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PROBLEMS OF THE SURGICAL DIABETIC

--Ralph E. Jorgenson

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Insulin and Modern Medical Treatment of the Diabetic have made possible Surgical procedures, which would not have been attempted twenty years ago, and have made possible a longer, happier, and more useful life for the Diabetic. We are thus confronted with the problem of making Surgery safe for the Diabetic, and giving him the same results as his Non-Diabetic brother. By cooperation of the internist and the surgeon, we can now aid the Diabetic with Surgical Complications. The mortality for the Surgical Diabetic is approximately one third what it was in the Pre-Insulin days.

The Surgical Diabetics have increased in numbers in recent years for two reasons: First - Diabetics are increasing, or at least, the number that are diagnosed, reported and treated are increasing. Second - Diabetics are living longer, thanks to Insulin and Dietary Management.

Joslin (1) stated that if Diabetes should increase in the next thirty years as it had from 1880 to 1910, that Diabetes would rival Tuberculosis as a cause of death, and would then continue to progress at the same rate for another generation. It would be responsible for nearly the entire mortality of the world. Part of this increase is due to greater accuracy in vital statistics, more frequent urine examinations, and increased life insurance examinations. These factors all mean diagnosis of the cases present, and mean little as to actual increase in the number of individuals with Diabetes. However, an actual increase is present, and in part, if not entirely due to two factors, increase in length of life and obesity in the average or the population as a whole.

The importance of Surgery in the Diabetic is increasing, because the increase in the number of Diabetics and the increase in the proportion that demand Surgery. Joslin (4) states that every other Diabetic becomes a Surgical Diabetic before he dies. Of the patients admitted to the University Hospital over one fourth of them presented Surgical Complications on admission.

No doubt Diabetes with its problems and complications has existed as long as men have had medical problems. Aretaeus, the Cappadacian, who lived in the Third Century A. D., gave a classical description of Diabetes. The Hindus about the Fifth Century A. D. described Diabetes or Mal Humeha (honey urine) with symptoms of thirst, foul breath, and languor. Garrison [24]. However, the true Pathology or cause of Diabetes was probably first suggested by Cowley, an English physician, in 1788. Over a century later Mehring and Minkowski produced Diabetes in animals by removal of the pancreas.

In 1921 Banting and Best working under the direction of Maileond produced Insulin in a crude form, and in 1922 Collip devised a method of purification which gave a product suitable for use in man.

We now have a method of treating or controlling Diabetes in the Diabetic Patient. He is living a happier, longer, and more useful life. The use of this product is more essential in the Diabetic with Surgical Complications than the normal Diabetic, and has aided greatly in his treatment.

THE DIABETIC AS A SURGICAL RISK

In the Pre-Insulin days only operations which were absolutely essential as life saving measures were performed. These operations were usually performed with ether or chloroform being used as an anesthetic, and Insulin was not available for pre-operative and post-operative treatment. John (2) reported in 1728 Pre-Insulin operations with a mortality of 31.3%. These cases were reported from various clinics in this country and should give a fair average of the Surgery in the Diabetic prior to the time of Insulin. In the same article he reports 3,676 cases in the Insulin area with a mortality of 12%. Thus we see that the Diabetic with Surgical Complications presents both a Medical and Surgical problem, and successful treatment depends on the treatment of the patients as a whole, minimizing neither the Medical nor the Surgical treatment.

Diabetics do have increased mortality and there is an increased risk in operating a Diabetic, but this may be minimized by proper treatment pre-operative and post-operative. The reasons for this increased danger are increased age of the Diabetic, obesity, cardio vascular disease, lessened general and local resistance, danger of acidosis, and the fact that Diabetes predisposes to certain Surgical conditions.

McKittrick and Root (3) state that sixty percent of the cases of Diabetes develop after the age of forty years, because Diabetes develops so late the bulk of the Diabetic Surgery is performed on individuals past middle life. Joslin (1) states that about eighty five percent of the Diabetics who become Diabetic after forty have been obese. The frequency of gangrene and sepsis points to a lessened general and local resistance and the frequent occurrence of coma

accompanying a Surgical infection in the Diabetic shows the danger of acidosis. McKittrick and Root (3) state that cardio vascular disease is so common in the Diabetic that arteriosclerosis in some degree may generally be assumed. Our Surgical Diabetic, then, is usually a patient presenting a Surgical problem. Diabetes and several of the complications just mentioned. A patient that might be termed a sub-standard Surgical risk, but approaches the standard as the controllable complications are cared for.

SURGICAL DIABETICS AT THE UNIVERSITY HOSPITAL

From 1917 to 1932 we have had 37,443 admissions to the University Hospital. Of this number 355 were Diabetic and 347 of these had Diabetes Mellitus or one out of every 108 patients admitted had Diabetes Mellitus.

Of the 347 patients we had 87 patients, who presented Surgical complications or more than 25% of our Diabetic patients had Surgical Complications when admitted to the Hospital. Some individual patients presenting two or three Surgical conditions, and a goodly number of them in serious condition demanding immediate Medical and Surgical treatment.

The average age of the Surgical Diabetic in this group was 50.4 years. Three of them were below ten years of age; two were between ten and twenty; three were between twenty and thirty; six between thirty and forty; twenty-two between forty and fifty; nineteen between fifty and sixty; seventeen between sixty and seventy; and fifteen patients over seventy years of age.

The majority of our Diabetics with Surgical Complications

were over fifty years of age, hence more complications would be expected if Diabetes were not present, and Surgery performed on patients of this age.

THE FOLLOWING SURGICAL CONDITIONS WERE FOUND

Gangrene of Foot or Leg in	14 Patients
Alveolar Abscess in	7 Patients
Tonsillitis with Tonsillectomy in	7 Patients
Perforating ulcer of foot in	6 Patients
Cholecystitis in	6 Patients
Cellulitis in	5 Patients
Carbuncle in	4 Patients
Cataract in	4 Patients
Enlarged Prostate in	4 Patients
Fibroids in	3 Patients

Two patients with each of the following toxic adenoma, epithelioma, hydroceal, appendicitis, carcinoma of pancreas, glaucoma and inguinal hernia. One patient with each of the following Surgical complications: ferruncle, carcinoma of sigmoid, hemorrhoids, rectal fissure, brain tumor, nasal polyp, mastoiditis, ulcer of hand, osteomyelitis, sinusitis, phlebitis, peritonitis, purulent vaginitis, deflected nasal septum, fracture of patella, infected bunion, pyosalpinx, gun shot wound of arm, gangrene of index finger, carcinoma of breast, and gangrene of scrotum.

In this group there were nineteen deaths or a mortality of 21.8%. This mortality is quite high but when we consider the large number of somewhat hopeless patients who have had either inadequate

or no previous Medical treatment, it doesn't appear so bad. A large number of these patients were in coma and died before they could be prepared for Surgery.

THE CAUSE OF DEATH IN THESE PATIENTS WAS

Surgical infection with Coma	5
Gangrene with Coma	6
Surgical infection Diabetes controlled	3
Incurable Malignancies	3
Brain Tumor inoperable	1
Pneumonia in patient with Surgical Complications	1

(Note - Only 7 of the patients who died had been operated)

Fifty four operations were performed on Diabetic patients with seven deaths or a mortality of 12.9% at or immediately after operating. We could consider this very good as to mortality in operation, when we consider that a goodly number of these operations were performed before the days of Insulin. John (2) reports a summary of 1728 Pre-Insulin and 3,676 Post-Insulin operations, which had been reported from various clinics in this country. The mortality was 31.3% Pre-Insulin and 12% Post-Insulin. We see here that our average mortality at operation is little above that reported Post-Insulin.

For anesthesia the choice of our surgeons has usually been local or spinal anesthesia. Nitrous oxide has been used considerably, and ether in a few cases.

MEDICAL PROBLEMS OF THE SURGICAL DIABETIC

The Surgical Diabetic presents all the problems of the normal or average patient with Diabetes Mellitus plus the fact that the Diabetes becomes worse, and the effectiveness of Insulin is lessened by acute infections or hyperthyroidism. Joslin (4) says, that an infection makes a Diabetic worse, and that hyperthyroidism is as harmful as an infection. Heyd (5) claims that infection lessens the protective powers of Insulin from fifty to seventy five percent. Smith (6) states that infection may render the Diabetic refractory to Insulin. Medical treatment, then, is essential, but should not delay emergency Surgery, but should be given promptly and soon after the operation.

"One can treat Diabetes after the operation as well as before, but if you don't cure the Surgical lesion there will be no Diabetic to treat." Joslin (4).

All Surgical Diabetics can be divided into two classes. Those with abnormalities which impair comfort but do not give immediate danger to life, and those that are acute inflammatory lesions and may demand immediate Surgical attention. The Medical problems in both classes are the same, but the first group can be treated over a period of time, and go to the operation in good condition. The statement of Saunders (7) may be true in this group.

"The critical and individual care received by the Diabetic patient both Pre-operatively and Post-operatively makes Diabetes per se an asset and not a liability."

McLean (8) states that Surgery in the second group is beset with pitfalls; usually complicated by ketosis, attendant dehydration, and loss of fluids with blood concentration. In either type it is

essential to restore the patient to as near normal physiological function as possible both before and after operation by the judicious use of fluids, food and Insulin.

McKittrick and Root (3) state that every Surgical Diabetic should be considered a candidate for Coma and treated with the possibility in mind.

In the elective cases Medical treatment should be directed toward the following conditions before operation, normal weight, normal blood sugar, normal carbon dioxide, combining power of the blood and normal urine. The diet should be high in carbohydrates, moderate in protein, and low in fat, and Insulin used to keep the fasting blood sugar below 150.--McLean (8). In this type of patient the period for Pre-operative treatment may vary from two days to two months.--McKittrick and Root (3). Patients should be fed to within two or three hours of the time of the operation, with the bulky foods left out before operation, so as to have the liver well supplied with glycogen and protect the patient from acidosis. At the New England Deaconess Hospital 150cc of orange juice is given three hours before going to the operating room, and ten units of Insulin if the patient needs it.--McKittrick and Root (3).

In emergency cases the following treatment is followed at the New England Deaconess Hospital.

1. Nurse prepares a warm bed with at least four hot water bottles.
2. Necessary equipment is in readiness at the bedside for catheterization, soapsuds enema, gastric lavage, sub-cutaneous infusion of normal saline, and for administration of caffeine and Insulin.

In the care of the patient.

1. Urine is secured and tested for sugar and diacetic acid every hour.
2. Hourly records of pulse, respiration rate, and temperature are kept.
3. Enema to remove accumulated feces.

If coma is diagnosed orders for the treatment are left.

Hot liquids given by mouth not more than 100cc per hour.

Liquids may be given per rectum if the patient is dry or given sub-pectorally, except in the presence of pulmonary rales. Patients are sometimes given salt solution intravenously in quantities from 250cc to 500cc.

The diet is kept below 50 grams carbohydrate, 25 grams of protein, and 25 grams of fat for the first twenty-four hours, unless there is marked improvement in the patient. Caffein sodium benzoate is injected sub-cutaneously, five grains every hour for four doses, and as indicated there after. Insulin is given, the dosage depending on the conditions of the patient.

When operations are to be performed in a few hours, they attempt to avoid over treatment with Insulin, and do not attempt to render urine sugar free in a few hours.--McKittrick and Root (3).

The treatment given for acidosis here is quite similar to that used by Joslin in Diabetic Coma. Joslin (9).

COMMON SURGICAL INFECTIONS IN THE DIABETIC

The patient with Diabetes Mellitus is as susceptible to the Common Surgical Infections as the Non-Diabetic of the same age, and especially those with inadequate dietary treatment or susceptible to carbuncles and gangrene much more than the Non-Diabetic. In either case we have a patient that demands immediate and adequate Medical care to prevent acidosis and coma and prompt surgical treatment. The greatest difficulty in many cases is that the diagnosis is difficult to make, due to the complication of acidosis and difficulties in diagnosis not met with in Surger of the Non-Diabetic.

Appendicitis in the Diabetic presents difficulties not ordinarily met with in the Non-Diabetic. McKittrick and Root (3) state, "Acute appendicitis in the Diabetic is insidious in its onset, treacherous in its course and uncertain in its outcome." The following symptoms often occur in Coma, and make the diagnosis of acute abdominal lesions difficult, nausea and vomiting, pain in the abdomen which may be cramping, obstipation, dry tongue, slight fever, abdominal spasm, and tenderness which is usually not well localized and leucocytosis from 12,000 to 40,000.--McKittrick and Root (3). While other symptoms may be present in Coma, the presence of Coma does not rule out an acute abdomen, and the condition requiring Surgical relief may be the underlying factor.--Smith (10). The problem of the surgeon may then become a problem of differentiation of the generalized tenderness and rigidity of impending Coma, and the localized findings of Appendicitis. Smith (10) says, "Localized tenderness and rigidity should be accorded their classic significance, but ketosis must rank with asepsis in Surgical conscience." After diagnosis of acute appendicitis is made, it is not advisable to

delay operating.--McKittrick and Root (3).

In other abdominal operations, the indications for Diabetic Surgery are about the same as in the Non-Diabetic, and with Diabetes controlled, the danger should be but little more than in the Non-Diabetic of the same age and physical condition.

There is some disagreement among Medical men as to the relationship of Gall Bladder disease to Diabetes. The majority contend that Cholecystitis is a predisposing factor, and that Cholecystectomy will favorably influence the Diabetes if a diseased Gall Bladder is present. However, Adams (25), states that Cholecystitis is a doubtful factor in the causation of Diabetes Mellitus, but in the presence of obesity or arteriosclerosis may play a part. He also reported that statistics at the Mayo Clinic did not support the view that removal of a diseased Gall Bladder would favorably influence co-existing Diabetes.

SURGICAL LESIONS MORE COMMON IN THE DIABETIC

Diabetics are liable to certain types of lesions, due to early arteriosclerosis and other abnormalities. Quoting Von Norden (19), (in 511)
 "All cells of Diabetic organisms are especially liable to both autogenous disorders and external injuries, as they lack the normal power of burning food substances for Energy and building up and repairing their protoplasm, in addition to being poisoned by products of abnormal metabolism." Skin infections, gangrene, and carbuncles make up the majority of Surgical lesions which are more common in the Diabetic than the average individual.

Gangrene in the Diabetic may develop with or without infection, usually developing at the sight of some minor injury, and is more common in the foot than all other locations combined. It usually begins gradually after slight injury, especially of the toes. The part becomes swollen, edematous, and dusky red, and very painful. Necrosis usually spreads to the sub-cutaneous tissues, with suppuration and decomposition. It is much more common in the neglected Diabetic than in the patient, who is well cared for, and has been taught to watch his diet and avoid minor injuries to his feet.-- McMahon (11).

Flotner and Fitz (12), report Gangrene as a complication in 7% of 963 Diabetic patients admitted to the Peter Ben Brigham Hospital between 1913 and 1925. The lower extremity being affected 65 times and the upper extremities 4 times.

We see that this lesion is very common, and its seriousness may be noted by any one, who will note the large number of amputations, and the high mortality in operations for Diabetic Gangrene. Apfelback (13), states that the mortality in amputations for Diabetic Gangrene at the Cook County Hospital is from 65% to 70%.

Treatment of Diabetic Gangrene lies first in the prevention of injuries and infection which would prevent Gangrene, at least in part, and make further treatment unnecessary. Root (14) says, "Exclude infection and trauma and death from Diabetic Gangrene would disappear." Some of the causes of Gangrene, which are preventable are, trauma, tight shoes, epidermophytosis, and cutting corns without precautions. Saunders (15) States, "If every patient suffering from Diabetes had expert Medical care, and could or would live under improved hygienic conditions, infection would not occur any more often than in the Non-Diabetic patient. This is proven by the fact that there are, at least, 100 Public Ward Diabetic patients requiring Surgery to one Private well-cared-for Diabetic."

Treatment of Gangrene, which is established, is dependent on the extent and type of the Gangrene; the history and findings; the severity of Diabetes, and the success of Medical treatment in controlling it; the economic aspect, and the cooperation of the patient.--Harbinson (16). These factors must all be considered in deciding whether Medical treatment or amputation will be used. Each case presents an individual problem, and only a few definite statements can be made as to when Surgery is advisable. Amputation is advisable in the presence of a rapidly spreading process; in the presence of virulent infection with septicemia, and in the Diabetic condition that cannot be controlled by frequent and increasing doses of Insulin.--McMahon, Scharf and Bartlet.(11) Surgical treatment of a gangrenous extremity is usually amputation. The more radical procedures usually giving the best results.--McMahon Scharf, and Bartlet (11).

Medical treatment of Gangrene is a slow and long drawn out

process due to the limited blood supply to the part, and the limited capacity of the tissues to metabolize food material.

Harbinson (16) recommends the following:

1. Diet and Insulin.
2. Bed rest with exercise and breathing exercises.
3. Position of extremity at a level where the color will be nearest normal.
4. Frequent change in position of the patient.
5. Adequate fluids.
6. Thermotherapy - Oven heat for one half hour, followed by soakings in normal saline at 100 degrees F. Hot compress of 1-1000 neutral acraflavine or gentian violet. When odor is offensive, hot compress of one fourth percent phenol. When infection no longer present, discontinue compress and expose to ultra violet light.
7. Diathermy.
8. Massage (light efflurage).
9. Medication for relief of pain. Antisyphyletic treatment if necessary.
10. Drainage if pus is present.

Carbuncles are much more common in the Diabetic and the prognosis is much worse than in the Non-Diabetic. Frost (17) says, "One of the most frequent, distressing, and grave infections of the Diabetic is that of carbuncle. Sloughs are slow to separate, healing is laborious, acidosis hard to control, and toxemia rampant." Treatment of carbuncle in the Diabetic consists of controlling the Diabetes by diet, Insulin, and fluids, and Surgery for the local process. Frost (17) and Apfelback (18) state that excision is the Surgical procedure of choice.

Xray probably has some value in the treatment of carbuncle in the Diabetic, especially if the treatment is begun early. Dr. Frank Conlin of Omaha, claims to have gotten exceptional results in six selected cases, in which he used this method of treatment combined with strict Medical control of the Diabetes.--(26).

Dr. J. E. Summers states that excellent results may be obtained by the use of cautery with a soldering iron.--(27).

Elective Surgery in the Diabetic may be performed with little more danger than in the Non-Diabetic. Lesions which impair comfort, but do not give immediate danger to life, may be taken care of in the Diabetic as well as the Non-Diabetic, and can be just as safe, if the Diabetes is kept under control and acidosis avoided. For this Pre-operative care is essential, and the Diabetic should come to the operation with his condition under perfect control by diet, and Insulin, and the liver well stored with glycogen. Joslin (4) states that Glycogen in the liver is everything to the Diabetic and carbohydrate should be given within three hours of the operation.

When elective Surgery is to be done in the Diabetic, it is essential to control complications by Medical means. The Diabetes should be kept under control by the use of diet, and Insulin, particular care in keeping the urine sugar free, and avoiding the chance of acidosis by feeding adequate carbohydrates in proportion to the fats and seeing that the patient does not burn up his own body fat at a time when food is not supplied. Carbohydrate should be fed up to within three hours of the operation and soon after.

Gilchrest (20) states that pre-operative treatment should aim at the following conditions - full nourishing diet, freedom from

signs of acidosis, absence of sugar in the urine, improved nutrition, and replenished glycogen stores in the liver. He recommends a normal diet to within six or eight hours of the time of operation, and that twenty grams of glucose, accompanied by Insulin, if necessary, be given three hours before operation. Post--operative, Gilcrest (20) recommends fluid and carbohydrate in small amounts soon after operation. The patient should be regarded as a candidate for acidosis and treated as such. Twenty to forty grams of glucose, buffered by Insulin in the severe Diabetic given every three or four hours. As convalescence continues, a gradual change to the normal diet should be made.

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ANESTHESIA IN THE DIABETIC

Local or Spinal Anesthesia are the choice in most clinics, and considered best because they upset the metabolism of the organism much less than the general Anesthetics. Of the General Anesthetics Ethylene is favored, and nitrous oxide considered in the same light.-- McKittrick and Root (3). While Ether and Chloroform are shunned by most clinics, because of their effect on the liver, and the metabolic upset they produce, Ether has been used with good results at the Mayo Clinic in recent years.

Joslin (4) states, "It is more important for a surgeon and anesthetist to use the anesthetic they prefer, and to which they are most accustomed, than on account of Diabetes to work with strange tools.

SUMMARY

1. Diabetes is increasing or at least the number of cases that are being diagnosed and treated are greater now than at any time previously.
2. Surgical Diabetics have increased in numbers, because we now have more Diabetics and Diabetics are living longer, because of Insulin and dietary treatment.
3. Diabetics are sub-standard Surgical risks, because of the possible complications due to Surgery, advanced age in the average Diabetic, circulatory disturbances, and inability to metabolize carbohydrate as the normal individual.
4. One patient in every 108 admitted to the University Hospital was a Diabetic, and over one fourth of these presented Surgical Complications.
5. Medical treatment of the Surgical Diabetic is as essential as Surgery, and the judicious use of diet, Insulin, and fluids is as

essential as the proper use of the Surgical instruments.

6. The Diabetic is just as susceptible to common Surgical conditions as his Non-Diabetic brother, and especially susceptible to conditions such as gangrene and carbuncle, due to early arteriosclerosis and defective metabolism.

7. Diagnosis of Surgical conditions in the Diabetic may be made difficult as they simulate Diabetic Coma.

8. The Diabetic should be prepared for elective Surgery by the judicious use of Insulin, diet, and fluids, and should come to operation with the urine sugar free and the liver well stored with glycogen.

9. Local or Spinal Anesthesia upset the metabolism very little, and Ethylene and Nitrous Oxide much less than Ether or Chloroform.

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