was received for the experiments outlined in this report.

After washing the fibrin repeatedly it is allowed to stand in distilled or tap water for twenty-four hours or longer—until all of the enmeshed red blood-cells have been laked. This brings out the natural white color of the substance and prevents it from assuming a muddy appearance during the subsequent sterilization. After placing the fibrin (previously divided into smaller pieces) into a roomy glass jar containing normal salt solution, the mouth of the latter is covered with cotton and gauze and sterilized. The sterilization softens the fibrin and thus facilitates its absorption by the tissues. It is now ready for use. In this form the fibrin will keep for months.

Two sets of experiments were conducted on animals—dogs and cats. In the first the hæmostatic qualities of fibrin were investigated by using it in a variety of wounds, some with torn vessels and others with lacerations of the sinus walls. When dipped into a physiological salt solution and pressed against bleeding points with a sponge or a wisp of dry cotton, fibrin was found to control the hæmorrhage even better than wet cotton. The soft and pliable nature of this substance made it adhere to rough and smooth surfaces alike. While fibrin probably exerts no appreciable chemical influence on the process of coagulation it appears to possess some mechanical property favorable to the formation of a firm clot. The difference between fibrin and cotton in this respect was clearly shown when pledgets of each material were pressed over bleeding spots and then removed again after a lapse of a minute or two. Fibrin was found to adhere to the underlying structures much more firmly than cotton. This fact probably accounts for the more efficient hæmostasis noted with the former when larger vessels were dealt with.

Clotting may perhaps be hastened by dipping the pieces of fibrin into a solution such as the Kocher-Fonio coagulin (3).

More or less difficulty is frequently encountered in keeping a deeply placed fragment of fibrin in its proper position. In removing the gauze or cotton used to make pressure over the implant the former is apt to loosen or tear the pledget from its bed. A simple expedient found to meet this complication consisted of a ball or finger-shaped piece of dry cotton about which was wrapped a sheet of rubber protective tissue. The edges of the latter were secured at its base with thread. A pledget of fibrin was mounted on the smooth end by firmly squeezing a piece wet with salt solution against the protective. This form of applicator permitted ample pressure to be made on the implant without adhering to it or to the surrounding structures.

In the second series of experiments small pieces of fibrin were imbedded in the cerebral hemispheres of cats. After varying periods the animals were sacrificed and the implants with the surrounding cerebral tissues were examined histologically. The absorption of small blocks of muscle (autotransplants) was followed in a similar way.

About two weeks subsequent to the implantations, sections showed the results of the reaction usual for foreign bodies in general. Great numbers of leucocytes together with numerous new connective-tissue cells surrounded the alien material. Here and there slender new blood-vessels were seen penetrating into the mass. Occasional giant cells appeared near by.

When the animals were allowed to live four to five weeks the process of absorption was found much advanced. Of blocks of muscle tissue which originally measured nine to ten millimeters in all diameters only a few scattered fragments were visible. Implants of fibrin of a similar size appeared at the expiration of this time as a loose granulation tissue enclosing many leucocytes and a few areas suggesting hyaline degeneration. After the sixth week neither substance could be identified.

The reaction of the cerebral tissue was more marked to the muscle implants than it was to the pieces of fibrin. There were greater numbers of leucocytes present with the former and the exudate and granulation tissue extended farther into the enveloping

brain substance. This was most clearly seen while remnants of the foreign bodies were still perceptible. At a later period, six to seven weeks for pieces of the aforementioned proportions, only a small amount of scar tissue marked the sites of implantation of both materials.

The tolerance of the tissues for larger blocks of fibrin proved to be equally good. A piece which measured approximately three and one-half by two by one and one-half centimeters produced no untoward clinical effects and the same type of healing and absorption was discovered when the animal was subsequently sacrificed.

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# ESSENTIAL UTERINE HÆMORRHAGE[1]

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THE importance to the economy of the ductless glands is now an accepted fact, and consequently many hypotheses have been developed to explain the relations of these glands to various important functions, which were previously either wrongly interpreted, or not at all explained.

Experimentally it has been demonstrated that the generative glands possess an internal secretion. Hegar (1) and Kehrer (2) have shown that castration in female animals resulted in atrophy of both internal and external genitals. Halban (3) transplanted ovaries under the skin of castrated animals, and in those instances in which the transplants took found that the atrophy was prevented. These experiments clearly proved that the ovaries possess a function that exerts a protective influence over the condition of the genitals and acts independently of the nervous system; in other words, a function chemical, or otherwise, acting through the blood stream. Knauer (4) also demonstrated the same fact, and Ribbert (5) and others proved that only a portion of the gland is necessary to maintain the normal condition of the genitals. These experiments demonstrated the existence of an ovarian internal secretion, but just which particular histological structure or structures elaborated this secretion or secretions, if there be more than one, has not been definitely determined. The graafian follicle, the corpus luteum, and the so-called interstitial gland have all been suggested as the possible source.

Bischoff (6) in 1844 first suggested that the periodic maturation of the ovum and the subsequent rupture of the follicle caused menstruation. Recently this theory has been discredited and to the corpus luteum the important rôle has been assigned. Halban, to demonstrate the dependence of menstruation upon the presence of the ovary, transplanted the generative glands under the skin of castrated baboons who continued to menstruate so long as the transplants remained; when they were removed, however, menstruation ceased. Menstruation, in other words, was dependent on the ovary but independent of the nervous system. What part of the ovary is the active one in this regard is still uncertain.

The graafian follicles are present at birth, undergo periodic growth and rupture, and persist even after the climacteric. These structures possess, in addition to their generative function, most probably other important secretory functions, and many writers are inclined to attribute some internal secretory

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