Treatment

Routine treatment consisted of a low fat and high carbohydrate diet, glucose twice or thrice daily, and a small dose of magnesium sulphate in the early morning. When the skin became free from icterus, patients were allowed up and were put on ordinary diet. When vomiting was frequent, excellent results followed the administration, by intravenous drip transfusion, of a few pints of normal saline with 5% glucose. Nausea and abdominal discomfort, persisting during the icteric stage, were sometimes troublesome symptoms. Some degree of relief was obtained by the use of sodium taurocholate, 4 to 6 gr. in cachets. Alkaline powder was also useful. Calcium lactate is indicated in unusually prolonged cases. The majority of cases require a spell of convalescence: alcohol should be forbidden during this period.

Summary and Conclusions

A short clinical description of 168 cases of infective hepatitis is given. Two fairly distinct types of onset are recognized and described. It is emphasized that the subsequent clinical course is almost identical in the two types.

The average duration of icterus was 24 days; the icteric stage lasted from 15 to 35 days in just over two-thirds.

The liver was palpable in 50% of cases and the spleen in 10%. Gross hepatomegaly was associated with prolonged jaundice, and the larger the liver the longer was the duration of icterus.

The diagnosis in the pre-icteric stage is often difficult, and in many cases will remain uncertain until bile pigment appears in the urine.

Hippuric acid tests for liver function by the oral method were performed in 14 cases when icterus was at about its height during the first three weeks of jaundice. Evidence of impaired function was found in all cases.

Recovery of liver function (as measured by the hippuric acid test) appears to be slow in some cases. In the convalescent stage of the illness, when icterus had just disappeared from the skin but remained in the sclerotics, evidence of liver insufficiency was demonstrated in 19 (65%) of the 29 cases tested. Impairment of liver function in the convalescent stage occurred in mild, average, and severe cases, and bore no constant relation to the presence or absence of hepatomegaly.

Evidence of liver insufficiency after total disappearance of jaundice was demonstrated in 4 cases.

Six cases with a history of one or more previous attacks of the disease are mentioned. Second attacks appear to be no worse than the first. The results of hippuric acid tests performed in 4 cases showed little or no evidence of residual liver insufficiency.

I wish to thank Col. H. D. F. Brand for permission to publish these cases, and Capt. A. D. Morgan, R.A.M.C., for help with the hippuric acid tests.

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P. Freud, G. D. Rook, and S. Gurian (*Amer. J. Dis. Child.*, 1942, **64**, 895), who report a case in a female infant aged 3 days, state that there are only five cases on record of herpes zoster in the newborn. Trauma and toxins could be excluded, so that an infectious origin was very probable. As in the other cases of herpes zoster in infants, evidence of pain and discomfort was absent. Complete healing took place in six weeks and there was no scarring.

THE SIGNIFICANCE OF BLOOD-PRESSURE READINGS IN GENERAL SURGICAL WORK WITH SPECIAL REFERENCE TO THE CARDIAC INDEX

BY

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Blood-pressure readings have been made before, during, and after general surgical operations in my practice since 1932. They have proved to be valuable and instructive. They were started with the need to detect and counteract the marked falls of blood pressure that occurred during spinal anaesthesia, and were used in the search for further aids in the detection of poor surgical risks with a view to excluding the necessity for the explanation "the operation was successful, but unfortunately the patient died" (Dodd, 1940). This note attempts to assess the significance of blood-pressure readings in general surgical work in the light of this experience.

Before Operations

The Cardiac Index.—It was from Mr. Ernest Miles that the significance of the Moot-McKesson cardiac index was learned. This estimation is more widely known than formerly, but it is seldom taught, and, because of this, when it is mentioned it meets with some scepticism. The cardiac index is estimated as follows:

The normal systolic blood pressure is 120 mm. Hg and diastolic 80 mm. Hg, the difference—the pulse pressure—being 40 mm. The cardiac index is reckoned by working out the percentage fraction which results by placing the pulse pressure as numerator over the diastolic pressure as denominator. Ordinarily the pulse pressure is 40 and the diastolic pressure 80, giving a fraction of $\frac{40}{80} = 50\%$.

The Significance of the Cardiac Index.—Clinical experience has shown that patients with a cardiac index between 33 and 80% are fair surgical risks, between 80 and 100% and between 25 and 33% they are doubtful and poor operative risks, while above 100 and below 25% no surgical procedure is safe: Miles said that opening a whitlow in such a patient is likely to prove fatal. This cardiac index has proved of assistance in the selection of patients for operation, and also after operations, when the blood pressure has been measured and serious disturbances found. It indicates the need for measures to improve the tone and fill the cardiovascular system—necessities that might otherwise be overshadowed by the problem of surgical diagnosis and the operation. Clinical improvement almost invariably follows these remedies, especially in elderly people, in whom the blood pressure is often around 140/70, giving a cardiac index of 100%. Pre-operative rest in bed for one, two, or three weeks, with a fluid intake of 6 to 8 pints daily and cardiac tonics, approximates these figures to, say, 130/80, and major operations have then been undertaken with consistently uneventful convalescences.

The opinion at present held as a result of these studies is that the blood-pressure figures in themselves mean little: it is the relation of the diastolic and systolic which matters—i.e., the cardiac index; a high or a low systolic blood pressure between 100 and 200 mm. is immaterial to the surgeon considering a major operation so long as the cardiac index is around 50%. Actually, in a period of ten years, during which the blood pressure of all new surgical out-patients has been taken, a systolic pressure of over 180 or lower than 100 has been rare in adults.

Condition of Heart and Blood Vessels

The taking of the blood pressure, apart from yielding the systolic, diastolic, and cardiac index values, gives good data concerning the regularity or otherwise of the heart-beats and, by the strength of the beat, the quantity of the heart output. These features, when noted with the stethoscope over the artery at the elbow, arrest the observer's attention more certainly than the routine clinical examination of the heart and pulse. Considerable variations in regularity and size of the pulse are detected, and the systolic and diastolic readings also sometimes

vary from hour to hour and from day to day, denoting cardiac and vasomotor instability.

Sometimes when the diastolic pressure is being read it will be found that the arterial murmur continues until the pressure in the armlet is zero; this is interpreted as denoting aortic incompetence or a sclerotic or spastic artery, which is a further factor for consideration by the surgeon in a contemplated major operation on an elderly subject.

Illustrative Cases

Case 1: Coronary Thrombosis, ? Acute Abdomen.—A man aged 44 was admitted with an acute abdomen; the diagnosis was obscure: ? an acute gall-bladder, ? an acute appendix, ? an acute pancreatitis—certainly something "unusual." He was a stout, plethoric person. The blood pressure was 140/70, giving a cardiac index of 100%. In view of the uncertain diagnosis and the cardiac inefficiency, no immediate operation was proposed. The next day the picture was still confused; the blood pressure was 100/80, and a coronary thrombosis was considered. Operation was out of the question. Dr. Geoffrey Bourne agreed with the cardiac diagnosis. After a stormy period the patient recovered.

Case 2: Heart Efficient; Gangrenous Cholecystitis.—A man aged 69 was seen with apparently acute cholecystitis and colic. Five years before a partial gastrectomy for cancer of the stomach had been performed. The question was, "Was this a case of gall-stones or a metastasis obstructing the biliary apparatus?" He was in good condition; the blood pressure was 140/85 (cardiac index 64%). Operation was performed forthwith, and a gangrenous gall-bladder obstructed by a stone removed. He made an uneventful recovery.

Case 3: Auricular Fibrillation; Gall-stone Colic.—A woman of 67 was admitted with acute gall-stone colic. The question of immediate operation was excluded when the blood pressure revealed a fibrillating heart and figures of 140/60, giving a cardiac index of 133%. The patient was rested for four weeks. The blood pressure improved to 135/80 (cardiac index 68.75%), and a large stone was removed from the common bile duct. Although the operation was done under a local anaesthetic she had a stormy convalescence with four days of persecution delirium, and the fibrillation returned, but ultimately she recovered.

Case 4: Auricular Fibrillation, Gall-stones, and Jaundice.—A business man of 65 had had gall-stone colic and jaundice shortly before being seen. Operation was needed. His blood pressure was 120/50 (cardiac index 140%). The pulse was irregularly irregular, and there was considerable variation of the output at each systole. The heart was fibrillating. Rest in bed for nearly three weeks restored regularity, and the pressure improved to 140/80. Cholecystectomy and exploration of the common bile duct were performed. Convalescence was uneventful, and in spite of strenuous work (iron and steel trade) no further cardiac irregularity has been noted in five years.

Case 5: Diabetic Gangrene.—A woman with diabetic gangrene of the foot, and a blood pressure of 110/50 (cardiac index 120%), was undergoing amputation above the knee under open ether anaesthesia. She died on the table.

Case 6: Diabetic Gangrene.—A physician friend, J. B., related the following: A patient had diabetic gangrene of the foot. Immediate amputation was advised. The relatives asked for a physician's opinion. "My intuition," he said, "was that she was not fit enough then for the operation, but I could find nothing definite to back up my feeling, when I remembered the cardiac index. The blood pressure was 120/55, giving an index of well over 100%. I explained this to the doctor and surgeon, and they agreed to the delay. And she hasn't died," he concluded.

Case 7: Carcinoma of Stomach.—A man aged 66 was seen in consultation for indigestion which was clearly due to carcinoma of the stomach. He looked reasonably well, and energetically discussed the operation, its cost, time, place, etc. His blood pressure was 60/50 in the left arm and 70/60 in the right. I was puzzled as to the significance of this finding in an apparently fairly normal man. The usual pre-operative rest, transfusion, fluids, etc., were advised. He died suddenly that night.

Case 8: Varicose Veins.—A busy housewife had gross varicose veins. The operation of ligature and injection was advised. Her blood pressure was 140/70. She was rested two days, but it remained 140/70-80, giving a cardiac index of about 100%. Circumstances pressed for early operation, and as the procedure was small and was to be done under a local anaesthetic it was performed, although with uneasiness concerning the cardiac efficiency. She ran a high temperature after operation, and the pyrexia continued for several weeks, with malaise and a small pulmonary embolism as indicated by pain, cough, and blood-stained sputum.

Such has been our unsatisfactory post-operative experience when the cardiac index was less than 33 and over 85%: some complication develops—e.g., abdominal distension, chestiness, pulmonary embolism, delirium, strangeness of manner,

or sepsis. When the fundamental cardiac weakness is recognized and is treated by pre-operative rest in bed, a fluid intake of 5 to 6 pints daily, and gentle cardiac tonics—given orally, seldom by injection—these incidents are avoided. When the cardiac defect is found after the operation, then attention is focused on the cardiac and vasomotor condition, while local treatment to the operation area—e.g., meteorism—becomes a secondary consideration. Heart stimulants are given orally, not by injection, to feeble and aged subjects, because in the early days of this study two patients (aged 65 and 67) with carcinoma of the stomach who were being prepared for operation with nikethamide (coramine) 1 c.cm. subcutaneously t.d.s. died suddenly from cerebral embolism. It was considered that a thrombus had passed out of the left auricular appendage into the systemic circulation.

Blood-pressure Readings During Operations

The Anaesthetic.—By taking the blood pressure every five minutes during operations surprising falls and variations have been found, irrespective of the type of procedure, whether major or minor. They occur with all sorts of anaesthesia—a statement based on thousands of readings during the period 1933-43 (Dodd, 1940). The variations in pressure are wide during spinal anaesthesia, somewhat less with general anaesthetics, and much less with local infiltration of novocain or amethocaine hydrochloride (decicain). The progress of the blood pressure is unpredictable. A severe fall in blood pressure is not regarded as an indication of shock, but, taken with other factors, it is helpful.

Blood-pressure-raising Agents.—Remedies directed to the restoration and maintenance of the blood pressure around normal have lessened the post-operative morbidity and also the mortality. Certain drugs have been proved as pressor agents, particularly pholedrine (Dodd, 1942) and methedrine (Dodd and Prescott, 1943), and 30% hypertonic saline 20 to 40 c.cm. (Walker, 1936). Cardiac tonics such as nikethamide, leptazol (cardiazol), digitalis, strychnine, etc., have no pressor effect, while by contrast that of adrenaline and icoral is too violent for clinical use.

Position of Patient on Operating Table.—This affects the blood pressure. When the bridge of the operating table is raised for gall-bladder and kidney procedures a steady fall in pressure ensues, but with the lowering of the bridge the blood pressure recovers. This bridge is painful to patients: pneumatic pillows are more comfortable. Sudden changes from the Trendelenburg to the horizontal position also cause falls in pressure; lifting from the table to the ambulance and thence to the bed is also associated with a fall, which is considerable and recovers but slowly after major procedures.

The Operative Procedure.—Exploration of the abdomen and palpation of the common bile duct are nearly always followed by a fall in blood pressure, and in some cases with weakening and temporary irregularity of the pulse. With a well-planned local and regional infiltration this is largely eliminated. Pulling on the mesenteries or parietal peritoneum to close the abdomen causes a similar fall, as also does packing the intestines into the abdomen. Manipulation of the renal pedicle affects the pressure adversely, while in a radical breast operation the pressure is continuously low, with limited response to the usual dose of pressor drug.

Pentothal during Operation.—The interesting fact was noted that if pentothal in 5-10% solutions (say, 3-5 c.cm.) is injected quickly a prompt fall in blood pressure occurs, which gradually recovers as the respirations strengthen. The safe rate of injection is 1 c.cm. per half-minute.

Death on the Table.—Death on the operating table is an abrupt shock to a surgical team. Only one death has occurred on the table (from a ruptured thoracic aneurysm) when pressure observations were being made. One assistant said that patients "never look like dying" when such readings, and the necessary corrections, are made. With regard to conventional operations without pressure observations, there readily come to mind three deaths on the operating table which were first detected by the surgeon.

Post-operative

Choice of the Remedy in Collapse.—Taking the blood pressure gives an indication of the remedy required by a patient. Thus

a man may be cold and somewhat cyanosed, with a weak pulse, yet the blood pressure be within normal limits. This patient's need is a cardiac tonic such as nikethamide plus oxygen. On the other hand, the pulse may feel average but the blood pressure is below 80 mm. Hg; here a pressor agent is required. Observers who have taken thousands of pressure readings constantly report such findings, and also their inability to estimate the blood pressure by palpating the pulse.

A male, 24 hours after a three-quarter partial gastrectomy for a large gastric ulcer and a duodenal ulcer, collapsed and became unconscious. His respirations were 48 and forcible, the pulse was 160, but the heart-beat was regular and sounded strong at the apex. The blood pressure was 80/60 (cardiac index 33%) and his nails were white. In this case oxygen and a pressor agent to restore the blood pressure were necessary. Both were given, and in five minutes consciousness was regained and recovery followed. The conventional cardiac tonic would probably have been ineffective.

Another finding is that of simultaneous cardiac and pressure weakness or failure. The pulse is feeble and irregular and the pressure low. A combination of nikethamide or leptazol 1 c.cm. and pholedrine 1 c.cm., given together intramuscularly, yields a powerful effect.

Fluid Loss.—Should there have been a considerable loss of fluid, as after gross injuries or extensive operation, then an infusion of blood or plasma is necessary to fill up the circulatory system. Stimulants or saline will not act in this capacity: in fact, continuous saline is harmful to shocked patients because the body has no storage facilities for salt-and-water, which waterlogs the bases of the lungs.

Post-operative Observations.—Post-operative observations of the blood pressure are important after the use of spinal anaesthetics and after the shock-producing procedures. Low readings are found up to four days after operation. Response to pholedrine or methedrine or intravenous hypertonic saline is prompt.

Summary

The Moot-McKesson cardiac index is described and its value indicated in major operations.

Some factors affecting the blood pressure at operations are described.

After operations, the need to give primary attention to the cardiovascular system rather than to the operation area is emphasized.

The help available from blood-pressure readings in the choice of the correct remedy is described.

Continuous intravenous infusions of saline post-operatively in shocked patients are deprecated.

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CONTINUOUS ADMINISTRATION OF INTRAVENOUS ANAESTHESIA

A SIMPLE METHOD

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In view of the increasing popularity of intravenous anaesthesia and the growing number and complexity of devices (Semans, 1941) for its administration, we would like to place on record a method which we have been using at the Middlesex Hospital for more than two years. It is simple to carry out, gives accuracy of dosage, and is economical in materials.

The Apparatus

This is a positive-pressure drip saline infusion apparatus (Fig. 1), consisting of a saline reservoir, drip-bulb and tubing, glass aspiration indicator, needle, and a means of providing positive pressure.

1. **Pressure.**—This is provided as follows: (a) *By a hand bulb*—e.g., of a sphygmomanometer or Higginson's syringe. A clip is often needed to prevent leakage back through imperfect valves. (b) *By an oxygen cylinder.* A Y-tube is connected in the tubing

from the reducing-valve of an oxygen cylinder to the flowmeter. The remaining arm of the "Y" is joined to the shorter tube of the saline reservoir. By restricting the flow from, say, 4 litres a minute to 2 litres, by means of a screw-clip on the tubing which

FIG. 1

leads to the flowmeter, enough pressure is built up to drive over the saline (Fig. 2). The 2 litres a minute from the flowmeter can be administered to the patient via a nasal catheter, B.L.B. mask, or in combination with nitrous oxide from a Boyle machine.

FIG. 2

2. **Saline Reservoir and Rubber Stopper.**—(a) The Baxter vacoliter screw-topped saline-bottle has the advantage that it is squat and not easily overturned, and the screw top cannot be blown off. (b) Any bottle in which sterile saline for intravenous use is supplied can readily be adapted by fitting a suitable-sized rubber stopper with two holes through it. Two tubes—metal, to prevent breakage—are pushed through the rubber stopper. One of these reaches almost to the bottom of the container; the other ends above the surface of the saline.

3. **Drip-bulb.**—A Murphy or similar drip-bulb is attached to the longer of the two tubes by rubber tubing; a clip on this regulates the flow of saline.

4. **Rubber Tubing.**—The latex type of tubing is the most satisfactory, as air bubbles can be seen through it.

5. **Glass Connexion.**—Apart from joining the latex tubing to the pressure tubing, this will show if blood had diffused back along the tube when the needle was introduced into the vein. If the connexion remains free of blood, only that part of the apparatus distal to it need be sterilized or changed between cases.

6. **Pressure Tubing.**—This is used as it withstands repeated needle puncture without leaking. It should be about 4 to 6 in. in length.

7. **Aspiration Indicator.***—This is a short straight glass tube with a small bulb blown in its centre. There are two metal mounts—one to fit a needle, and the other to fit a Record syringe. The indicator can first be used between syringe and needle (Fig. 3) when

FIG. 3

the induction dose is given. The aspiration test of the position of the needle can be performed without contaminating the syringe with blood. The indicator is then removed and fitted between the pressure tubing and a larger needle.

8. **Needle.**—A short-bevel size 1 (Record) about 1½ in. long is quite large enough (equivalent to about 4 or 5 serum needle).

9. **Arm Splint.**—A piece of wood about 4 in. by 1½ in. by 4 ft. is padded for half its length. Two domette "tails" are attached to the padding to fix the arm in place.

10. **Tourniquet and adhesive tape** are also required.

Technique

Pressure is raised in the saline reservoir and the regulating clip opened, allowing saline to flow until all air bubbles are removed. The clip is closed, and the level in the drip-bulb is adjusted by the clip on the side tube. The patient is then induced, using up to 0.5 g. of 5% pentothal solution in a 10-c.cm. syringe. For ease of venepuncture and the patient's comfort use the aspiration indicator and a fine needle (Vann Bros. "evipan" size) (Fig. 3). The

* Also known as "varicose vein amount"; obtainable from John Bell and Croyden Ltd.