since the operation and the patient is still vomiting, insulin should be given. When post-anaesthetic hydration is feared, intravenous glucose and subcutaneous oxygen should be administered rapidly, any excess of glucose being excreted by the kidneys. Pulmonary hydration is especially likely to occur after prolonged anaesthesia in a bad subject if the patient has recently received an injection of a substance with a large nucleus and high molecular weight, such as intravenous arsenobenzene or S.U.P. 36. Glucose and oxygen should therefore be given to all patients who are under treatment for syphilis.

A rough and ready test for determining whether the vomiting is due to splanchnic shock—caused by the precipitation of hydrated protein particles in the abdominal viscera—or to dehydration of protein particles, is to draw off some blood in a syringe. If the blood flows readily and is bright red the protein particles are probably hydrated, but if it flows with difficulty, clots rapidly, and is dark in colour the particles are probably dehydrated. It is most important to determine which condition is present, as the wrong treatment will only accentuate the disorder it is desired to remedy.

THE ORTHODOX ATTITUDE TO GLUCOSE.

Surgeons have recognized the value of glucose without, for the most part, understanding its action. The general tendency is to focus attention on ketosis, which is one of the by-products of shock, and to counteract it by giving glucose in the belief that it replaces the large quantities of sugar consumed in the state of shock or under anaesthesia. The empirical surgical attitude, which is correct within limits is well represented in Barrington-Ward's book *The Abdominal Surgery of Children*. The author rightly eschews purgatives and enemata, and provides the child on the day before the operation with a full diet and a bottle of barley sugar. A light meal and more barley sugar are given on the morning of the operation. When the operation is severe or the patient's resistance appears to be low, a 5 per cent. solution of glucose is given subcutaneously during the thirty-six hours before operation. Older children receive a 10 per cent. solution of glucose in water per rectum. In very anxious cases transfusion is performed and salines are injected during the operation. For the treatment of post-operative ketosis Barrington-Ward gives 10 per cent. glucose per rectum every four hours, or 5 per cent. glucose intravenously, preferably by Matas's drip method. His remarks on alkaline treatment are very interesting from McDonagh's point of view. Quoting the work of Brown and Graham, he says that sodium bicarbonate cannot be depended upon to reduce the acetone in the blood and urine, but is beneficial in producing a rapid return to normal of the low alkali reserve. Glucose, on the other hand, he remarks, causes a rapid diminution of the blood and urine acetone as well as a rise in the alkali reserve, and arrests the formation of ketone bodies. While advocating large doses of sodium bicarbonate as an adjuvant, he definitely gives it second place. The reason for the success of glucose is, of course, not that it substitutes missing sugar, but that it goes straight to the root of the trouble and dehydrates the protein particles. This is proved by the fact that other chemicals which cannot replace sugar, such as di-hydroxy-acetone and adrenaline, produce the same result.

THE TECHNIQUE OF GLUCOSE ADMINISTRATION.

Glucose solution, to exert its full effect, must be used within twenty-four hours of its preparation. I always use and recommend a 10 per cent. solution at a temperature of 100° F. Before an operation it must be given slowly, or it will rapidly be excreted by the kidneys. When it is administered slowly any excess is absorbed by the liver as glycogen and let loose into the blood stream in the form of glucose as required. If the patient's protein particles are already hydrated, the glucose can be given faster than when it is merely desired to increase the glycogen reserves.

The use of glucose at operations can be summarized as follows:

A. Always give glucose before a severe operation: (1) when the liver efficiency is suspected—for example, where there is a history of jaundice; (2) when the metabolic rate

is high—for example, in Graves's disease; (3) when the patient is undernourished or emaciated.

B. Always give glucose after a severe operation when a blood transfusion is impossible.

C. Give glucose after any anaesthetic: (1) where loss of blood has been heavy and blood transfusion is not practicable; (2) where the patient shows signs of shock—cerebral, pulmonary, or splanchnic; (3) where glucose has not been given before the anaesthetic; (4) where a rough surgeon has operated, or where it has been necessary to use more than the usual amount of anaesthetic; (5) where there is a history of epilepsy.

TRAUMATIC RUPTURE OF THE STOMACH.

BY

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In the *British Medical Journal* of July 27th Mr. F. Hector Scotson published two very interesting cases of rupture of the stomach alone, from external non-penetrating violence, which, owing to absence, I have only just seen. That this condition is very rare is evidenced by the literature on the subject from British sources which he has so ably collected.

It may be of interest to quote some extracts from foreign literature on the subject before recording a case under my care in 1927.

Rehn¹ in 1896 collected 13 cases, of which only 2 were uncomplicated. Only 2 recovered, including Rehn's own case.

A. Schwarz² in 1909 reported one fatal case in which both stomach and duodenum were completely torn through.

A. Piancastrelli³ in 1922 stated that only 22 cases of traumatic subcutaneous rupture of the stomach could be found in literature. In his case, the twenty-third, which proved fatal, the abdominal wall under the skin was ruptured and the stomach almost divided in half.

G. Ipsen⁴ quotes a case of his own in the same year, in which the rupture was in the pylorus, and the patient recovered.

H. Neuberger⁵ quotes a fatal case of his own in which there was also injury to the pancreas. He is of opinion that the grave prognosis in these cases is due to concomitant injury to the ganglion coeliacum, which lies dorsally to the stomach.

From this it will be seen that only 9 cases were of rupture of the stomach as the only viscus, and that only 3 recovered.

My own case, like those of Mr. Scotson, showed no signs of external injury, and was not complicated by injury to any other viscus.

A seaman, aged 29, was admitted to the Royal Naval Hospital, Malta, on January 27th, 1927, with a history of having fallen from a ladder and been struck in the lower abdomen by a piece of iron projecting about 12 feet below. He had had a full meal about one and a half hours previously. The patient, a very small, spare, and well-developed man, was groaning and doubled up. There were signs of shock, and the pulse was 92. There was no sign of any injury to the abdominal wall. The abdomen generally was held rigid, but was not board-like, and the patient sat up to take off a tight garment. There was no dullness in the flanks. The liver dullness was present, and there was no hyperaesthesia to pin reflex. Pain was referred to the lower abdomen and radiated down to the testicles. Clear urine had been passed twenty minutes before examination. He was suffering from marked shock, and groaning, with intervals of quiet.

In the absence of any marked physical signs I decided, wrongly as it turned out, to wait for further signs; after five and a half hours the pulse rose to 120, there were distinct signs of tympanites, and the leucocyte count was 15,300. He was therefore given a general anaesthetic, and the abdomen was opened by a right central paramedian incision. The peritoneal cavity was found to be full of turbid fluid. On swabbing this out it was found to be coming from the right upper quadrant. The incision was therefore extended upwards. A hole with everted mucous membrane, and easily admitting the forefinger, was found on the anterior surface and near the greater curvature in the pyloric end of the stomach. Its appearance was almost identical with the picture of this condition in Walton's *Surgical Dyspepsias*. There were no signs of any ulcer present. The gall-bladder was covered with a lymphatic exudate. The liver edge was bruised but not torn. There were no signs of injury to any other viscus. The burst was sewn with Lembert over primary deep sutures, peritoneal toilet performed, and a drainage tube was placed in the under surface of the liver.

The patient was almost pulseless at the end, and nearly died of shock, although the operation did not take long, owing to the patient's favourable build. Severe shock lasted for twenty-four hours, but was overcome by intravenous glucose saline. He

eventually made a good recovery and returned to duty. He was well and fit a year afterwards, when I last heard of him, and suffered no inconvenience.

In this case the shock, as compared with a case of perforated ulcer, was out of all proportion to the injury and the subsequent operative "manhandling," and suggests Neuberger's theory that in these cases there is usually some damage to the coeliac ganglion.

REFERENCES.

- ¹ *Die Verletzungen des Magens durch stumpfe Gewalt*, 1896. ² Über traumatische subcutane Rupturen des Magen und Darmkanals, *Deut. Zeit. f. Chir.*, 1909, xcv, p. 101. ³ Su di un caso di rottura sottocutanea traumatica dello stomaco, *Riforma Medica*, 1922, xxviii, p. 1038. ⁴ Ein Fall von contusio subcutanea cum ruptura ventriculi, *Norsk Mag. f. Laegevidensk.*, 1922, II, 7, p. 514. ⁵ Ein Fall von subcutaner Magenruptur, *Wien. klin. Woch.*, 1923, xxxv, p. 849.

AUTO-BLOOD-TRANSFUSION IN TWO CASES OF RUPTURED TUBAL PREGNANCY.

BY

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AUTO-TRANSFUSION, first used in Germany by J. Thies in 1914, appears to have found more favour in that country than in England or America. Reports received are, however, eminently satisfactory, and it is difficult to understand why the method is not more frequently adopted in cases of emergency, when much recoverable blood has been lost. Two cases illustrating its value are here recorded.

CASE I.

A woman, aged 36, who had been married eleven months, was admitted to the Royal Surrey County Hospital at 11 a.m. on June 14th, in a collapsed condition. No pulse could be felt at either wrist, and there was considerable dyspnoea. She was conscious. She had had amenorrhoea for two months, and had remained well until the evening before admission, when, at 8 o'clock, she was attacked with violent abdominal pain, diarrhoea, and vomiting. Thinking that the attack was due to some error of diet, her husband gave her castor oil, brandy, and gin. She spent the night in great agony, and fainted in the morning; arrangements were at once made to remove her to hospital. Her menstrual history had been normal except for dysmenorrhoea; she was cured at the age of 23 with some improvement, and there had been no dysmenorrhoea after marriage.

Operation.—The abdomen was opened and found to be full of blood, which was mostly fluid, but there were many large clots. Three pints of it were ladled out of the abdomen into a large jug; the larger clots were rejected, but many clots went into the jug. This blood, strained through several layers of gauze, was citrated and 1½ pints were transfused into a vein in the right arm by my colleague Mr. Steele. The left tube was found to be ruptured at the ampulla and was removed. The ovum was not seen. At the end of the operation the patient had a small but countable pulse, and by evening her condition had ceased to cause anxiety. Convalescence was smooth and uneventful.

No suitable donor was available at the moment, and I feel certain that the reinfusion is responsible for saving the patient's life.

CASE II.

A married woman, aged 38, with nine children, the youngest aged 1 year and 4 months. The last menstrual period ceased on October 5th, 1929. At 7 p.m. on October 29th she was taken with sudden severe abdominal pain, which continued throughout the night. She was admitted to hospital in a collapsed condition at 1.30 p.m. on October 30th, completely blanched; the pulse was just palpable, but not countable, and could not be felt at all during her preparation for operation, though it was just palpable at the wrist immediately before operation.

Operation at 2.30 p.m. under gas-oxygen anaesthesia. Three measured pints of blood were rapidly ladled out of the abdomen and put into a jug, being filtered through several layers of gauze. This was again filtered into another jug containing the appropriate quantity of the solution of sodium citrate, and from thence infused into a vein in the right arm by Mr. Steele, the infusion being finished at the same time as the operation. The left tube was ruptured in its middle portion and was removed; the ovum was not seen.

The patient went back to bed in good condition. There was very little coagulation of blood in the abdomen, and she must have recovered a very large proportion of the blood she had lost. There was no shock or reaction, and at 6 o'clock the same evening she was sitting up in bed with a good colour, talking to her neighbours, a little excited by her adventure, but otherwise none the worse. There has been no hitch in her recovery to date.

Presumably the dislike of reintroducing into the circulation blood which has been lying in the abdomen is due to the fear of sepsis or of the blood having acquired some toxic character secondary to coagulation. As a student I was taught that the raised temperature, which so frequently accompanies the process of absorbing blood which has been effused into the tissues, was due to the absorption of fibrin; but from the recent experiments of Horace Greeley,¹ it seems likely that the poisonous property is present, or also present, in the defibrinated blood, and is dependent on the disintegration of platelets. When there is no reason to suspect contamination, the danger of sepsis does not appear to be a large one, as no cases of septicaemia following autotransfusion have been reported. Burch² recommends that blood, even when known to be contaminated, should not be thrown away, but should be given as a rectal drip.

The fear that reinfused blood may have some toxic action is not confirmed by a study of the reported cases. Topler³ reports twenty-four cases of smooth recovery after reinfusion, in ruptured extrauterine gestation; similar success accompanied Burch's four personal cases. In the 164 cases reported in European literature (collected by Burch) there were only fourteen deaths, and of these only one (haemoglobinuria) could possibly be attributed to the toxic character of the blood reinfused. In only six cases was there a post-operative reaction. It may be that this immunity is due to the tendency of blood which has been effused into the peritoneum or pleura to remain fluid for a considerable time, thus enabling whole unaltered blood to be used for transfusion, any clots being strained off in the gauze without breaking them up. Two of Burch's cases were ruptured tubal pregnancies; another was a case of splenectomy, in which much blood had been lost, and the fourth a nephrectomy. Burch says (1923) that "two cases are reported in English literature, one by Dr. Ogilvie of Guy's Hospital, and one by Sampson of the General Hospital, Birmingham." Mention may also be made of the case reported by Devine and Kinsella (*British Medical Journal*, 1928, vol. ii, p. 568), in which auto-transfusion was successfully employed for traumatic intra-abdominal haemorrhage in a boy aged 12.

In a recent article by Lillian K. P. Farrar⁴ the early history of auto-blood-transfusion is traced from the first suggestion by William Highmore in 1874⁵ to two articles by Duncan⁶ in 1885 and 1886. In Duncan's second article he states: "I make it a practice in all larger amputations, because there is no risk and every ounce of blood is serviceable; . . . to my own mind the principle of reinfusing the patient is now definitely established." Nevertheless, the practice seems to have lapsed until it was reintroduced by Thies in 1914. Dr. Farrar kept sealed ampoules of sodium citrate solution in the operating room, ready for auto-blood-transfusion in cases of ruptured tubal pregnancy, but the frequent changes of personnel made it impossible to secure all the help required for the transfusion when the operation itself needed her entire attention. She concluded that the necessary team work could only be obtained by frequent practice of the technique in simpler cases, and arranged to try the measure in clean hysterectomies for myoma uteri. She was surprised to find the transfusion so valuable in these simpler cases.

Except in cases where large quantities of blood have accumulated in the abdomen, Dr. Farrar collects the blood by a suction apparatus. She points out that sponges should never be used, as the squeezing out injures the red cells, and, for the same reason, care is taken not to shake or stir the blood.

Dr. Farrar reports twelve cases, the last being especially dramatic. She says that the technique could not have been carried out in such a grave emergency if the staff had not been trained to team work in the simpler cases.

REFERENCES.

- ¹ Horace Greeley: *Proceedings of Staff Meetings of Mayo Clinic*, vol. iv, No. 22, May, 1929.
² Lucius E. Burch: *Surg., Gynecol. and Obstet.*, vol. 36, 1923.
³ B. Topler: *Deut. med. Woch.*, 1922, xlviii, 92.
⁴ Lillian K. P. Farrar: *Auto-Blood-Transfusion in Gynaecology*, *Surg., Gynecol. and Obstet.*, 1929, vol. xlix, p. 454.
⁵ William Highmore: *Lancet*, 1874.
⁶ Duncan: *British Medical Journal*, 1885, 1886.