

9. Hofbauer, J. I.: Nasal Application of Solution of Pituitary for Obstetric Purposes, *J. A. M. A.*, 89:24, 1927.
10. Mayes, H. W.: Mercurochrome to Secure Vaginal Antisepsis During Labor, *Am. J. Obst.*, 30:80 (July), 1935.
11. Williams, N. H.: Personal communication.
12. Morton, D. G.: A Comparison of the Results Obtained in the Induction of Labor by Means of Bag or Bougie, *Am. J. Obst.*, 18:849 (December), 1929.

DISCUSSION

HENRY A. STEPHENSON, M. D. (490 Post Street, San Francisco).—Doctor Thompson has written a most timely paper. For the past few years there has been a tendency to attempt induction of labor in patients, in which no real indication for such induction existed. Most conservative writers have given the following indications for induction of labor: (1) To save the life of the mother; (2) in certain diseased conditions of the fetus; (3) postmaturity; and (4) contracted pelvis. Certainly one should be sure that a definite indication exists before attempting induction.

The requirements for induction have been outlined by Doctor Thompson, and are so well stated that no further comment need be made. The same may be said about the pitfalls attending induction.

Doctor Thompson aptly puts the crux of the situation, in stating, "When one induces labor he becomes responsible for any and all troubles that may follow."

In making the above remarks it is not my intention to detract from the value of the method of induction which he outlines. Where one has a definite indication for induction the above outlined method is indeed the best, and the least dangerous of any which have been described to date, and in my hands has given very satisfactory results.

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DONALD G. TOLLEFSON, M. D. (511 South Bonnie Brae, Los Angeles).—Rupture of the bag of waters to induce labor has become a frequent obstetrical procedure, since Slemmons first reported his series. Most of the articles have mentioned only the successes. Doctor Thompson's paper is unique in that it reports certain difficulties encountered in what has appeared to be a very simple means of electing the time of delivery near term. One cannot disagree with any of Doctor Thompson's observations, but as discussants, we should emphasize their importance.

Since the adoption of this procedure, we are less concerned about dry labors, and when induction is indicated another valuable method is available. As brought out in this discussion, the question of date of term is difficult to determine. We must depend on the changes taking place in the cervix, which has been aptly described as "the preparatory stage of labor." If this does not take place before the patient is induced, we are courting disaster. If it has occurred, the onset of labor will usually be within a short time and induction will not be necessary.

Prematurity adds to fetal mortality. It is, therefore, important that induction should not be attempted until the conditions, as outlined, are present. We then can assume that maturity has been reached.

While many writers have reported that a high percentage of patients will be eligible for induction, according to these standards, it has been my experience that only a very few patients will have the requirements for elective interference. At Los Angeles County General Hospital, we have noticed a high incidence of prolonged labors, with an increase in morbidity and mortality in cases following induction before these conditions have been obtained.

Dr. Thompson's conclusions are those which any doctor who has had experience with this method can, without question, heartily endorse.

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JOHN W. SHERRICK, M. D. (350 Twenty-Ninth Street, Oakland).—In discussing the question of difficulties encountered in the induction of labor, I want to congratulate the essayist on his excellent and exhaustive presentation of the problem. Certainly, the problem of shortening labor and making it easier has not been solved.

In inducing labor we have employed a technique varied to meet the needs of the individual case. We have given up the use of quinine, believing that it adds little of value to

the operation, and thus we have avoided the dangers that it may impose. Our usual procedure is the use of castor oil, to be followed in three to four hours by stripping and rupture of the membranes, and the use of repeated small doses of pituitary or thymophysin hypodermically. Sedation is used as indicated. If there is reasonable doubt of accomplishing productive labor, we refrain from rupturing the membranes as we feel, with the author, that in such cases it does not aid materially and does increase the hazards to both the patient and her baby.

We have used this procedure electively in a large series of cases and, with one possible exception, have found it safe, effective and a material aid in shortening labor, provided we have selected our cases wisely. We have had no maternal or fetal mortality in cases so handled, and have not felt that it adds materially to our morbidity. We feel that this method is most satisfactory in well-chosen cases, but have had considerable difficulty in those poorly chosen, and, therefore, have established rather rigid requirements before resorting to rupture of the membranes.

We have chosen cases for this procedure on practically the same basis as outlined by Doctor Thompson, namely, adequate pelvic measurements, engagement of the presenting part, reasonable softness of the cervical tissues, effacement and/or partial dilatation of the cervix. Under such conditions our results have been most satisfactory. Real difficulty has been encountered only in those cases in which the cervix was not effaced and/or the presenting part unengaged. In such we have had difficulty in securing real induction of labor and in accomplishing dilatation of the cervix. Many of these cases have, after several hours of ineffective pains, been finally terminated by manual assistance in securing dilatation of the cervix, with the usual lacerations which were repaired immediately postpartum. We have had no serious untoward results, such as prolapsed cord, sepsis, etc., from such interference, but we no longer recommend induction of labor unless the requirements outlined above can be met.

In spite of Doctor Thompson's conclusions, and while cognizant of the fact that there are real hazards and that often undue publicity may arise in a given case, we still feel that this procedure is safe and effective, provided one meets the requirements stipulated.

ESTROGENIC HORMONES: THEIR CLINICAL USAGE*

By C. F. FLUHMANN, M.D.
San Francisco

DISCUSSION by E. Kost Shelton, M. D., Los Angeles.

THE employment of extracts made from ovarian tissue was first introduced over forty years ago. These preparations were mostly desiccated gland products administered orally, and were long the subject of much discussion. They were advocated for all types of so-called ovarian deficiencies, and never lacked enthusiastic advocates and skeptical opponents.

The advances of recent years in our knowledge of the endocrine control of reproduction have shown that such "ovarian extracts" are biologically inert, and the favorable results obtained from their usage probably should be attributed to a psychotherapeutic effect. In their place, our attention has been directed to a very interesting group of chemical substances known as "estrogenic hormones" or "estrogen."

The estrogenic hormones are capable of inducing certain changes, normally controlled by the ovaries, in the accessory genital organs of women and ex-

*From the Department of Obstetrics and Gynecology, Stanford University School of Medicine.

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perimental animals. This is manifested in their ability to counteract the atrophy that follows castration, and to induce the proliferative phases of the estrous or menstrual cycles. The most pronounced of these changes are noted in the uterus, vagina, and breasts.

The property of the estrogens to repair the post-castration atrophy of the vagina of rodents is the basis of biologic tests employed for their demonstration. The animals used are mature female rats or mice which have been castrated for one week or longer. As a result of the excision of the gonads the epithelium of the vagina undergoes a pronounced atrophy, and is represented by two layers of small cuboidal cells. The injection of sufficient estrogenic material in these animals results in an intense proliferation of the mucosa, so that in sixty hours it has assumed the appearance of a fully-developed squamous epithelium, with large non-nucleated cornified cells at the surface. The presence of these cells in scrapings or smears of the vaginal wall constitutes a positive result in the Allen-Doisy test, the procedure generally employed in clinical studies and the standardization of extracts. In the Fluhmann mucification test the same changes are employed as criteria, but they are observed in microscopic preparations of the vaginal wall instead of smears.

DISTRIBUTION

The application of such tests has shown that estrogen is not a single specific hormone of the ovary, but is widely distributed in plant and animal life. It has, for instance, been demonstrated in the blood, urine, liquor folliculi, corpora lutea, and placentae of many species; in yeast, buds of *salix caprea*, sugar beet, parsley, cherry, plum, wheat, rice, fish roe, hen's eggs, petroleum, lignite.

The occurrence of estrogenic hormones in women is of much interest. Blood tests in female children show that estrogens are absent up to the age of about eight years. After this time they may be demonstrated, and their appearance is coincident with the gradual development of the secondary sexual characters. During adult life there is a cyclic rise and fall of estrogen in the blood and urine which follows the events of the menstrual cycle. In typical cases the hormone increases during the early part of the cycle, and reaches a peak in the midinterval, at about the time of ovulation. Then there is usually a progressive drop in its production until the time of the menses, although occasionally a secondary rise may be present with the onset of the flow. During pregnancy, estrogenic hormones are present in tremendous quantities.

The nonspecificity of the estrogens is shown by the fact that they are present in appreciable quantities in the blood and urine of men, and of women following castration and after the menopause. This is of especial interest, and demonstrates that they have also an extragonadal source of production.

The application of estrogenic hormone tests to clinical problems has been the subject of many investigations during recent years. It is a fertile field and many interesting discoveries have been reported, but it is beyond the scope of this paper to make further reference to this aspect of the ques-

tion. However, I do feel that this work is still an academic research problem, and that there is no justification for the widespread adoption of estrogenic hormone tests as a routine clinical procedure.

CHEMISTRY

The widespread dissemination of estrogens is explained by the fact that many substances have estrogenic properties; that is, they are able to induce estrous changes in the vaginae of spayed rodents. They have been found to belong to an interesting group of bodies, the phenanthrene series, which also includes cholesterol, the bile acids, ergosterol, calciferol, and the male sex hormones.

Three estrogens have been isolated and purified from the urine of pregnant women, and are of especial importance in clinical studies. The first is estrone, also known as theelin, or ketohydroxy-estrin. The second is estriol, or theelol, or trihydroxyestrin. The third has been recovered in pure form from follicular fluid, and it is thought that it may be a specific product of the ovary. It is estradiol, or dihydroestrin.

STANDARDIZATION OF EXTRACTS

The clinical use of estrogens has been much hampered by the confusion arising from the "units" employed. There are few, indeed, who are not bewildered by the vast array of rat units, mouse units, biologic units, international units, and so forth.

The standardization of estrogenic hormones is conducted with the Allen-Doisy test, and either rats or mice are employed. In 1932, an international standard was adopted in London under the auspices of the Health Organization of the League of Nations. This standard consisted of 20.9 grams of pure estrone contributed by several countries, and the international unit is the quantum of activity of one-tenth gamma of this preparation. In other words, one milligram of pure estrone contains 10,000 international units.

The adoption of the international unit is a great advance, but the products of different manufacturers must be compared with each other with great hesitation. The transposition of rat or mouse units into international units is still dependent on a preliminary standardization by means of the Allen-Doisy test, and the evaluation of such units in different laboratories varies greatly.

Several commercial houses have abandoned the use of units and substituted the actual weight of the hormone in milligrams. It is possible, and certainly very desirable, that eventually such a procedure will be generally adopted, and greatly simplify the problem.

COMMERCIAL PREPARATIONS

There are now many potent commercial estrogenic hormones available in this country. They are preparations of estrone, estriol, estradiol, or derivatives of these substances. Their common sources are urine of pregnant women or pregnant mares, human placentae, and in some cases they are partly synthesized.

The estrogenic hormones are usually administered hypodermically, orally, or by local application.

1. *By injection.*—The estrogenic hormone most often used in this manner is estrone, although Progynon-B (Schering Corporation) is a benzoic acid ester of estradiol. It is supplied in ampoules, and almost always dissolved in oil in order to avoid a too rapid elimination of the hormone after injection. The dosages employed vary from 0.02 milligram (200 international units), to 5.0 milligrams (50,000 I. U.). Among the preparations available are:*

Amniotin (E. R. Squibb & Sons).
 Estrogenic Substances (Reed and Carnrick).
 Estrone (Abbott).
 Estrone (Eli Lilly & Company).
 Progynon-B (Schering Corporation).
 Theelin (Parke, Davis & Company).

2. *Oral Administration.*—The extracts used for oral administration are practically all made of estriol.† They are available in capsules, tablets, or in liquid form. Since oral administration requires much larger dosages than the hypodermic route, the preparations are correspondingly more potent, but there is less unity in standardization methods employed in this group and direct comparison is impossible.

Amniotin (E. R. Squibb & Sons).
 Emmenin (Ayerst, McKenna & Harrison).
 Estriol (Abbott).
 Estriol (Eli Lilly & Company).
 Progynon-DH (Schering Corporation).
 Theelol (Parke, Davis & Company).

3. *Local Application.*—The treatment of certain vaginal lesions is preferably conducted by topical applications, and a number of suppositories containing approximately 1,000 or 2,000 I. U. each are available for this purpose.

Amniotin (E. R. Squibb & Sons).
 Progynon-DH (Schering Corporation).
 Theelin (Parke, Davis & Company).

In addition, there is an aqueous preparation of Theelin and one of Progynon-DH in an ointment base for topical application.

ADVERSE EFFECTS

The large dosages of estrogen which have been recommended by various authors, especially in Germany, have given rise to some fears of possible secondary adverse effects. However, the studies of Mazer and his collaborators indicated that injections of large dosages over periods of two to three months produced no appreciable changes in body weight, basal metabolism, blood pressure, blood count, coagulation and bleeding times, blood chemistry and urine.

If estrogenic hormones are used in the first half of the menstrual cycle they may cause a delay in the appearance of the subsequent menstruation, and in amenorrhic or postmenopausal women they may lead to a period of abnormal uterine bleeding.

Experimental studies have shown that under certain conditions some estrogenic substances have

*The many trade names employed has led to much confusion, and it seems desirable to list some of the better known types available in the United States. The list, however, does not purport to be complete, nor has it been chosen discriminately.

†Emmenin is a product containing estriol monoglucuronide as one of its active principles, and Progynon-DH is a preparation of estradiol.

carcinogenic properties. For this reason, fear has been expressed that the use of estrogen in the human may have an important influence on the development of malignant tumors. However, conditions in the human are very different from those in experimental animals, and there is little reason for believing that any serious danger really exists in the employment of estrogen in therapeutic dosages.

INDICATIONS

At the present time a correct evaluation of the indications for the clinical use of estrogenic hormones is very difficult. They have been recommended for a great variety of conditions, and it is very apparent that some of these are based more on the imaginative speculations of deluded clinicians and the over-enthusiasm of high-power salesmen than on sound scientific observation. However, attention must be directed to the treatment of lesions where results can be carefully adjudged from demonstrable anatomic changes. In this group belongs the treatment of gonorrhoeal vulvovaginitis in children, senile vaginitis, atrophic rhinitis, and, in a somewhat similar manner, climacteric symptoms.

The treatment of *gonorrhoeal vulvovaginitis in children* is now successfully carried out by the use of suppositories containing approximately 1,000 I. U. of estrogenic hormone. They are introduced daily at home, and the progress of the patient is determined by weekly vaginal smears. It may be necessary to prolong the course of therapy over many weeks, but usually negative smears are obtained in about three weeks.

The *atrophic changes of the vulva and vagina which follow castration or the menopause* may produce very distressing symptoms. There may be a vaginal discharge, slight bleeding, pruritus vulvae, dysuria, and dyspareunia. The application of estrogen suppositories is very effective. Rapid relief is obtained by the daily usage of suppositories of 2,000 I. U., and improvement is often seen within the first week, although it may prove necessary subsequently to repeat the treatment.

In recent months interest has centered on the treatment of *atrophic rhinitis and ozena* with estrogenic substance. This procedure was developed by a group of investigators at McGill University, and is based on the observation that the nasal mucosa responds to estrogenic stimulation. A solution of estrogenic hormone in oil is sprayed into the nostrils twice daily, each application consisting of 200 to 300 I. U. It is reported that within a few weeks distinct improvement is noted, with a lessening of abnormal secretion and an actual favorable change in the appearance of the conchal mucosa.

The *vasomotor and nervous symptoms of the climacteric, or following castration*, are successfully treated in a large percentage of cases by the use of estrogenic hormones, given either orally or by hypodermic injection. They have been recommended in small dosages such as 50 to 200 I. U. by mouth two or three times a day, and increasing gradually until relief is obtained. In the hands of many observers this has proved a satisfactory plan, but it is hard to determine whether the success of

this therapy is from an actual endocrine effect or whether it is purely suggestive treatment. It is well known that favorable results can be obtained also by employing biologically inert ovarian substance or mild sedatives. On the other hand, the employment of large dosages of estrogen, such as 5,000 to 20,000 I. U. by intramuscular injection every three to four days for periods of several weeks, has resulted in improvement in severe resistant cases, and two signs indicate that an actual endocrine effect is produced. In the first place, there is a proliferation of the vaginal mucosa which can be demonstrated by the use of smears or biopsy specimens. Secondly, the function of the anterior hypophysis is modified. It is known that after castration, or during the climacteric, unduly large amounts of anterior pituitary gonadotropic hormone appear in the blood and urine. In 1930 I suggested that this phenomenon may be associated with so-called climacteric symptoms. This phase of the problem is being discussed in detail by Doctor Murphy and me in a sectional paper at this meeting. It has been shown that the gonadotropic hormone can be made to disappear by the injection of large dosages of estrogen and that this disappearance is associated with clinical improvement. The effect, however, is usually only temporary, and within a few weeks or months the hormone is again present in the blood and urine and the symptoms recur.

With the other indications which have been advanced for the clinical usage of estrogenic hormones, one enters on less certain ground. The exact reasons for their employment are not very clear, there are many spontaneous recoveries which can be wrongly accredited to the therapy, and above all, a favorable influence often can be attributed to a psychotherapeutic effect. In this category, therefore, treatment with estrogen should be regarded as still in the experimental stage.* However, three conditions deserve special consideration, namely, amenorrhea, dysmenorrhea, and periodic mastalgia.

The employment of estrogenic hormone for most cases of functional amenorrhea is not based on sound physiologic principles. The amenorrhea usually results from deficient ovarian function, and this hormone cannot stimulate the gonads. It is merely substitutive therapy, and although uterine bleeding may be produced easily it is not true menstruation, but an abnormal flow which does not necessarily recur in the months following cessation of the treatment. On the other hand, proponents of this type of therapy believe it is indicated in the presence of uterine hypoplasia. They maintain that large dosages of estrogen over long periods of time (such as 10,000 I. U. twice weekly for two to three months), produce a growth of the uterus and eventually a restoration of normal cycles.

The results obtained in the treatment of primary dysmenorrhea direct especial attention to the usage of estrogen in some cases, although the difficulty of evaluating such results makes one hesitate to accept them without reservation. The reason for employ-

ing these substances is based on the observation that periodic bleeding in hyperplasia endometrii is usually painless, and this condition is due to excessive stimulation with estrogenic hormone. It also is believed by several authors that estrogen may help to overcome the uterine hypoplasia which often accompanies dysmenorrhea. In this condition, estrogen is employed in daily oral dosages of 100 to 500 I. U. over periods of three months or more, or in larger dosages given intramuscularly during the two weeks preceding the onset of menstruation. Another method of administration is the intranasal route. This procedure is begun with the onset of the pain, and 200 I. U. of an aqueous solution is used every hour for six doses. A few drops at a time are instilled into each nostril with an eyedropper.

The condition of periodic mastalgia, or painful breasts, during the premenstruum has received considerable attention in recent years, and estrogenic hormones have been highly recommended as an effective method of therapy. It is necessary to postpone final judgment, however, since good results have been reported from biologically inert ovarian substance as well as ridiculously small amounts of potent estrogenic hormone. It is difficult to conceive that such a procedure can have a true endocrine effect. A number of investigators advocate the employment of as much as 100,000 I. U. of estrogen weekly for a period of three months in an attempt to produce an artificial inhibition of the anterior lobe hyperfunction which they believe is the causal factor.

In conclusion, attention must be directed to a definite contraindication to the use of estrogenic hormones, namely, abnormal uterine hemorrhage. Since estrogen stimulates a growth of the endometrium, its administration may result, not in cessation, but actually in an increase, of the bleeding.

The fantastic claims made for the estrogenic hormones have inevitably caused them to be regarded by many physicians with a good deal of suspicion. It is unfortunate that such is the case, but it is hoped that a sane consideration of their function in normal physiology may lead to a correct evaluation of their place as therapeutic agents.

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DISCUSSION

E. KOST SHELTON, M. D. (921 Westwood Boulevard, Los Angeles).—Doctor Fluhmann's comprehensive treatment of the subject leaves very little to be said by way of discussion. Coming as it does from the pen of a pioneer in gynecologic endocrinology, it is refreshing to note how clearly he has presented the use and avoided preaching on the abuse of the estrogenic substances.

As he has pointed out, the estrogenic preparations are substitutive in the same sense that insulin and thyroxin are substitutive and should be handled accordingly. It has always been difficult for me to see the rationale of treating a patient with an undeveloped uterus, ovaries, or adnexa by such means when there is a remaining hope that the patient's own ovaries may be made to function and manufacture her own estrogens. This, of course, would have to be accomplished by use of the pituitary or pregnancy prolactin or other endocrine means. There is also some possibility that a dormant but potentially functioning ovary may be retarded instead of enhanced as regards development and function.

Only with the advent of the more concentrated preparations have we been able to objectively study their effect upon the body economy. The measurable presence of pitui-

* The use of estrogenic hormone has been recommended for oligomenorrhea, migraine headaches, vomiting of pregnancy, toxemias of late pregnancy, induction of labor, acne, hirsutism, frigidity, climacteric hypertension, arthropathia ovaripriva.

tary prolan in blood and urine, signifying complete or almost complete cessation of ovarian function, as Doctor Fluhmann pointed out nearly a decade ago, and now his finding that this pituitary fraction may be made to disappear by an adequate dosage of estrin, are extremely important from many standpoints. Some of the most alarming vasomotor disturbances involving cardiac rate and rhythm marked vacillating changes in blood pressure and bizarre edemas may be handled more effectively in the light of these findings. Proper dosage in such patients is all-important, as many have received inadequate treatment, without relief, over a long period of time.

MUSCLE GRAFTS: IN THE SURGERY OF THE HEART AND LUNGS*

By H. BRODIE STEPHENS, M.D.

AND

HARRY BENTEN, M.D.

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DISCUSSION by Albert H. Elliott, Jr., M. D., Santa Barbara; Paul C. Samson, M. D., Oakland.

PEDICLED muscle grafts have been employed in surgery for a variety of purposes. Credit is given for such a graft by Wangenstein¹ for the closure of a persistent duodenal fistula, as well as for filling up a cavity in the femur, following curetment of a bone cyst. Dixon,² McNealy and Shapiro³ recommend the employment of viable muscle grafts for the plugging of or reinforcing the suture lines in wounds of large blood vessels. Reid⁴ believes that pedicled muscle flaps may be of value in the obliteration of aneurysmal sacs of blood vessels.

Abrasanhoff⁵ is accredited as the first to suggest and employ successfully a pedicled muscle graft in the closure of a bronchial fistula.

We have employed viable muscle grafts for the closure of bronchial fistulas, chronic empyema cavities and, in one instance, such a graft was successfully utilized in filling up a cavity resulting from an infection in a thoracoplasty wound.

PEDICLED MUSCLE GRAFTS AS TRANSPLANTS

It would appear correct, therefore, to assume that pedicled muscle grafts are worthy transplants. They seem certainly to have a peculiar faculty to resist digestion, either from the ferments of secretion or suppuration.

The fairly recent suggestion by Beck⁶ and the actual employment by him of a pedicled muscle flap to provide a new blood supply to the heart (the latter being impoverished because of coronary thrombosis or sclerosis, in many human cases), brings us to the question of the fate of such muscle transplants. Churchill⁷ but recently, in a discussion on the use of transplants to close bronchial fistulas, stated it was his opinion that a muscle graft functioned merely temporarily as a plug, that the graft does not permanently fill the cavity in the sense that a dentist fills a tooth, but the graft is slowly absorbed and replaced by fibrous tissue.

The literature is sufficiently stocked with discussions upon the technical methods in the handling of

pedicled muscle grafts and their clinical application, but there is a decided paucity in the histologic study of the end result. It became our advantage to study at necropsy a pedicled muscle graft which had been utilized to close the remains of a lung abscess cavity, as well as several bronchial openings, some two years before. In this instance the graft could still be grossly distinguished from the surrounding lung parenchyma; it had remained viable and had filled up what had been a considerable hole in the left lower lobe. Fibrous tissue had replaced the striated muscle for the most part, but histologically many striations were still visible. Furthermore, there were many large blood vessels, both in the substance of the graft itself and running along the surface of the graft, connecting the visceral surface of the lung to the chest wall. It was the pathologist's opinion that these large vascular connections accounted for the machine-like murmur which was audible over the region of the graft before death.

BLOOD SUPPLY OF GRAFTS

Pedicled muscle grafts would seem, therefore, to retain their bulk and viability indefinitely and, in addition, will survive in a comparatively unfavorable environment. The experimental studies of Pool and Garlock⁸ further substantiate this conclusion. The final problem under discussion is that which concerns the effectiveness of such a graft as a conveyor of new blood supply. O'Shaughnessy⁹ is of the opinion the great omentum would serve as the best means to provide blood to an ischemic heart, and cites convincingly the manner in which the omentum has been seen to nourish a large fibroid of the uterus, or again the Talma operation, where the omentum is utilized to shunt the portal blood through other channels. Mautz and Beck¹⁰ recently concluded that adipose tissue has been most promising for developing new arterial connections with the coronary arteries, in their hands. These authors utilized pericardial and mediastinal fat and omentum, and are of the opinion that these fatty tissues develop connections with more regularity than when skeletal muscle is used. They further state that frequently pedicled muscle grafts are disappointing, because the pedicles become converted into scar tissue and an abundance of collateral channels fail to develop. However, in several instances, they report that excellent collateral connections were observed between the coronary arteries and the arteries of the chest wall, via the substernal muscles.

At the present time, sufficient information is not available to state whether the anastomoses through grafts can exceed the size of the normal collaterals of the heart. However, observations indicate that in the late stages of coronary arterial obstruction blood actually flows into the heart through the extracardiac connections, since it is only in severe coronary arterial obstructions that these vessels have been seen to persist and enlarge.

OMENTUM

It appears likely, from the foregoing brief discussion, that the omentum is probably superior to the pedicled muscle graft as a conveyor of new blood supply. Certainly there is not the danger of atrophy in the omental transplant which will occur

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