unhonoured but are not debarred from practice, in which, if they have a good sales personality, they may be financially successful.

With the advance of technical surgery to the undertaking of feats of greater and greater difficulty, needing not merely the highest technical skill and anatomical knowledge but the design of a plan embracing the whole pre- and post-operative period to eliminate risks that have brought disaster in the past, the difference between the results of the expert and the would-be expert is increasingly apparent. To-day there is nothing to prevent any surgeon on the staff of a hospital—indeed, any man who has secured a legal qualification to practise—from attempting to pin the neck of a femur, resect a carcinoma of the oesophagus, remove a tumour of the brain, or tie a patent ductus arteriosus, without any more valid qualification for the task than boundless self-confidence and a cursory perusal of an article in one of the journals. The system has in the past produced some brilliant surgical freelances; it has also filled innumerable graveyards.

It seems inevitable, in a world where the rights of the individual will be acclaimed in a universal charter, that the individual who is sick must be assured of a service that is, at any rate, above a datum line of adequate competency. It would be folly in the extreme to attempt to limit surgical enterprise by setting certain standards of orthodoxy which must be followed by all. But it would be less than justice to the patients for whom we stand responsible to allow free rein to the enterprise of the type of surgeon known as courageous—courage in this context meaning willingness to face any risk so long as it is borne by the patient. We must insist that no man shall undertake any of the more hazardous operations till he has been trained for it by apprenticeship in simple tasks, till he has studied its steps in the clinics of acknowledged masters, and till he has practised it under supervision.

The pyramid of responsibility must be the key to our surgical organizations—not the hard and static Pyramid that stands on the Nile as a monument to past oppression, but the human pyramid that forms the finale at the circus, where the man at the top, who is usually the father, is hoisted up and supported by a willing phalanx below, where he feels the stresses of each member transmitted to him and encourages or chides as the performance of the night demands, but where, at the end, he brings all forward to take the bow.

AN OUTBREAK OF HEPATITIS IN A DIABETIC CLINIC

BY

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From Jan., 1943, until Jan., 1945, 63 diabetic patients attending the clinic at the Royal Hospital, Sheffield, have been diagnosed as suffering from hepatitis. The clinic supervises approximately 450 patients of all ages; elderly females preponderate.

Prodromal Symptoms

Anorexia, loss of weight, and vomiting were often encountered. Vague abdominal pains set a diagnostic problem until the full clinical picture developed. Tingling of fingers and neck rigidity may have been early neurological manifestations (Lescher, 1944). Enlargement of the liver, with tenderness, was noted in 30 patients. The organ was firm, the edge blunted and tender. Splenic enlargement was evident in three patients. In one the spleen was felt 2 in. below the costal margin; in the other two the tip could be felt. Two patients showed macular skin rashes 24 hours before the jaundice appeared and 11 had stiffness of joints.

TABLE I.—*Duration of Prodromal Symptoms before Appearance of Jaundice*

No figures available	8 patients
1–3 days	4 „
4–6 „	7 „
7–9 „	18 „
10–12 „	9 „
13–15 „	8 „
16 days and over	9 „

TABLE II.—*Clinical Features in 63 Patients*

Enlargement of liver	30
Enlargement of spleen	3
Anorexia	53
Loss of weight	47
Vomiting	38
General malaise	14
Stiffness of joints	11
Fever	6
Diarrhoea	6
Pruritus	3
Macular rash	2
Tingling in fingers and neck rigidity	2
No symptoms	2

Course and Complications

Immediate complications occurred in a number of cases owing to the sudden disturbance of carbohydrate metabolism. The disturbance was akin to that seen in diabetics suffering from any infectious disease. The lowering of carbohydrate tolerance and ketosis occurred mainly in younger people, and were temporary. Insulin had to be increased and the diets altered to suit patients who had no desire for food.

Another complication was acute atrophy of the liver. Two patients died from this. One patient showed acute shrinkage of the liver one day after the jaundice became manifest. She recovered, but the severity of the diabetic state has permanently increased, and instead of 60 units of insulin she now requires 120 units. Apart from this she has kept well for the last 18 months.

Delayed complications occurred in 8 cases. They were associated with the persistence of the jaundice for some time and the transition from acute to chronic hepatitis. Two patients died. The 6 who are alive are in various stages of ill-health.

TABLE III.—*Deaths and Cases of Chronic Hepatitis*

Case	Age	Duration of Jaundice	State of Health
1	27	7 days	Died. Acute yellow atrophy (confirmed at P.M.)
2	56	16 „	Died. Subacute atrophy (confirmed at P.M.)
3	73	240 „	Died 300 days after onset of jaundice. Cirrhosis of liver. No P.M.
4	64	90 „	Died 110 days after onset. Cirrhosis of liver (confirmed at P.M.)
5	62	180 „	Severe ascites; 190 pints removed so far
6	67	90 „	Liver no longer palpable. Anorexia. No free fluid
7	65	300 „	Liver 1 in. below costal margin. Anorexia
8	65	105 „	Liver no longer palpable. Liver function tests remain abnormal. Feels quite well
9	67	120 „	Liver 2 in. below costal margin. Anorexia
10	58	110 „	Anorexia; backache. Liver small and nodular (confirmed at laparotomy). Ascites and oedema of legs absorbed

Patients suffering from chronic hepatitis showed little disturbance of carbohydrate metabolism. They all required small doses of insulin before the onset of hepatitis, and continued with them afterwards. There was neither ketosis nor excessive glycosuria.

There appears to be a relation between duration of jaundice and failing liver function. There is also a direct relation between the age groups and the duration of jaundice.

TABLE IV.—*Age and Duration of Jaundice*

Age	Duration in Days									
	10	20	30	40	50	60	70	80	90	100+
–9	1									
10–19		1	1							
20–29	1		1	1	1	1				
30–39		1	2	2						
40–49			4		1	2				
50–59		4	3	3	2		1	1		
60–69		1	2	3	5	2	1	1	2	6
70+			2	2			1			1

In 49 cases jaundice cleared in under 2 months, with an average duration of 33 days. Six patients in whom the jaundice lasted for 3 to 8 months have apparently recovered completely, 6 are still ill, and 2 died after 300 and 110 days' illness respectively.

It is noteworthy that all the chronic hepatitis cases and all but one of the deaths occurred in persons over 55 years of age. The age and sex incidence of cases (Table V) shows a preponderance of older patients, and it is possible that age as well as diabetes played a part in producing the high incidence of fatalities and chronic hepatitis.

TABLE V.—*Age and Sex Incidence*

Age in Years:	0–	10–	20–	30–	40–	50–	60–	70–	80+	All Ages
Male ..	1	—	4	3	2	—	6	1	—	17
Female	1	2	3	3	4	13	16	3	1	46
Total ..	2	2	7	6	6	13	22	4	1	63

Method and Spread of Infection

The cases of hepatitis might have been due to infective hepatitis spreading by contact among patients attending the clinic or to homologous serum hepatitis (Ministry of Health Memo, 1943) spread by syringes used for collecting blood. Certain data are presented and analysed in order to investigate these possibilities.

Organization of the Clinic.—It has been the practice of this clinic to let the patients attend periodically. They arrive in the fasting state in a large out-patient hall, and sit on benches, which are usually overcrowded on clinic mornings (60 to 70 patients may attend). They queue slowly to have their weights recorded and then have venous blood drawn for blood-sugar estimations. The sister in charge of the collection of blood draws it, using a fresh needle on each patient. The needles are boiled for 20 minutes. The syringes are never boiled, but are kept in spirit and rinsed in sterile water before use. The patient returns to the out-patient hall, perhaps getting some tea from the buffet, has his breakfast, and awaits the medical interview. Thus there were opportunities in the clinic for spread either by contact or by syringes.

Monthly Incidence of Cases.—Table VI shows the number of cases occurring in each month from Feb., 1943, to Dec., 1944. The incidence increased in June, July, and Aug., 1943, decreased during the next three months, and rose to a sharp peak in Dec., 1943.

TABLE VI.—*Monthly Incidence of Cases*

	J.	F.	M.	A.	M.	J.	J.	A.	S.	O.	N.	D.	Total
1943 ..	—	2	1	1	3	5	6	6	4	4	3	11	46
1944 ..	2	—	1	1	2	2	1	3	3	—	—	2	17

Owing to the irregularity of attendance, and consequently of contacts between cases, no conclusions as to the method of spread of infection can be drawn from the monthly incidence.

Contact Between Successive Cases.—The possibilities of contact between cases were studied on a chart of attendances at the clinic. It was assumed that cases were infectious during a fortnight before and a fortnight after the onset of illness. In 7 cases the incubation period might have been 20 to 40 days, and in 23 others it might have been 41 to 120 days. In 4 cases the incubation period might have been either 20 to 40 or 41 to 120 days. Thus 11 cases could be accounted for on the basis of the 20–40-day period found in infective hepatitis, and 23 cases on the 41–120-day period found in homologous serum hepatitis. The latter number might have been increased by assuming a longer period of infectivity in the infecting case. Thus, in just over a third of the cases there was a possibility that the incubation period was that which usually follows parenteral administration of icterogenic serum (Havens, Paul, and van Rooyen, 1945). On the other hand, there were 7 cases in which the incubation period might have been 20 to 40 days, and it is impossible to dismiss completely the idea that some of the cases may have been due to contact-spread of infective hepatitis.

Similar conclusions are suggested by two instances of apparent spread to contacts who did not attend the diabetic clinic.

1. Girl aged 17, admitted in pre-coma. Jaundice appeared next day. A nurse in charge of this patient came down with a sharp attack of hepatitis 30 days later; it lasted three weeks. The nurse had a bad relapse lasting several months.

2. Man aged 26, admitted with hepatitis and ketosis. His wife developed jaundice 51 days later.

The incubation period in the first case suggests that the disease was infective hepatitis, while the second is perhaps another instance of the long incubation period occasionally observed in the contacts of cases of homologous serum hepatitis (Propert, 1938; Beeson, Chesney, and McFarlan, 1944; Neefe *et al.*, 1944).

Two patients were possibly infected at home.

1. Mrs. A., aged 66; lives with her married daughter. Her son-in-law had jaundice in mid-June, her daughter in early August, she herself 27 days later.

2. Mrs. B., aged 63; nursed her daughter, who had jaundice. She developed it 56 days later.

Mrs. A.'s was almost certainly a case of infective hepatitis, while Mrs. B. might have been infected by a missed case at home or by contact or syringes in the clinic.

The epidemiological picture of this outbreak was complex, and it appears that both contact and syringe transmission occurred. There were no instances of second attacks to suggest the activity in this epidemic of two immunologically distinct icterogenic agents, and the data available suggest an identity rather than a difference between the agents of infective hepatitis and homologous serum hepatitis. This may, however, apply only to the present epidemic, because other workers have recorded data suggesting differences between the agents (Witts, 1944; Beeson, Chesney, and McFarlan, 1944).

Discussion

Graham (1938) published the first account of an epidemic of jaundice in a diabetic clinic. He saw 28 cases in two and a half years. Overcrowding, considered one of the important contributing factors, was abolished and the epidemic quickly subsided. Cameron (1943) and MacCallum and Bradley (1944) showed that the virus of infective hepatitis could be transmitted by intravenous injection of icterogenic serum taken from a case during the pre-icteric stage and the early days of the jaundice. The present epidemic occurred at the time of a high incidence of the disease among the general population. There was also some overcrowding, which was intensified by the queueing for weighing and bleeding. As the blood was collected in syringes which were not boiled, it is possible that small amounts of infective material might contaminate the needles (MacCallum and Bauer, 1944; Cameron, 1943; Salaman *et al.*, 1944). The sister in charge of bleeding also gave injections at the V.D. clinic. There was no transfer or exchange of syringes between the two clinics, which are in different parts of the hospital.

In view of the possibility that infected syringes were the cause of the epidemic, all routine blood-collecting was stopped after Sept. 1, 1944, and only special cases were bled. The number of blood samples was thereby reduced from 50–70 to 5–8. The technique of drawing blood has not been changed. Since then only one case has appeared after an interval of 93 days. With the abolition of routine blood-collecting, overcrowding also diminished and, one supposes, the coincident droplet infection with it. There was less waiting and queueing, and the patients did not stay quite as long, because they took their breakfast at home.

The unusually high death rate and incidence of chronic cases compared with other outbreaks compels one to consider whether dietary factors came into play (Cullinan, 1939; Snapper, 1941; György and Goldblatt, 1942; McLean, Ridout, and Best, 1937; Aylward and Holt, 1937).

Since the advent of the slow-acting insulins the diabetic diets have been steadily increased. The diets used at this clinic are not high-carbohydrate diets in the strict sense. According to severity, age, and occupation, 120 to 200 g. of carbohydrate is taken each day. The diabetics who contracted jaundice had made use of their special meat and fat rations. They received 70 to 100 g. of protein and 100 to 150 g. of fat. Family rations were encroached upon by all the patients questioned. There is, in fact, no evidence to show that in these diabetics liver damage could be caused by dietary restriction or excess alone. On the other hand, there seems to be no doubt that insufficient diets may protract and aggravate liver damage caused by hepatitis. In the elderly diabetics who developed chronic hepatitis food intake had been poor and nutrition had suffered accordingly.

Summary

An outbreak of hepatitis in a diabetic clinic extending over two years and involving 62 patients is described. There were 4 deaths, and 6 patients were left with evidence of residual liver damage.

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TRANSMISSION OF INFECTION DURING WITHDRAWAL OF BLOOD

BY

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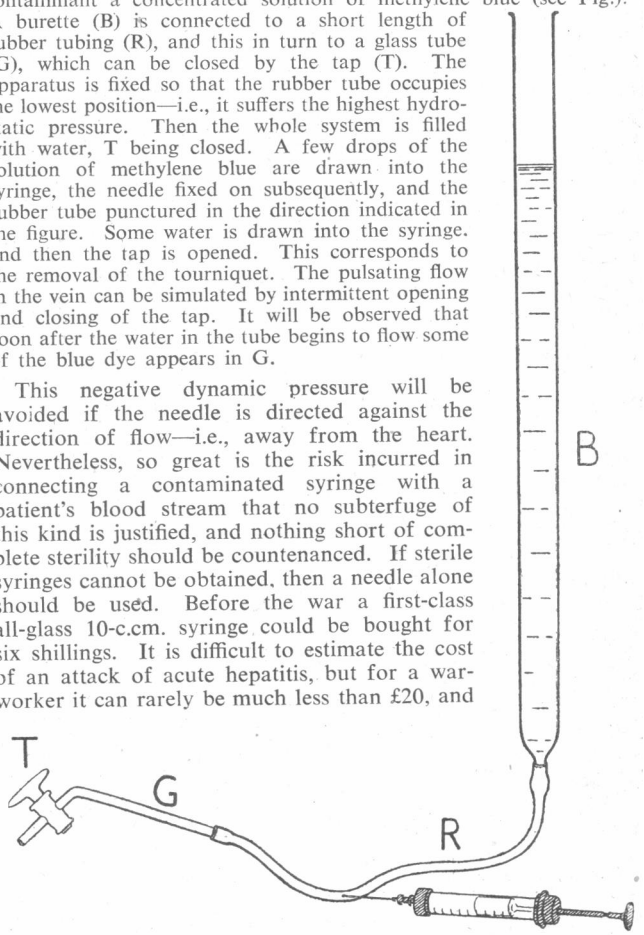
It is now generally realized that jaundice may be transmitted by syringes used for intravenous therapy if the syringes are merely rinsed with sterile water between cases and not sterilized by heat. Bigger (1943) showed that it is extremely difficult to sterilize a syringe by rinsing it even with antiseptics, and Salaman and co-workers (1944) reduced the incidence of jaundice in a V.D. clinic to vanishing-point by using properly sterilized apparatus for each individual patient. It is not so generally appreciated that there is almost equal risk of transmitting disease by syringes used for venepuncture. Sheehan (1944) attributed a long-drawn-out epidemic of jaundice in a sanatorium to transmission by the syringes used for taking blood for erythrocyte sedimentation rates, and in the present number of the *Journal* (p. 623) Droller records an outbreak of jaundice in a diabetic clinic which appears to have been in large part due to transmission by the syringes used for obtaining venous blood for estimation of blood sugar.

The orthodox method of taking a venous blood sample with a syringe consists in first placing a tourniquet on the upper arm to produce venous distension and then puncturing a vein at the bend of the elbow, inserting the needle in the direction of the heart. Blood enters the syringe under pressure from the vein, and a sample is taken by gently withdrawing the plunger. When the desired amount is collected the tourniquet is released and the needle withdrawn from the vein. Throughout the procedure direct contact with the vein is established by means of the sterile needle only, and since during the whole operation the pressure in the vein has been higher than that in the syringe it is assumed that no flow of blood can have taken place from the syringe into the vein.

In Droller's clinic the same syringe was used for all the patients bled on any one morning. It was washed out between cases and the needle was changed. It may appear strange that infection should have occurred through the syringe, though there is obviously a possibility that, unless great care is taken in changing needles, some of the contents of the wet syringe may be forced up the lumen of the needle and contaminate the point. But even if every precaution is taken in fitting the needle, some of the contents of the syringe not only can but *must* be discharged into the patient's vein during the venepuncture, and therefore material must inevitably be transmitted from one patient to another if the syringe is communal and unsterilized. This can very easily be proved by deduction or experiment.

The hydrostatic pressure of a fluid is equal to the actual pressure only if the fluid is at rest. Apart from its hydrostatic pressure, a fluid in motion exerts also a *dynamic* pressure, which depends on the speed and the direction of flow and which can have positive and negative values. In venepuncture the tourniquet must be released before the needle is withdrawn, to avoid the formation of a haematoma, and this is the determining factor in the transmission of infection. The operator ceases to exert traction on the piston of the syringe at this point, particularly if he is working single-handed. A flow of blood takes place in the vein when the tourniquet has been released, and this flow occurs in the direction in which the injection needle points—i.e., it causes a *negative* dynamic pressure in the opposite direction. As soon as this negative dynamic pressure attains a higher value than the static-pressure difference between vein and syringe, blood must flow from the syringe into the vein. In other words, the flow of blood in the vein sucks some of the contents of the syringe into the vein against the static-pressure head, very much as the contents of a throat spray are drawn up into a passing stream of air. It is clear that if the syringe was contaminated the contaminant will be drawn into the vein together with blood from the syringe.

The effect of the negative dynamic pressure can be demonstrated by substituting for the vein a tube filled with water, and for the contaminant a concentrated solution of methylene blue (see Fig.). A burette (B) is connected to a short length of rubber tubing (R), and this in turn to a glass tube (G), which can be closed by the tap (T). The apparatus is fixed so that the rubber tube occupies the lowest position—i.e., it suffers the highest hydrostatic pressure. Then the whole system is filled with water, T being closed. A few drops of the solution of methylene blue are drawn into the syringe, the needle fixed on subsequently, and the rubber tube punctured in the direction indicated in the figure. Some water is drawn into the syringe, and then the tap is opened. This corresponds to the removal of the tourniquet. The pulsating flow in the vein can be simulated by intermittent opening and closing of the tap. It will be observed that soon after the water in the tube begins to flow some of the blue dye appears in G.



This negative dynamic pressure will be avoided if the needle is directed against the direction of flow—i.e., away from the heart. Nevertheless, so great is the risk incurred in connecting a contaminated syringe with a patient's blood stream that no subterfuge of this kind is justified, and nothing short of complete sterility should be countenanced. If sterile syringes cannot be obtained, then a needle alone should be used. Before the war a first-class all-glass 10-c.cm. syringe could be bought for six shillings. It is difficult to estimate the cost of an attack of acute hepatitis, but for a war-worker it can rarely be much less than £20, and for a trained soldier it must be much more. It is therefore penny wise and pound foolish to economize in sterile syringes; but false economy of this kind is still much too prevalent in civil and military clinics and hospitals. The infecting dose of the virus of infective hepatitis is probably of the same order of size as some of the larger protein molecules, and a little contamination with this virus can go a very long way. A venepuncture, whether for taking blood or injecting drugs, is a minor operation, and there is no excuse for any lapse from the classical principles of sterility.

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