splintage is purposely made nonconstricting. It should not be forgotten that ischemia can occur in this and other varieties because of the injury alone and that the encircling dressings may have nothing to do with it.

For two years now I have been experimenting with a portable motorized device for setting fractures and dislocations and liberating stiff joints (fig. 1). I call this the repositor. The apparatus essentially consists of an electromotor attached to a spring device, which in turn is fastened to a strap or harness attached to the limb. When the motor is started, the strap pulls and then relaxes, so that intermittent traction is applied to the limb instead of the steady pull that has hitherto been employed when manual methods or the fracture table have been used.

A pull from zero to 100 pounds can be automatically given, with a variable period of relaxation and at varying speeds.

Every fracture and dislocation is set not by setting the bone but by setting the elastic muscles, tendons and ligaments, and hence the importance of intermittent traction as compared with continuous traction. This apparatus permits, so to speak, a systole and a diastole; in other words, labor pains are imitated.

When used with the fluoroscope, this method should make the setting of fractures and dislocations almost automatic and I am becoming convinced that this device is of value in that group ordinarily regarded as irreducible without operation.

In fracture dislocations of the joints, notably of the carpus, I have had excellent success. Likewise, in fractures of the cervical spine the repositor has been extremely valuable, and the newer model, soon to be marketed, will be more portable and more practicable to take to the patient when an electric light socket is available.

This motorizing of the fracture table is encouraging enough to me to warrant this preliminary statement of my experimentation.

OSTEOMYELITIS

Osteomyelitis, incidental to infected fractures or otherwise, is still an unsolved problem. Orr has done well to call attention to the value of débridement and immobilization; but it must not be forgotten that this method is essentially the bipp treatment used by the English during the war and later abandoned because of recurrences. Baer in Baltimore is quite enthusiastic over the maggot method and quite recently I spent half a day in surveying this procedure. However to me, despite many methods and many procedures, the old adage "Once an osteomyelitis, always an osteomyelitis" still prevails.

END-RESULTS

The restoration of function is the chief end of traumatic surgery. The methods of estimating end-results should be standardized so that all physicians will speak the same language. This cannot be done by the use of words such as "good," "fair" or "bad," but it can be done by the use of numerals if the common denominators can be mutually agreed on.

For some years I have been using the three factors of function, union and contour to list my own end-results. By function I mean capacity to perform. By union I mean the state of repair. By contour I mean the external appearance. Hence function + union + contour = end-results.

I rate perfect function as 60 per cent, perfect union as 20 per cent, perfect contour as 20 per cent. This rating makes actions three times more valuable than any other factor, and with that element all are in substantial agreement. For example, in a fractured wrist, I make an estimate that function is only half perfect and hence allot 30 per cent instead of 60 per cent; union also is only half perfect and hence scores 10 per cent instead of 20 per cent; contour is also limited half, and hence I rate it 10 per cent instead of 20 per cent. Now my rating is $30 + 10 + 10 = 50$ per cent.

To me this seems a better determination than to use such words as "fair" or "poor."

Let some method be agreed on to solve the problem. Surely, if one can rate in figures at a horse show or cattle show one should be able to do likewise with human beings. Incidentally, if a substantial agreement can be reached there will less often be quarrels with compensation boards and like agencies who now have a rating scheme that all too often makes the physician's own rating none too flattering to his surgical accomplishments. If surgical societies throughout the country would adopt a rating scheme, the situation would soon be clarified and the statistics would then all be based on the same factors.

CONCLUSION

Here now in review some of the phases of traumatic surgery have been presented, special stress being placed on the treatment—traumatotherapy.

In closing let me venture the suggestion that the coming advances in surgery will be in this field, for in reality the tillage has just been begun and the harvesting awaits the diligent plowing and planting.

Finally, let me quote Einstein in something all can understand when he says: "Everything that men do or think concerns the satisfaction of the needs they feel, or the escape from pain."

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HYPOGLYCEMIA ASSOCIATED WITH HYPERTROPHY OF ISLANDS OF LANGERHANS

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In recent years, since blood sugar determinations have become almost routine, hypoglycemia has become of increasing clinical importance. However, a review of the literature reveals that although much has been written concerning the subject there are marked variations in the blood sugar norms, the symptomatology and the etiology that are reported as characterizing hypoglycemia. It is my purpose to consider these observations, and to add to them a report of my own case, which clinically appeared to be uremia with low blood sugar estimations and at autopsy proved to be subacute glomerular nephritis and hypertrophy of the islands of Langerhans.

The divergence of opinion concerning the blood sugar normal is apparent to any one who seeks to establish a norm. Sendraril and Planques cite eight authorities who agree that any reading below 90 mg. is to be considered a hypoglycemia. Joslin states that the average fasting normal is 100 mg. per hundred cubic centimeters.

of blood. Pribram reports three cases of mild chronic glycosuria in which the blood sugars ranged around 80 to 90 mg. and in which weakness, chronic constipation, vomiting, and headaches were the principal clinical symptoms. On the other hand, Harris says that patients exhibiting hypervascularism usually show readings below 70 mg. Banting, Campbell and Fletcher place between 70 and 50 mg. the milder symptoms of hypoglycemia, and below 50 mg. the acute, distressing ones. We have observed a fasting blood sugar of 54 mg. in a Negro patient who exhibited no symptoms whatever. Nevertheless, most authorities agree that the normal blood sugar limits are between 80 and 120 mg. per hundred cubic centimeters of blood.

The most complete symptomatology is that given by Sendrall and Planques, who report a hypoglycemic syndrome that includes fatigue, anxiety, irritability, lassitude, gnawing hunger, twitchings of the muscles, tremors, phenomena simulating drunkenness, diplopia, vasomotor changes, hot flashes, secretory irregularities, lacrimation, profuse perspiration, vertigo, syncope, loss of emotional control, convulsions and coma. The authors emphasize the fact that these symptoms do not appear simultaneously or in all cases. This statement is confirmed by Sevironhaus, Kirk and Heath, whose opinion is that the blood sugar concentration at which symptoms appear varies in different individuals in the region between 40 and 50 mg. per hundred cubic centimeters of blood.

The conditions in which hypoglycemia are found are many and varied. Lowered blood sugars are discovered in the presumed circulatory changes which follow the intravenous injection of albumose and peptone in dogs, according to Pemberton, who also states that hypoglycemia is produced by alkalosis and by hypocalcemia and that it follows the intravenous injection of sodium bicarbonate, which also decreases suprarenal hyperglycemia. Greenwald and Eliasberg report two fatal cases of profound hypoglycemia following first degree burns.

Levine, Gordon and Derick found a correlation between hypoglycemia and the physical condition of runners at the end of a race, such as the marathon. McCrudden and Sargent cite the fact that hypoglycemia is found in progressive muscular dystrophy.

Both Pettersson and Mario Cayrel have observed symptoms of hypoglycemia in parturients, and Cayrel asserts that the administration of sugar often induces uterine contractions. It is interesting to note that Van Creveld made a study of sixty cases of premature children during fasting and noted a lower blood sugar than usually occurs in full term children of the same age. He considers this fact to be an argument for the functional immaturity of the premature.

The hypoglycemic cases which particularly challenge the interest of the investigator and exhibit the most marked reductions in blood sugar are those arising from definite pathologic changes. These abnormalities tend to fall into three etiologic categories: hepatic, endocrinal and pancreatic.

Hypoglycemia of hepatic origin is due to disturbances either in the sugar mobilization or in the storage mechanisms of the liver. These dysfunctions seem to be caused by certain forms of hepatic diseasewise. Lowered blood sugars occur with parenchymatous changes in the liver caused by chloroform, by arsphenamine, by the fungus Agaricus bulbosus, by phosphorus and by hydrazine. Josephs reports eight cases, in children, of hypoglycemia which he believes was of liver origin. The postmortem observations of fatty degeneration of the liver cells, in two of these cases, confirm his opinion. Nadler and Wolfer describe a marked hypoglycemia that was associated with a primary liver cell carcinoma so extensive as to involve 75 per cent of the liver tissue, with degeneration of the remaining tissue.

Hypoglycemia is also coexistent frequently with certain abnormalities of the pituitary, thyroid and suprarenal glands. The fact that the suprarenal and pituitary extracts will raise the blood sugar, and therefore are used to abort hypoglycemic attacks, suggests that the suprarenal and pituitary glands may be a causal factor in lowered blood sugar. Evidence of the activity of the thyroid is presented by Holman in the report of a case following subtotal thyroidectomy. A study of spontaneous hypoglycemia, with necropsy, was made by Pettersson, whose patient developed hypoglycemia following a premature labor. The lowest blood sugar was 25 mg. per hundred cubic centimeters of blood, and autopsy revealed marked atrophy of the suprarenals and thyroid, with enlargement of the pancreas.

Glycosuria also follows high section of the cord, or section of the nervous connections of the suprarenals. Suprarenal insufficiency, complete removal of the suprarenals, and Addison's disease produce hypoglycemia. Marfan is of the opinion that the manifestations of Addison's disease and of glycosuria are similar. He attributes these facts to the action and the effect which the thyroid, pituitary and suprarenal glands exert on the metabolism of the sugars.

Hypoglycemia induced by the injection of insulin and insulin-like substances is so well known that it requires no discussion. Severe cases of hypoglycemia, several of which were fatal, have been found in diabetes mellitus by Jonas, Woodyatt and others.

Certain tumors of the pancreas have been reported as a cause of glycosuria. Adenomas, or hyperplasias of this gland are not uncommon, as evidenced by the series of cases reviewed by Cecili and Warren; but, since they were not accompanied by blood sugar...
analyses, they cannot be definitely connected with hypoglycemia. McClennahan and Norris 24 report a case of hypoglycemia associated with hypertrophy or adenoma of the islands of Langerhans. Thalheimer and Murphy 25 describe a similar case in which the only pathologic lesion found at autopsy was a small, primary, pancreatic nodule which, the authors believe, was either a carcinoma or an adenoma. Wilder and his colleagues 26 definitely associate carcinoma of the islands of Langerhans with hypoglycemia. In this case the patient presented typical hypoglycemic symptoms with lowered blood sugar, and necropsy revealed a carcinoma with metastasis arising primarily from the island cells. Recently, Howland, Campbell, Maltby and Robinson 27 reported the removal of a tumor from the body of the pancreas by operation, in a case involving hypoglycemia. Microscopic examination showed the tumor to consist of masses of cells of the type found in the islands of Langerhans, with certain features of a malignant growth. After operation the patient remained free from symptoms of blood sugar poisoning normal. 

Compensatory hypertrophy and hyperplasia of the islands of Langerhans in the pancreas of a child born of a diabetic mother are reported by Gray and Feemster. 28 The child, who, incidentally, was premature, died on the third day of life, at which time its blood sugar was reported as 0.67 mg. per hundred cubic centimeters of blood. The pancreas showed hypertrophy and hyperplasia of the islands of Langerhans, with normal acinous tissue, as well as hypertrophy of the cells of the medulla of the suprarenals. The average diameter of the islands was 290 by 212 microns, the largest being 394 by 335, compared with the normal average of 116 by 100 microns. This enlargement is considered by the authors as compensatory to the increased blood sugar of the mother.

The observations of Gray and Feemster were preceded by those of Dubreuil and Anderodias, 29 who also reported a case of giant islands of Langerhans in a child born of a diabetic mother. The islands were from twenty to thirty times larger than the normal, and the enlargement, in contrast to the postmortem observations of Gray and Feemster, was more than three times the normal width, being 350 Gm.

The reports concerning the pathologic changes in the pancreas were particularly interesting in the light of my own case which, unlike the cases reported by Dubreuil and Anderodias and by Gray and Feemster, occurred in an adult who exhibited definite evidence of uremia. As far as it was possible to ascertain, a similar case with autopsy has not been reported in the literature.

REPORT OF CASE

A Negro man, aged 56, was found in the street, unconscious. On admission to the ward, Sept. 29, 1929, he could be aroused only with great difficulty. His wife stated that he had not been feeling well for the past eleven months. He had been very weak but had continued his work as a railroad watchman. Two weeks previous to his admission to the hospital, he had consulted a physician who told him that he had kidney trouble. In addition to the symptoms mentioned there had been one other—marked frequency of urination. The patient's past medical history revealed that he had had typhoid as a young man. The family history was unknown to the wife. They had had no children.

The patient, who was well developed and well nourished, was in a state of coma. The skin was cold and clammy. There was no paralysis or rigidity, and the reflexes were normal. The respirations were noisy, irregular and rapid. The pulse was slow, regular, and of good volume; the blood pressure was 168 systolic and 92 diastolic. The sclera was slightly jaundiced. A marked arcus senilis was noted in both eyes; the pupils were equal but reacted poorly to light. The breath was fetid. The teeth were in poor condition. The tongue was clean. The interscapular and costovertebral râles were heard at both bases of the lungs. The heart was not enlarged; the sounds were of good quality and regular, and no murmurs could be heard. The abdomen was soft, and no masses or organs were palpable. The hands and feet showed slight edema.

The following morning the patient was still unconscious and could not be aroused. He was somewhat rigid and exhibited numerous twitchings of the face and arms. The respirations were more labored and irregular. The chest was filled with moist râles, and there was a systolic murmur at the apex of the heart.

The urine showed a specific gravity of 1.012, a cloud of albumin, no sugar, and many hyaline and light granular casts. The blood count showed: erythrocytes, 2,900,000; leucocytes, 12,000; hemoglobin, 50 per cent. In the differential white count, neutrophils numbered 78 per cent; large lymphocytes, 4 per cent, and small lymphocytes, 16 per cent. The blood Wassermann test was negative. The blood urea nitrogen was 133 mg. per hundred cubic centimeters of blood and the blood sugar 45 mg.

At noon, 100 cc. of blood was removed, and 10 Gm. of dextrose was given intravenously. About one hour later the blood urea nitrogen was 98 mg. and the blood sugar was 68 mg. per hundred cubic centimeters of blood. At 10 p.m., the 900 cc. of blood was given intravenously, and 500 cc. of saline solution of dextrose. Following the first blood sugar report, he had been started on retention enemas of 5 per cent dextrose.

The morning of October 1, the symptoms were more pronounced. The pulmonary edema was much more marked and respirations were Cheyne-Stokes in character. Since admission, the patient had voided very frequently but was incontinent. The urea nitrogen was 203 mg., the creatinine, 19.2 mg., and the sugar 25 mg. per hundred cubic centimeters of blood. The urine was the same as in the previous report. At noon, the patient was given 50 Gm. of dextrose intravenously. At 2:45 p.m., death occurred.

A postmortem examination, limited to an abdominal incision, was performed within an hour after death by Drs. John Eiman and Ethel L. Rahe, to whom I am indebted for the pathologic studies. Blood removed at autopsy showed a urea nitrogen of 197 mg., creatinine of 20.2 mg., and sugar of 92 mg. per hundred cubic centimeters. Both ureters and the pelvis of the kidneys were dilated. The left ureter, at 2 cm. from the kidney, measured 13 mm. The right ureter, at about the same distance, measured 2.4 cm. in diameter. The capsule of the left kidney stripped with difficulty, leaving a fairly smooth surface. On section, the kidney was found to contain numerous pockets filled with blood-tinted urine. The right kidney was similar to the left. The microscopic picture was that of subacute glomerular nephritis.

The pathologic changes in the liver consisted only in passive congestion, and the spleen was not at all abnormal. There were areas of fatty infiltration of the suprarenals, but this condition was not considered to be so marked as to interfere with normal function.
The pancreas measured 17 by 4 by 2 cm., which is slightly smaller than normal. The head was rather soft and had a greasy feel. The remaining portion of the pancreas was fairly firm. The cut surface showed the lobules to be distinct, and there was a slight ooze of blood from the vessels. Grossly, there appeared to be no malignant growth or tumors of any kind. Microscopic examination revealed that in some places the interstitial connective tissue was considerably increased. This increase occurred most frequently in the areas where the enlarged islands were located. In other places, the interstitial connective tissue was about normal. There was no evidence of tumor formation throughout five sections. A slight atrophy of the parenchymatous tissue existed near the head. This atrophy was associated with a slight increase of fat in the interlobular connective tissue spaces. The larger vessels showed considerable fibrosis, and an occasional duct was dilated.

The islands of Langerhans, although definitely enlarged, were not distorted, and the cells showed no degeneration. Certain areas appeared to show a hyperplasia. In one very large island, fatty infiltration could be seen. There was no fibrosis or lymphocytic infiltration. Sections, stained by van Gieson's method, revealed that fibrous tissue was apparent interlobularly, and in some places was increased. However, there was no fibrosis in or around the connective tissue of the islands.

Ten islands of Langerhans from the pancreas were measured and recorded in measurement: 375 by 225 microns; 360 by 390; 345 by 330; 345 by 270; 330 by 200; 315 by 225; 300 by 285; 300 by 210; 270 by 150; 240 by 225. The average size of the ten islands was 328 by 242 microns.

The size of the islands of Langerhans in the normal pancreas varies greatly. Lugasse suggests that islands over 200 microns in diameter are large. MacCallum found the normal average diameter to be 157 by 146 microns. Much larger islands have been noted in cases of diabetes by Cecil and others.

**Comment**

In this case, the relation of the marked retention of nitrogen and creatinine to the urinary and postmortem observations in the kidney indicated that the precipitating cause of death most probably was of nephritic origin. Just what part the hypoglycemia played in this condition is difficult to say, for it has been found that the blood sugar determinations in uremia tend to be on the high side of normal. This observation is confirmed by Kolnner and Boerner, who state that the blood sugar in uremia is from 0.1 to 0.2 per cent, while the normal is from 0.08 to 0.12 per cent.

It was not possible to establish any relation between the pancreatic changes and the observations on the urinary system. It would seem most probable that they had both been present for some time and were entirely separate pathologic conditions.

In view of the fact that postmortem examination revealed no other cause for the glycosenemia than the hypertrophy of the islands of Langerhans, with supposedly increased insulin production, we conclude that this was the etiologic factor in the hypoglycemia of our case. We believe that hypertrophy of the islands of Langerhans offers an explanation for some cases of chronic hypoglycemia, which generally are of long duration, show only mild symptoms, and are relieved by a diet high in carbohydrates. It is conceivable that periods of high sugar ingestion, or temporary abnormal functioning of a sugar regulating mechanism other than the pancreas, may provoke hypertrophy of the islands and bring about a hyperinsulinism which continues after the unusual stimulus has been removed.

**Summary**

Hypoglycemia appears to be due primarily to pathologic changes in the liver, endocrine glands or pancreas, and is seen in various diverse conditions. A case is presented which clinically appeared to be uremia with low blood sugar estimations.

Autopsy showed hypertrophy of the islands of Langerhans and nephritic changes.

It would seem that hypertrophy of the islands of Langerhans may be a cause for hyperinsulinism and hypoglycemia.

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**Intravenous Use of Extract of Liver**

**Maximal Responses of Reticulocytes from a Single Injection Derived from One Hundred Grams of Liver: Preliminary Communication**

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and

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In the early stages of the chemical fractionation of liver, begun in an effort to isolate the active principle effective in pernicious anemia, Cohn, Minot and their associates produced an active extract, the so-called fraction G, which could be readily prepared and was found to be eminently satisfactory in the treatment of pernicious anemia. Later Cohn, West and their respective associates produced numerous experimental fractions, which were given by mouth; but it was not until Cohn was able to prepare fractions which gave no specific protein reactions and which had no reducing effect on the blood pressure of animals that it was considered possible to administer the active principle intravenously to patients. After this stage of the work had been reached, Cohn, West and their respective associates prepared many potent fractions, which were injected intravenously into patients.

The methods of preparing fractions then regarded as suitable for intravenous use were technically difficult and sufficiently laborious to render it impractical to prepare more than the small amounts of experimental fractions utilized in the search for the active principle. With an entirely different objective, namely, to discover the least number of steps necessary to produce from liver a potent fraction that could be injected intravenously with safety, we have adapted to our practical

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29. Cited by Saphir, Otto: Changes in Liver and in Pancreas in Chronic Pulmonary Tuberculosis, with Special Reference to Islands of Langerhans, Arch Path 7: 1026 (June) 1929.
