Injection treatment for hernia: its inefficacy

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THE INJECTION TREATMENT FOR HERNIA:
ITS INEFFECTICACY

by

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Senior Thesis Presented to the College of Medicine,
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HISTORY

The injection treatment for hernia is not at all new. Before the days of antiseptic surgery there was a definite need of some such treatment, which would eliminate the dangers of infection. Cauterization for the purpose of forming an eschar in the treatment of hernia was used from the earliest times. Paulus (34) has a nice description of the method of cauterization used in his time. But still this did not get away from the possibility of infection.

Velpeau (43) was the first man to publish work on the injection treatment for hernia. Cauterization and velpeau's method had the same end result in mind, which was the formation of sufficient eschar formation to prevent the hernia from reappearing. In most cases at that time cauterization was not quite as radical as done by the ancients.

Some surgeons laid bare the hernia and cauterized the ring to a great depth; others just touched the neck with a button cautery. A number of chemical caustics were employed at the same time. Some of these were sulphuric acid, muriate of antimony and potash. These were applied to the skin over the hernia, as well as in the sac itself or to the coats of the sac.
Velpeau criticised direct application to the skin on the grounds that if the inflammation extended to the peritoneum it would cause the death of the patient. However, he believed were the caustic applied to the sac it would lessen the danger of peritonitis, and, as a matter of fact, he believed this was the only chance of a cure by this method.

Velpeau's own method was purely an injection method. It is inferred by his writing that he was the first to employ this mode of treatment, but that he developed the idea from the results obtained from the treatment of hydrocele. At that time wine was used to inject hydroceles, but it was being demonstrated that tincture of iodine was superior to this. Therefore in 1835 Velpeau conceived the idea of using iodine in the injection of inguinal hernias.

It wasn't until 1837 that he had his first opportunity for employing his idea; this was after he had employed it successfully in the treatment of hydrocele. In this instance he made an incision about an inch long through the tissues of the scrotum to the external surface of the sac. He introduced a trochar into the sac and secured the opening of the sac on the canula by means of forceps. One assistant com-
pressed the inguinal canal to prevent the solution from running into the peritoneal cavity, while another injected the solution. The solution was six "gros" of tincture of iodine to three ounces of water. After all points of the sac were covered with iodine the solution was allowed to run out of the sac through the canula. After the canula was removed the wound was closed "by means of three points of twisted suture."

He makes no mention of after treatment or care, but states that after three months there had been no recurrence of the hernia.

From reading the work of Velpeau one comes to the conclusion that although the anatomy was understood and the nature of the defect known, none of this was utilized in the treatment. The efficacy of all the treatments depended on the formation of a cicatrix which would plug the passage. This was even true in the operative treatment. Velpeau stated:

The operation for hernia almost of necessity produces a wound which will suppurate, and the whole surface of which will become covered with cellular granulations as high up as into the ring. By this means a new tissue is formed which is the base of the cicatrix, and which by its great elasticity and the adhesions it contracts with the surrounding tissues, is certainly calculated to close up, by a firm consolidation, the tract of the hernia.
At the same time in this country Pancoast was (33) doing similar work, using a trocar and canula fitted with a syringe, capable of holding a drachm of fluid. His technic was to place the patient on his back, press on the external ring with a finger to displace the cord inwards and "bring the pulpy end of the finger on the spine of the pubis." The trocar was then pushed into the area at the outside of the finger until it came against the "horizontal portion of the pubis" just to the inner side of the spine of that bone. The trocar was then retracted slightly and then turned upward, when the point was in the sac it was then run into the inguinal canal and the sac scarified freely. This was done to the inner surface of the upper part of the sac as well as that just below the internal ring. The trocar was then withdrawn from the canula and half a drachm of either Lugol's solution or tincture of cantharides injected into the sac. When the canula was removed the operation was completed.

As after care a compress was pressed down over the external ring and a truss slipped down over this. The patient was kept in bed for ten days.

Pancoast stated he did thirteen of these opera-
tions, but could not state how permanent the cure was, due to the inability to follow up the cases afterward.

Pancoast didn't directly claim the origination of this method, but he does state:

Very recently M. Velpeau has published a process almost precisely the same as that just described.

I believe he infers they were co-originators of the method, working independently of each other.

Marcy (28) quoting Warren states the credit of the origination of the method belongs to Pancoast. From reading the literature it would seem the credit belongs to both of them.

In 1892 (24) the method of widest repute was that of Dr. George Heaton, of Boston, who published his work in 1843. He used the fluid extract of oak-bark. His first work was done in 1832, although he wasn't successful until several years later in getting cures. This was before Velpeau's first work, but since the work wasn't published until 1843, six years after Velpeau did his first work, there could be no claim for his having originated the method. However, Heaton was the first one to use the true hypodermic injection without any preliminary incision.

His operation created much discussion in Boston,
and was generally adversely criticised, and his methods were claimed by some to be unprofessional. There was no doubt of his enthusiasm. He had good results, but not always an entire cure.

Dr. Joseph H. Warren (44) was the most famous of Heaton's followers. He modified and improved the needles and syringe used by Heaton, and also the medication. Warren modified the operation by not injecting into the sac; he injected into the rings and around the sac.

Warren, in his writing, gives a clear insight into the reason for the enthusiasm over the injection method. The surgical treatments at that time were severe and "likely to be attended with a great danger of life, if not absolute loss of it." This was in 1880.

Warren, as the others at that time, used just one injection. The patients were treated as bed patients and had to wear trusses and limit their activities. He felt if the patient went for a year without return of the hernia, it could be considered as a permanent cure. This belief is not justified at the present time as will be brought out later in the paper.

The status of the injection treatment in the
1890's may be determined from the statement of Marcy:

-- the danger in competent hands is slight, but the results are certainly not as satisfactory as the profession was led to expect.

Manley (25), in 1893 was the next author to publish work on the injection treatment for hernia. He showed great enthusiasm and emphasized the proper selection of cases for this type of therapy. He favored operation in many of the individuals whom he saw.

In 1925 McDonald (38) reported on twenty-five years experience with this method. He recommended this form of therapy for hernia. He emphasized the fact that antagonism and indifference had contributed greatly to hinder the progress of this method. He reported that 90 per cent of all hernias which came to him could be treated by this method.

In 1927 Ignatz Mayer (29) claimed twenty-eight years of experience with the injection treatment for hernia, using a complicated formula for the fluid. Rice (38) states that the credit of modernizing this mode of therapy should go to Mayer. Mayer claimed 98 per cent of his cases had permanent relief. At the same time he attacks the other men's percentages by saying a Doctor never sees his own failures because they go to other Doctors. It would be interesting to
know in what way he was different from the other men that his statistics should be acceptable. However, he finished his article by stating that the subcutaneous method is not a cureall, and just selected cases could be used.

Hall (19) of New York was apparently the first to approach the injection method in a truly scientific manner. His work seems to have set off a flurry of research. He stated there were two serious objections to the old methods of injection treatment. First the solutions employed were decidedly irritating, painful and had to be used over a period of months. Second it was necessary to wear a truss during treatment and for a long time afterward, which was not done in the old methods.

He went carefully over the work of Pina Mestre, a Spanish physician. He states that Mestre's solution was free from the above objections. Its active principles were alcohol and tannic acid.

Then we find for the first time the publication of histological work done to determine the actual tissue reaction to the injection fluid. He definitely showed that fibrous tissues were formed, but as we shall see later he did not carry on this work long
enough.

Between 1927 and 1929 Hall treated thirty-three patients with hernia and only one had recurred at the time his work was published. Since this was done in 1929 he cannot claim permanent cures for the others, nor have we any way of telling what the subsequent course of these has been.

Wolfe (49) in 1931 worked out variations in the constituents of the solution "hernial" by injecting rats. He worked out a solution considered satisfactory, which was manufactured by the Fitch Company of New York. He described the histological response as a seroplastic exudation followed by the formation of adhesions resulting in a connective tissue barrier blocking the inguinal canal.

During the decade of 1930 to 1940 the literature has been flooded with articles dealing with the injection treatment for hernia. These have all more or less contributed to the history of this type of treatment, but most of these will be covered in the following chapters of this work.
THE ANATOMY OF THE INGUINAL REGION

From the foregoing history it should be apparent that the early men who used the injection method of therapy for hernia thought of the anatomy of the region only from the standpoint of what structures to avoid. If there is a rationale for any surgical or operative procedure it should be based on the existing anatomical conditions; each case should be individualized. This has become increasingly apparent in the injection method of treatment for hernia. More and more men are expressing the necessity for selection of cases for this method.

Watson (45) states:

A thorough knowledge of the anatomy of the inguinal region is necessary in order to recognize the variations from the normal and to select the hernia operation which will give the best chance of permanent cure in each individual patient.

Since this is a discussion of the efficacy and not the treatment per se, there would be little advantage in detailing the anatomy of the inguinal region. Therefore I shall just stress the important structures as they would be concerned in the injection of this region.

The varieties of inguinal hernia are the indirect
and direct with an intermediate form, spoken of as the saddle-bag type. The indirect is so named due to the fact it passes through the internal inguinal ring, down the inguinal canal and out the external ring. The direct, so named, since it takes the most direct route through the abdominal wall structures. It passes through the lower fifth of the inguinal canal.

The internal ring is situated midway between the anterior superior spine of the ilium and the pubic tubercle. It lies 3 cm. above Poupart’s ligament. It lies immediately lateral to the inferior epigastric artery. This structure is not actually a ring, but it marks the site at which the spermatic cord passes through the transversalis fascia as it makes its exit from the abdominal cavity and the point at which the hernial sac of the indirect hernia leaves the peritoneal cavity.

The inguinal canal is not a canal in the usual sense, but a chink or flatsided passage in the thickness of the abdominal wall. In early life there is no canal; one ring lies directly behind the other, so as to facilitate the easy passage of the testis. In the adult the canal measures approximately 4 cm. in length. Its direction from the internal to the ex-
ternal ring is downward, forward and medial.

The anterior surface of the canal is formed by the fascia of the external oblique muscle. Posteriorly it is bounded by the transversalis fascia. The superior surface is formed by the arching fibers of the internal oblique muscle, and the inferior surface is occupied by Poupart's ligament. The canal contains the spermatic cord in the male and the round ligament in the female.

The external ring is formed by the splitting of the fascia of the external oblique muscle into two pillars. The external fibers unite with Poupart's ligament, pass lateral to the cord, then beneath it and insert into the spine of the pubis. The spermatic cord in the male and the round ligament in the female pass through this ring, after which they enter the scrotum and the labia majora respectively.

The inferior epigastric artery crosses Poupart's ligament perpendicularly, posterior to the inguinal canal at its lateral extremity, at the midpoint of Poupart's ligament. It lies at the medial border of the internal inguinal ring and passes between the planes of the transversalis fascia anteriorly, and the peritoneum posteriorly. It forms the lateral boundry
of Hesselbach's triangle. This vessel may be displaced by a distended ring or may be anomalous.

Hesselbach's triangle is bounded inferiorly by Poupart's ligament, laterally by the inferior epigastric artery and medially by the lateral border of the abdominal rectus muscle. This triangle is essentially bisected from its lateral apex to its medial border by the arching conjoined tendon. The upper part of the triangle is supported by all three muscle layers of the abdomen, and this portion is therefore rarely a factor in the development of hernia. Direct inguinal hernias pass through the lower portion, where protection is served only by the weak transversalis fascia.

The conjoined tendon of the internal oblique and transversalis is usually triangular in shape with its base inserted into the crest of the pubis and the pectineal line. It is situated immediately behind the inguinal canal and the external ring. In the direct inguinal hernia the tendon may form one of the coverings of the sac.

It is generally believed that all indirect inguinal hernias are due to a preformed sac, which consists of an unobliterated portion of the processus vaginalis. The indirect hernia leaves the abdomen
through the internal ring, and is divided into three varieties, according to the degree of descent of the sac. They are incomplete, complete and scrotal.

In the incomplete (bubonocele) the sac remains in the inguinal canal, in the complete the hernial sac emerges from the inguinal canal at the external ring, and in the scrotal the hernia passes down into the scrotum.

Indirect hernias are also classified into congenital, infantile, and funicular varieties, according to the degree of patency of the processus vaginalis, but since this distinction has no direct bearing on the discussion, description of these will be omitted.

The direct inguinal hernia takes the most direct route through the abdominal wall, passing through the lower fifth of the inguinal canal. It is also called the internal inguinal hernia and the straight inguinal hernia. The direct hernia can only develop through the lower part of Hesselbach's triangle. As a direct hernia passes out of the external ring it encounters the external spermatic fascia. This fascia is closely attached to the cord and does not readily allow dissection between it and the cord. For that reason the direct hernia seldom descends into the scrotum.
The saddle-bag type of hernia is just a combination of the indirect and direct hernias, and may be present in varying degrees.
ETIOLOGY

At the present time the saccular theory of formation of hernia is generally the accepted one. This was propounded by Russell (39), by which he explains the etiology of hernia on the basis that the processus vaginalis fails to become normally obliterated, wholly or in part. The numerous anatomical varieties of indirect inguinal hernia are explained as diverticular offshoots from the processus vaginalis, which occur during the descent of this structure during embryonal life. The properitoneal, interstitial and subcutaneous hernias are varieties of this anomaly. This then puts indirect hernias in the congenital class exclusively.

Russell has described three groups of indirect hernia:

A. The processus vaginalis being normal in shape resulting in two varieties of hernia: total hernia in which the processus vaginalis is open throughout its entire length, and the partial hernia in which the processus vaginalis has closed throughout only a portion of its lower limit

B. The processus vaginalis having been distorted in its funicular portion with lateral sacculations so as to result in properitoneal, intermuscular, and superficial inguinal hernia

C. The processus vaginalis having been dis-
torted by implication of its testicular portion in the abdominal wall with the result of a hernia magna, encysted, or infantile hernia or a hydrocele.

In addition to this factor Watson (45) lists the anatomic cause for indirect hernia. He summarizes them as follows:

(a) The descent of the testis which carries with it a process of peritoneum, transversalis fascia, and cremasteric muscle; (b) the weak spot at the internal ring, which makes it unable to resist sudden increase in intraabdominal pressure caused by straining, coughing, whooping cough, pregnancy, tight lacing, obesity, ascites and tumors; (c) the hernia cannot break through outside the internal ring because of the well developed iliac and transversalis fascia; (d) the fact that there is usually a weak point near the inner side of the internal ring that is unprotected by muscle or tendon; (e) the existence of an unobliterated processus vaginalis or a preformed sac.

It does not necessarily mean that because there is an existing processus vaginalis, that a person will develop an indirect inguinal hernia, but it is necessary for the processus vaginalis to be present for the formation of the hernia. In other words these conditions listed by Watson must all be present to some degree to allow the formation of the hernia.

Watson goes on to list the secondary factors involved in the formation of indirect inguinal hernia. One of these I consider exceedingly pertinent. During the first world war many of the recently called
men developed hernias and this was early in their training period. These men were pulled from sedentary occupations and thrown into strenuous unaccustomed exercise. Watson states that added resistance that comes from such training made later appearance of hernia infrequent.

Possibly those who were going to develop hernias developed them early. The way to prove his statement would be to take two groups of men; throw one group into the strenuous exercise immediately as done in World War one and the other group gradually built up to the strenuous exercise over an extended period of time. It would be interesting to note which group had the higher incidence of hernia, or if they were the same would those in group one show up at once, and those in group two come on over an extended period of time.

Moorhead (31) stated that a single act of violence could not cause a hernia unless the overlying tissues had been damaged, or unless the violence produced such severe intra-abdominal pressure that immediate onset of symptoms would result. Repeated acts of violence, however, can produce a hernia.

Rice (38) quoting Taylor states 16 per cent of
individuals presenting hernia on one side, subsequently develop a hernia on the other side. This would lend weight to Watson's statement that heredity is a predisposing cause.

In conclusion then, we may say that the presence of the preformed sac, no doubt, explains the underlying etiologic factor of all indirect inguinal hernias.

Just as the etiology of indirect hernia is the open processus vaginalis, so a poorly developed inguinal musculature is the etiologic factor in a direct inguinal hernia. As a rule the entire region is involved with all of the structures being effected in some degree. Any variety of abnormalities may occur. There may be an open funicular peritoneum with perfectly closed processus vaginalis, or we may find any combination of abnormalities. Watson states that many writers consider the direct inguinal hernia as a variety of hernia in the linea semilunaris, since the weak spot in Hesselbach's triangle is the lowest part of the linea semilunaris.

Watson sites one case where he operated on an indirect hernia by the Bassini method, only to have the patient return a year later with a direct hernia. Bisgard (5) states that because of the frequency of
this occurrence he always incorporates the strengthening of this area when he operates on indirect inguinal hernias.

Another factor in the development of direct hernias is the physiological atrophy of all tissues occurring with increasing age. The tissues tend to lose their ability to retain the contents of the abdomen. The inguinal regions being the weakest points, this weakness of tissues is first apparent here. There is usually a gradual bulging, which is first unnoticeable and then discomfort finally brings it to the attention of the individual. Then as the factors leading to increased abdominal pressure, such as, hypertrophic prostate with obstruction, constipation, coughing, heavy lifting, etc., the hernia tends to become much larger. It is possible to show the increase in the aged can be traced and explained in this manner.
THE IMPORTANCE OF TECHNIC

This chapter is for the discussion of the role of technic, rather than the actual technic of the injection treatment. Technic is one of the important items in this treatment. Biegeleisen and Tartakow (4) point out that a review of the literature shows a lack of interest in detailed standardized technic. They go so far as to state that those authors who mention technic do so in a general way, and favor angles of injection which they, Biegeleisen and Tartakow consider essentially unsafe.

They state the aim is the adhesion between important structures as the result of fibrous tissue growth, and not just the formation of a mass of fibrous tissue, which in itself will not prevent the recurrence of the hernia. "It is, therefore, important to place the needle point in the proper fascial plane by a definite orderly and systematic plan. at the completion of the case a line of adhesions will be formed in much the same manner as after a thorough surgical operation."

This is all very well where the layers are all present and intact, but here we must keep in mind
the anatomy of the region and the etiology of hernias. From this one perceives the necessity for selecting the cases for injection, and it would seem that only small indirect hernias could be successfully treated. This will be borne out later in this paper.

Biegelseisen and Tartakow go on further to state that before attempting to use the injection treatment for hernia one should be thoroughly familiar with the detailed anatomy of this region. This can only be done by repeated cadaver injection and dissection. When one considers the anatomy, it is realized that important structures are only fractions of centimeters from the needle point. They state that none of these dangers were taken into consideration by any of the previously published technics. The technic Biegeleisen and Tartakow have worked out does, thus lessening the dangers of complication from the injection treatment.

They bring out a further point in the treatment that is interesting. As was pointed out in the first chapter the original operation consisted of injecting iodine directly into the sac. This was later dropped in favor of injecting around the sac and into the adjacent tissues. Now these men in their article state it is necessary, not only to deposit irritating sol-
utions in the canal itself, but outside it. They make no mention of injecting in the sac itself, but they could not very well inject into the canal without going into the sac a large percentage of the time. This swinging back and forth from one technic to the other would lead one to believe none were too successful.

Originally one injection was made, but it was later found that numerous injections were necessary. At present all of the authors agree on this point. Biegeleisen and Tartakow state that the average number of injections with their method is fifteen, but that this varies in the individual cases. Rice advocates eight to ten injections, and then for the patient to be seen at four, twelve, and twenty-eight weeks and then each six months until assured there is no recurrence. If an impulse is elicited at the end of any of these periods, it is an indication for further injections.

Dobson (14) lists sixteen injections as their average, and states that many of their patients were given two or even three courses of injections with a month or six weeks between courses.

Then we come to the truss. All of the authors
agree a truss should be worn, but they don't agree on the length of time. The time varies from wearing the truss until after five or six injections have been made to ten months after the injections are completed. Dobson states that in their successfully treated cases the patient was allowed to remove the truss at night after one month from the time of the last injection and that the successfully treated cases wore their trusses for an average of ten months.
THE ROLE OF THE SOLUTION

This chapter will discuss the trend of solutions and their efficacy from the beginning. Velpeau's original solution was a diluted solution of tincture of iodine, which was much too irritating and would cause necrosis. Rice describes the ideal solution as one which would produce no pain from its injection, produce no systemic reaction, be relatively nondestructive to tissues, be non-toxic if injected inadvertently into the blood stream, and should not be irritating enough to cause peritonitis if similarly injected into the peritoneal cavity. It should induce growth of fibrous tissue with a minimum of the exudative type of reaction. The solution should be mildly irritating; should not produce necrosis of the tissues and it should produce the minimal amount of polymorphonuclear infiltration.

Iodine does not fit in this classification at all. Pancoast used Lugol's solution and tincture of cantharides, but this did not get a following. Heaton used quercus albus, but this also proved too irritating. Schwalbe used 70 per cent alcohol, but this is far from meeting the requirements.

Then came Pina Mestre and his work; his solution
was much more satisfactory and has been used extensively. He claims 98 per cent cures, but it is difficult to accept this in the face of the work done by others.

Mayer used a solution of zinc sulfate, phenol and alcohol. His solution has had some acceptance. In the 1930's there were a great number of solutions on the market. The formulas of many of these were kept secret and it was difficult to determine the nature of their ingredients. Many of these, it is certain, contained alcohol and various acids, the most common of which was tannic acid.

The three solutions used by Dobson in his work were phenol-thuja (25 per cent phenol, 25 per cent specific tincture of thuja and 50 per cent alcohol), proliferol (Ulmer) (tannic acid, alcohol, four botanical tinctures, thymol and benzyl alcohol), and sodium psylliate (Searle) (a mild soap of a fatty acid). The reaction of the tissues to these solutions was essentially the same, except for more necrosis, which was noted in the phenol preparation.

Rice believes it is preferable to use a solution which requires no preliminary anesthesia. An anesthetic would mask or would disguise important signs
and symptoms which help in the avoidance of erroneous injections. Where the injection is being made too close to the cord or peritoneum the elicitation of pain as the needle point encroaches upon these structures leads to a change of course of the needle. With anesthesia this is impossible.

Biegeleisen (3) summarizes his article on solutions by stating that poor solutions are responsible for most of the complications following the injection for "reducible" hernia. From reviewing the literature this statement seems a little too positive for the present era, but there is no doubt this was true to a certain extent when work first started on this method.

Wernicke (46) states that the ideal solution has not yet been developed, and that if the same progressive scar tissue could be produced in the inguinal region that is produced in the lungs of silicosis cases, the success of the injection treatment of "selected" hernias could probably be assured. He further states an attempt is being made to produce such a solution with the various silica preparations.

That was in 1939, but so far nothing more has been mentioned in the literature concerning such a
solution. Therefore the situation now stands at this point; there still is no truly satisfactory solution available for the injection treatment of hernia.
RESULTS OF EXPERIMENTAL STUDIES

There is no argument among the various men who have done work with the injection treatment over the formation of scar tissue. All of the work has been about the same, and results comparable, but most of the work has only been carried as far as three months.

Rice (37) in 1935 did work which covered a period of forty-two days. They had an ingenious method for obtaining their material for microscopic sections. They had patients who were not sure as to whether they wanted injection or operation, these were gotten to try an injection, if they didn't like it they could have an operation. Likewise they saw patients, who after one or more injections, wanted operations. It was arranged so these people could be admitted to the hospital at intervals so sections could be obtained at intervals from fifteen hours to forty-two days after the injection of the irritating solution.

Rice states that no difficulties were encountered in the operations as a result of the previous injections, and this has been confirmed by some of the other authors. One case where ten injections had been made without a cure the scar tissue was similar to that encountered at a second hernia operation.
His results from the histological sections were as follows:

At the end of fifteen hours the section showed an exudative reaction with polymorphonuclear cells and round cells. There was also some proliferation of the fixed connective tissue cells and some evidence of cellular necrosis.

On the fifth day fibroblasts were seen with large dark staining nuclei. Polymorphonuclear cells were still present.

On the eighth day the fibroblasts were more abundant and likewise appeared more mature. The intercellular fibers were beginning to make their appearance. Newly formed blood vessels were seen. An occasional polyblast was found.

On the fourteenth day the fibrous tissue was found to lie in dense bundles. Fibroblasts seemed to have assumed more adult proportions. Their nuclei were smaller and the fibers more abundant. No polymorphonuclear cells could be found.

On the eighteenth day most of the fibrous tissue appeared to be mature.

At the end of the forty-second day the tissue was dense and looked like adult fibrous tissue. The fibroblast nuclei were small and the fibers were abundant.

Two years later Fowler (16) in his article states that a slow progressive resorption of repair tissue had long been suspected, and suggests that studies should be made along this line in hernial repair tissues.

This is what Dobson did. His work confirmed the
work of Rice, but he did not stop there. He went on and made sections up to ten months. At ten months his sections showed, in place of the diffuse sheets of fibrous tissue interlacing between muscle bundles, as was seen in the first four months, that the fibrous tissue generally appeared as small irregular scattered islands of compact adult fibrous tissue.

This work shows that the fibrous bands contracted from each other and from adjoining muscle bundles and fat. Clinical reports of hernias breaking down after two or more years would lead us to believe that resorption continues to take place over a period of years.

Jimenez (23) states that his solution is "liquified synthetic tendon" and claims that injection becomes organized as part of the living tissue and serves as a base for the formation of a great amount of new connective tissue. Then he gives his patients intramuscular injections of calcium which "gives the tissue formed by the protein a stony hardness." He implies that the area becomes calcified, but he has no experimental work to show what really takes place.

Dobson did further work to show the reactions within the important structures involved in the re-
compressed, it was not obliterated except in one instance. The significance of this is realized when the fate of the hernial sac is speculated on.

Most of the authors state that the sac is compressed or obliterated, not being sure which takes place. Rice, after operating on two previously injected cases for appendicitis and examining the internal rings, states that he believes the sacs are obliterated. The work of Dobson, however, seems to discredit this belief.

Out of the four dogs injected, only one had an obliterated processus vaginalis. From this we may infer that in the majority of cases the hernial sac is just compressed, rather than obliterated.

The explanation of the high recurrence rate reported by most of the authors can be made on this basis. As the connective tissue formed by the injections is absorbed, the pressure, which has been compressing the sac, is gradually released. Thus allowing the hernia to descend once more.
Every author lists complications in this method of treatment. Harris and White (20) give a list of complications which includes: excoriation of the skin under the truss prior to the injections, swelling of the cord, transient swelling of the penis, scrotum or inguino-abdominal region, hydrocele of the cord, swelling of the epididymis, fat nodules from superficial injection, intra peritoneal injections, needle in the vein, abscess, peritonitis, atrophy of the testicle, impotence and death. They had none of the last five of these complications in their series of cases, but other authors have reported having had these among their cases.

Harris and White found transient swelling of the penis, scrotum, or inguino-abdominal region in 90.2 per cent of their cases. This alone in an ambulant method of treatment, which extends over a period of several months, would discourage a great many people from going on with the treatment.

Fowler (16) does not believe impotence is really a factor, being more of a psychological complication, since it has been seen in cases where only unilateral injections were made.
Rice states that local abscesses have formed in two of their cases. These were directly attributed to errors in technic.

Rice also states they had six cases of chemical peritonitis after the injection of tannic acid-alcohol solutions. This was due to intraperitoneal injection. This condition he states will clear up spontaneously if there has been no damage to the bowel. He reports one case of gangrene of the bowel. It was thought the injection was made too near the mesenteric vessels of the ileum. The mesentery must have been lodged within the hernial sac. He reports the patient recovered after resection and anastomosis of the affected gut.

Hydrocele complicated the treatment in 1.5 per cent of the cases treated by Rice; this has been borne out by the other authors.

While Harris and White stated they had no deaths in their series, others have not been so fortunate. Berne (2) has reported on two deaths. He submitted these cases to refute the impression created by most of the writers. He states that many individuals are treating hernias by injection who ordinarily treat few hernias, inferring that this would lead to more
and worse complications. He goes further to state that the factors surrounding cases of this type are such as to lessen the chances of their deaths being reported, consequently he feels this suggests a higher incidence of this complication than the literature would indicate.

Rice, reporting on systemic reactions, makes the statement that occasionally, after the injection of tannic acid-alcohol solutions, the patient develops a systemic reaction manifested by rhinitis, generalized muscle aches and soreness. He reports there is no doubt it is due to these solutions. Sodium psylliate less often will produce a systemic reaction consisting of muscle aches and a sensation of feverishness, but these reactions are remarkably infrequent and never disabling.

Where inadvertently the tannic acid-alcohol solution has been injected into a vein a shock-like reaction may result, but when sodium psylliate solution is injected no systemic reaction results, other than the taste of soap in the mouth and a tingling sensation throughout the body.

On experimental animals where the solutions were injected into the veins the animals staggered around
for about ten minutes and then appeared to be perfectly normal.

Slater (40) writing on the inadequacy of the injection form of treatment reports that they had few complications. Two patients were in shock for several hours after treatment, requiring morphine and emergency ward care. Five had painful cords, lasting three to five weeks. Nearly every patient had some local pain; in two cases the patients could not resume work for several days. Two patients had to have emergency treatment for strangulated hernia. Here we find he disagrees with Rice. Rice stated that no difficulties were encountered on operating on cases after injections had been given, but Slater found repair was more difficult because of the fibrosis and inflammatory reaction. This seems the more logical finding.

Manoil (26) reports his complications were comparatively few during the last eighteen months of his study, due to improvement of his technic. This alone should make one realize this form of treatment is one which cannot be done as simply and without considerable knowledge as can be done in the injection treatment of varicose veins.
END-RESULTS

At this point we reach the greatest divergence of opinion on the whole subject of the injection treatment for hernia. Fowler may have had the answer to this when he stated:

Significant studies of end-results, however, take years of the most careful and thorough follow-up of a multitude of cases. Unlike surgery, the injection treatment is not essentially nor primarily a hospital procedure. But the office practitioner usually lacks the follow-up facilities and organization, for which reason relatively little has been done in this particular study.

This leads us back to Mayer, who claimed 98 per cent cures over a period of twenty-eight years of experience with over two thousand cases. As was stated earlier he attacks the surgeons on the grounds that when they have failures their patients go elsewhere, so they don't learn of their failures. He offers no proof or details to establish the reliability of his figure.

Fowler says the German workers, with better authenticated data, claim an end success of 94 per cent in several thousand cases over a period of forty years. This was even with a "very ineffective injectant." It is difficult to credit these results in the face of the latest reports of this method of treatment.
All of the early reports were enthusiastic, and all claimed high percentages of cures. Most of these were reports of cases, which had been finished with their treatments less than two years. As time has gone on reports have become less enthusiastic, and results have been less encouraging. Bratrud (6) reported 707 cases, and only nine in which final closure could not be obtained. He expected a considerable recurrence rate, however, due to the fact a substantial part of his series was composed of large sized hernias, with many contraindications for surgery. This also made the injection treatment difficult.

McKinney following up these cases, found 83 per cent cured after six months to three and a half years. The preponderance of recurrences was among older patients, and among those with the fewest average number of treatments. At that time it was considered that age and insufficient treatment were the major factors in causing failure. In the light of later reports, it may be regarded that these were just the first to break down, since there was not as much connective tissue to be absorbed.

Fowler claimed experience with some 800 cases, over a period of nearly seven years. He did not give
his percentage of cures, but he states he is convinced that Bratrud's immediate results are generally to be maintained in the end-results by the persistent follow-up reenforcement in the more difficult cases.
This would mean most of these patients would have to come back for treatment about every six months, and then take treatments over a period of several weeks.

Then to turn to the other side, we find Coley (9) reporting on the results obtained at Rupture and Crippled in New York, stated:

First results seemed satisfactory, but by the end of six months there were so many recurrences that the method was definitely abandoned.

Slater gives a clear picture of this method and possibly indirectly the public reaction to this method. He started treatment on approximately fifty patients, but only twenty continued through a full course. The others were forced to stop treatment for several reasons. Among these were pain on injection, annoyance of wearing a truss continuously day and night, and occasional untoward reactions. The full course of treatment for the remaining twenty consisted of an average of twenty injections a week or more apart depending on the case.

In the cases of the twenty who finished, ten were
direct hernias and ten were indirect. The patients' ages varied from twenty-eight to seventy-five years. The solutions used were: Mayer's in eleven cases, Sylasol in five cases, and Tropli suspension in four. All of the patients were discharged as cured at one to two years after treatment was started. The follow-up observation began two years after the first injection in all cases. The results were as follows:

<table>
<thead>
<tr>
<th>Follow-up period</th>
<th>Hernia present</th>
<th>Absent</th>
</tr>
</thead>
<tbody>
<tr>
<td>2 yrs. and 3 mo.</td>
<td>0</td>
<td>20</td>
</tr>
<tr>
<td>2 yrs. and 6 mo.</td>
<td>4</td>
<td>16</td>
</tr>
<tr>
<td>2 yrs. and 9 mo.</td>
<td>6</td>
<td>14</td>
</tr>
<tr>
<td>3 yrs.</td>
<td>8</td>
<td>12</td>
</tr>
<tr>
<td>3 yrs. and 3 mo.</td>
<td>12</td>
<td>8</td>
</tr>
<tr>
<td>3 yrs. and 6 mo.</td>
<td>17</td>
<td>3</td>
</tr>
<tr>
<td>4 yrs.</td>
<td>18</td>
<td>2</td>
</tr>
</tbody>
</table>

Slater summarized his report:

Twenty patients with hernias were treated by the injection method and carefully followed. At the end of four years two patients were cured.

We believe that the injection treatment of hernias is not satisfactory and should be used only when the patient must not be operated on, and then only after the method of treatment and its potentialities for cure have been fully explained to the patient.

Manoil is one of the last authors to still hang on to this method, although he does advocate its use only in old people whose ages prohibit operation, and
only where the hernia is reducible. The first part of this statement is against what most of the men believe. His results showed a total of 19.6 per cent of failures. In spite of this, and the fact that as the age increased the incidence of cure lessened, he stated:

The injection treatment is the method of choice for older patients provided the hernia is reducible and can be comfortably maintained with a truss. It should be the alternative method of treatment for younger patients who refuse operation.

Dobson's work has been one of the last published and the picture his work paints is anything but favorable for the injection treatment. They treated 101 hernias in 74 patients between September 1935 and June 1938. All patients were first offered operation, but this was refused. After one and one-half years it was found the recurrence rate was so high for direct and postoperative recurrent hernias that thereafter they only accepted indirect inguinal hernias for injection.

The technic of treatment and the solutions used were essentially the same as those used by the other authors. Dobson's exceptionally low percentage of complications indicates a definite familiarity with the work. Only patients who had been without their
trusses for six months or more after the last injection were considered in this estimate of the end-results. Follow-up studies for from six months to two and one-half years were obtained on 53 indirect inguinal hernias, 19 direct and 6 postoperative recurrent inguinal hernias. Recurrences were noted in 37.73 per cent of the indirect, 68.42 per cent of the direct and 100 per cent in the postoperative hernias. Interesting here is the fact that all of the postoperative recurrent hernias had direct defects.

Dobson also found the results of the first six months of the injection treatment very promising. He stated that it seemed as if they were curing all of the hernias, and the patients seemed well satisfied. His description will give a good idea of what a patient goes through when he is being treated by this method:

In the indirect inguinal hernias after four or five injections the tissues behind and above the external ring were firm and the external ring seemed tighter. The patients usually commented at that time that they were no longer aware of a hernia; they no longer felt the impact of the sac against the truss pad when they coughed or strained. After twelve to fifteen injections the entire region about the inguinal canal was firm and the abdominal wall in that area was almost as firm as sole leather. The outline of the external ring could be palpated, but the finger could
not be introduced into the canal. On introducing the needle for the injections, it was passed with difficulty through the layer of fibrous tissue which was 1 cm. or more in thickness. Usually the patient was then given a rest period of one month or six weeks during which time he wore the truss day and night. At the end of the rest period it was noted that the external ring had loosened up and much of the firm mass in and about the inguinal canal had disappeared. The patient was then given six to eight more injections. Following these injections, the external ring again became tight and the firm mass was again present in the inguinal canal. The patient continued to wear his truss day and night for another month and was then allowed to leave it off while in bed and while bathing. If any definite weakness was noted at that stage, many of the patients were given a third course of injections in the hopes of finally closing a small defect. The patient by that time had been wearing his truss eight to twelve months, had made thirty to forty office visits, and had received twenty to thirty injections. Most of the direct inguinal hernias recurred within three to four months after the last injection. All of the cases showed signs of disappearance of the scar tissue within two to three months following the last injection.

This gives an idea of what can be expected of the injection treatment in the hands of competent men, who have spent years on developing technic. One should speculate on what the results and complications would be were this method employed by the general practitioner, who does relatively little hernia repairing. One should also realize the results obtained by most of these men were on carefully selected cases.
PRESENT STATUS

One should, after reading the preceding chapter, have a fairly good idea as to the present status of the injection treatment for hernia, but in the light of the report by the Council on Pharmacy and Chemistry (11) of the American Medical Association I feel its findings should be included in this work.

In September 1936 the Council published a report based on questionnaires which were sent to a selected list of hospitals throughout the country. The essence of the report resulting from this was that although there were cases in which this treatment was applicable and effective, nevertheless it was to be borne in mind that the attempted cure of hernia by this method was not new; that it had failed to establish itself as a routine method for such treatment and was still in an early experimental stage; further, physicians who used this method should realize the dangers from an ethical, a legal and a financial point of view.

Then in 1940 the Council again sent out the same questionnaire to those hospitals which formerly replied. From these they found the same hospitals using the method as before except for one which had a-
bandoned its use. The number of hospitals stating they did not use the method remained the same; more hospitals seemed to think the method safe than unsafe; and more considered it ineffective than effective. In most cases the reply was "effective only in selected cases."

To give the best idea of the results obtained from the questionnaires is to quote directly from the August 17, 1940 report of the Council:

The consensus expressed by comments in reply to the last question indicate that one hospital has abandoned the injection treatment of hernia since the first questionnaire was reported, and others have narrowed its application to a smaller number of cases. Many hospitals concur in the opinion that this method is suitable only for small reducible indirect inguinal hernias. In general the importance of using careful technic, relatively nonirritating solutions and adequate truss support is indicated. Other hospitals indicate that surgical repair is the method of choice. The injection treatment being reserved for those cases suited to this method in which the patients could not or would not undergo surgical operation. In some instances evaluation of the injection method is withheld because of inadequate follow-up or insufficient lapse of time. Cooperation of the patient in the matter of truss wearing is considered an important factor in success. In those hospitals not employing the injection method for hernia (about 65 per cent of those consulted) various reasons are given: Its original use has fallen into disrepute over a period of years and abandonment of its employment as a regular procedure is evidence that the method has no permanent value; it was previously abandoned because it failed
to give useful results; scar tissue, whatever the origin, is a weak tissue, nonresistant to tension; the method is unestablished and opens the field of hernia treatment to incompetents, and the method is considered unsafe or unsatisfactory.

The report then goes on to state that the injection method of treating hernia may not be recognised for general use and should be employed only by those with special experience and with full cognizance of the dangers involved in the use of such solutions. The Council now concurs in the opinion that the method involves less danger of serious complications than surgery when employed in selected cases by those skilled in the injection of suitable standardized solutions of known composition and action. The report also states that the Council is not willing to recognise any such solution for New and Nonofficial Remedies and that present evidence indicates that better types of solution are to be desired. They go further to say they must condemn the exploitation of the injection treatment of hernia by manufacturers of solutions.

A clue to what may develop from the injection treatment is expressed in a recent article by Wilmouth (47). In connection with operative treatment of hernia he reports that it is believed that many recurrences
are due to lack of sufficient fibrous tissue union between the muscle and fascia which are satisfactorily sutured. Believing that an added stimulus to "fibroplasia" was necessary to secure firmer and lasting union, he injected irritating fluids during and after operation. He states his result was a strengthening of the line of suture, and that in this way the number of recurrences may be reduced.
CONCLUSIONS

After reading most of the present and past literature on the subject of the injection treatment for hernia, and a certain amount of speculation, I have come to some very definite conclusions. First of all it has been brought out by most of the authors that it is not safe for anyone to use this method unless equipped with the proper technic and training. Next, the solutions at present in use are not truly satisfactory. The method is not without complications, even to the extent of death.

Further the method is not effective except in carefully selected cases, such as thin young adults with good musculature with recent, small, reducible indirect inguinal hernias. It is necessary for these cases to wear trusses for an extended period of time, and is also necessary for them to remain under observation for at least three years, possibly longer.

Experimental studies have shown that the process of absorption of the scar tissue formed by the injections of sclerosing fluids continues over a period of years, making retreatment necessary. These studies have also shown that this method of treatment does not
fulfill the requirements of adequate hernia repair, mainly, obliteration of the sac as advocated by Bassini, and the reenforcing by overlapping or living fascia technic of operation is not obtainable. The tissue which is formed is finally absorbed.

The end-results as shown by the various authors, even in selected cases, hardly make this treatment worth while.
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