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Pyogenic liver abscess

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At the turn of the century, the mortality from liver abscess was 100%. Surgical drainage reduced the mortality to 50 to 75% by 1930. Antibiotics led to a further reduction but there was little change in the mortality during the next 25 years until recently when the adoption of special localization techniques promised a great improvement. In the nineteenth century a common cause of liver abscess was undiagnosed appendicitis. This has been corrected, so eliminating deaths in the young age groups. The condition now affects predominantly the aged and enfeebled but it remains a condition with a high mortality and morbidity despite diagnostic awareness and therapeutic improvements. Liver abscess is sometimes only one manifestation of severe infection elsewhere. The initial features of the disease may be non-specific and the fully developed picture is late in appearing. Consequently there may be delay or failure in diagnosis. Inadequate drainage of multiloculated abscesses or failure to drain secondary abscesses adds to the problem. Few see many cases and this stresses the need for a continual review of the condition in all its aspects.

MATERIAL

During the 10-year period 1957-66, 48 patients with liver abscess were admitted to two Bristol hospitals, and have been classified as follows:

TYPE 1 (17 PATIENTS) In this group presentation was acute in immediate continuity with some other acute abdominal pathology. The abscesses were usually multiple, but in general there was no diagnostic problem. Table I summarizes the cases in this group.

TYPE 2 (31 PATIENTS) This group constituted the main problem and forms the basis of the paper. The abscesses were usually solitary with a 'chronic' presentation. There was no such time relationship as in type 1 and a prolonged search, often fruitless, was needed to determine a primary source of infection. The essential features of patients in this group are given in Table II. This type of abscess occurred twice as frequently as the acute variety.

TABLE I

SUMMARY OF PATIENTS WITH LIVER ABSCESS (TYPE 1)

No.	*Sex*	*Age (yr)*	*Source*	*Result*
1	F	86	Gallstones—cholangitis	Died
2	F	68	Gallstones—cholangitis	Died
3	F	46	Gallstones—cholangitis	Died
4	F	61	Gallstones—cholangitis	Died
5	F	88	Gallstones—cholangitis	Survived
6	F	53	Gallstones—cholangitis	Survived
7	M	24	Postappendicular	Survived
8	M	34	Postappendicular	Survived
9	M	24	Postappendicular	Died
10	M	61	Diverticulitis	Died
11	M	46	Diverticulitis	Died
12	M	55	Postoperative, gastrectomy (DU)	Survived
13	M	30	Trauma (via chest)	Survived
14	M	22	Trauma (via chest)	Survived
15	F	76	Acute Gram-negative bacteraemia	Died
16	F	68	Acute Gram-negative bacteraemia	Died
17	M	47	Postoperative, splenectomy (trauma)	Survived

Six patients were excluded from the review: two patients with infected metastases from carcinoma of the rectum and one with carcinoma of the stomach, two with non-specific granulomata of the liver, and one patient with a liver abscess due to empyema of an intrahepatic gall bladder. There were two cases of amoebiasis of the liver during the period under review.

In type 1 liver abscess, the most acute form was seen in patients nos. 15 and 16, who had multiple liver abscesses with jaundice, anuria, convulsions, and coma due to Gram-negative bacteraemia. These died within one week of onset.

In type 2 liver abscess, the preliminary diagnosis in hospital was correct in 26 of the 31 patients. In the remaining five patients, the initial diagnosis was brucellosis (2), perinephric abscess (1), and reticulosis (2).

ANALYSIS

This is largely confined to patients with type 2 abscess as these presented the main difficulty.

AGE INCIDENCE This is illustrated in Fig. 1, together with an indication of mortality. The increasing incidence with age is shown, 50% of the patients being over the age of 60 years.

TABLE II

SUMMARY OF PATIENTS WITH LIVER ABSCESS (TYPE 2)

No.	*Sex*	*Age (yr)*	*Pain*	*Jaundice*	*Fever*	*Rigors*	*Enlarged Liver*	*Leucocytosis*	*Site in Liver*
1	M	56	−	−	+	+	+	+	L
2	M	34	+	+	+	+	+	+	R
3	M	49	+	−	+	+	−	+	R
4	F	63	+	−	−	−	+	−	R and L
5	F	77	+	−	−	−	−	−	R and L
6	M	55	+	−	+	−	+	+	R
7	F	77	−	−	−	−	+	+	R and L
8	M	66	−	−	−	−	−	−	R and L
9	M	65	+	−	−	−	+	+	R
10	F	53	+	−	+	+	+	−	R
11	M	41	−	−	+	+	−	−	R
12	F	73	+	−	−	−	+	−	R and L
13	M	60	−	−	−	−	+	−	R and L
14	F	54	+	+	+	−	−	+	R
15	M	48	+	−	+	−	−	+	R
16	M	66	+	+	−	−	+	−	R
17	M	76	−	−	−	−	+	−	R
18	F	44	+	−	+	+	+	+	R
19	M	41	−	−	+	+	+	+	R
20	F	61	−	−	+	−	+	+	R
21	M	36	+	−	+	−	+	+	R
22	F	65	−	−	−	−	+	−	R
23	M	37	+	−	+	+	+	+	R
24	M	38	+	+	+	+	+	+	R and L
25	F	68	+	+	+	+	−	+	L
26	F	76	−	−	+	+	−	+	R
27	M	73	−	−	+	+	+	+	R
28	F	41	+	+	+	−	+	−	R
29	M	47	+	+	+	−	+	+	R
30	F	77	+	−	+	−	+	+	R
31	M	61	+	+	+	−	+	+	R

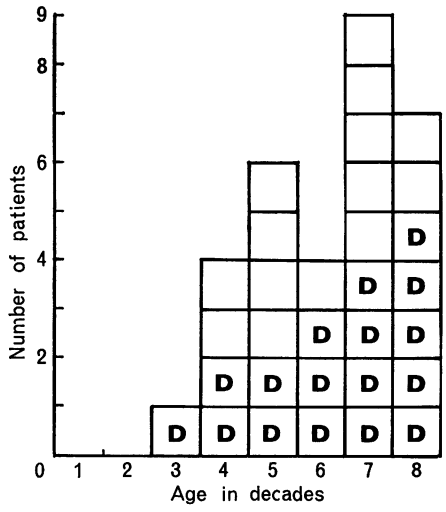

FIG. 1. *Age incidence of liver abscess.*

SEX RATIO There were 18 men and 13 women in the group.

SITE OF ABSCESS A marked prediliction for the right lobe of the liver was observed, more than two-thirds of the abscesses occurring in this lobe alone. There were abscesses in both lobes in seven of the 31 patients. The largest abscess in the series was 25 cm in diameter and the smallest 6 cm in diameter.

METASTATIC ABSCESSES IN OTHER ORGANS Abscesses other than in the liver were found in 14 patients, *ie*, in nearly half of the cases. In 10 patients, the second abscess was in the lungs, in two in the brain, and two patients had abscesses in both lung and brain.

CLINICAL PRESENTATION Table III shows the wide variety of presentation and clinical problem on the patient's admission to hospital.

The majority of patients were referred to medical units in the first instance, but it is important to refer patients with metastatic abscesses at once to thoracic and neurosurgical units. In the past, 30 to 40 years ago, brain abscesses were usually of the 'neighbourhood' variety secondary to middle ear or frontal sinus disease and carried a reasonable prognosis. Now an increasing frequency of metastatic brain abscess is evident; the liver, as well as the lung, must be borne in mind in searching for the source. Of the three patients with unsuspected liver abscesses, two were admitted from the waiting list with herniae, whilst the third was a diabetic with a large liver abscess.

TABLE II—continued

SUMMARY OF PATIENTS WITH LIVER ABSCESS (TYPE 2)

Presentation	*Metastatic Abscess*	*Surgical Treatment*	*Primary Source*	*Result*
Pyrexia of unknown origin				
PUO	—	Drainage	Lung	Survived
PUO	Lung abscess	Drainage (liver and lung)	Cryptogenic	Survived
PUO	Bilateral lung abscess	Drainage (liver and lung)	Cryptogenic	Survived
'Cardiac failure'	—	—	Cryptogenic	Died
Unsuspected	Lung abscess	—	Cholangitis	Died
Abdominal mass	—	Drainage	Actinomycosis	Died
Lung sepsis	—	—	Lung	Died
Coma	Lung abscess	—	Postoperative	Died
'Cardiac failure'	—	—	Diverticulitis	Died
Collapse	—	Drainage	Cholangitis	Died
PUO	Brain abscess	Drainage (brain)	Cryptogenic	Died
Coma	Brain and lung abscess	—	Pancreas	Died
Collapse	—	—	Cryptogenic	Died
Abdominal pain	—	—	Cholangitis	Died
Lung sepsis	Lung abscess	Drainage (liver and lung)	Cryptogenic	Survived
Abdominal pain	—	Drainage	Cryptogenic	Survived
Unsuspected	—	—	Cryptogenic	Died
Coma	Brain abscess	Drainage (liver and brain)	Cryptogenic	Died
PUO	Brain and lung abscess	Drainage (liver and brain)	Cryptogenic	Died
PUO	Lung abscess	Drainage (liver and lung)	Cryptogenic	Survived
Abdominal mass	Lung abscess	—	Actinomycosis	Died
Unsuspected	—	Drainage	Cholangitis	Survived
PUO	—	Drainage	Cholangitis	Survived
Abdominal mass	Lung abscess	Drainage	Crohn's disease	Died
PUO	—	Resection L lobe of liver	Diverticulitis	Survived
Coma	Lung abscess	Drainage	Cryptogenic	Died
PUO	—	Drainage	Cryptogenic	Survived
Abdominal pain	—	Drainage	Cholangitis	Survived
PUO	Lung abscess	Drainage (liver and lung)	Postoperative	Survived
Diarrhoea	—	Drainage	Diverticulitis	Survived
PUO	—	Drainage	Diverticulitis	Survived

TABLE III

CLINICAL PRESENTATION IN 31 PATIENTS WITH LIVER ABSCESS (TYPE 2)

Case No.	*Presentation*	*No. of Abscesses*
1	Pyrexia of unknown origin	11
2	Coma	4 (1 hepatic, 1 diabetic, 2 brain sepsis)
3	Abdominal pain	3
4	Abdominal mass	3
5	Lung abscess	2
6	'Cardiac failure'	2
7	Collapse	2
8	Unsuspected	3
9	Diarrhoea	1
	Total	31

CLINICAL FEATURES The frequency of important clinical features appearing during the course of the disease is shown in Table IV. The striking feature in the series was the insidious onset of the disease process, so much so that many patients were uncertain of the beginning of the illness. The length of such a history ranged from three months to three years, and formed a background even in those whose admission to hospital was precipitated by a sudden increase in severity of the condition. In only one patient (no. 30) was the duration of the symptoms short. The significance of symptoms and their duration may not be appreciated by the elderly and are attributed simply to their age.

TABLE IV

FREQUENCY OF CLINICAL FEATURES IN 30 PATIENTS WITH LIVER ABSCESS (TYPE 2)

Weight loss	(31)	100%
Anaemia	(31)	100%
Hepatomegaly	(23)	73·3%
Fever	(21)	66·6%
Leucocytosis	(21)	66·6%
Pain	(18)	56·6%
Rigors	(12)	40%
Jaundice	(8)	23·3%

The onset was usually painless with little else but malaise. When pain appeared it was either centrally disposed in the abdomen or in the right hypochondrium. Liver tenderness was common, but localized tenderness over the liver was late in appearing. Liver enlargement was the commonest physical sign.

Rigors did not occur daily, as in patients in the acute group, but only once or twice weekly, and there was no history of these in the majority. When present, they were interpreted as being indicative of thrombophlebitis in the portal radicles with spread of the abscess or of episodes of bacteraemia.

Whereas all the patients in the acute group (type 1) had jaundice, only approximately one in four had this feature in the main group. Usually it was not severe until the terminal stages, but in two patients it was a transient feature for a day or so occurring several months before admission. These had been labelled as attacks of viral hepatitis.

Although anaemia was present in all patients at some time, it was the original feature that caused the patient to seek medical advice in two cases, and was treated symptomatically only. Oedema occurred in those with low serum protein levels, especially in those with a fatal outcome. Local oedema over the chest wall alone, as seen in subphrenic abscess, was not common and was recorded in only three (10%) patients. Perhaps the most significant item requiring comment is the presence or absence of leucocytosis. The white cell count was raised in 21 of the 31 patients to a level ranging from 16,000 to 28,000 per c mm. One third of the series, however, did not have any leucocyte response during their stay in hospital. Among the fatal cases, nearly 50% (eight) did not have a leucocytosis. This observation needs to be stressed: a leucocytosis may not be evident in many cases of liver abscess, and its absence is of sinister import.

Although liver abscess may present with a variety of clinical patterns, the termination of the condition in fatal cases reveals a more restricted picture. Of 17 such patients, eight were in coma, seven had profound hypotension lasting from 24 hours to six days, one died from peritonitis due to rupture of the liver abscess, and one had terminal pulmonary fibrosis from an old actinomycotic infection of the lungs. In the patients in coma, this was hepatic in four, diabetic in one, and due to brain sepsis in three. All three patients in the series with coincident diabetes died.

METHODS OF INVESTIGATION All patients had plain radiographs of the abdomen and chest which demonstrated the large soft tissue shadow of the enlarged liver in the upper right quadrant of the abdomen. The right leaf of the diaphragm was raised and its respiratory excursion reduced. In about 25% of the cases, the base of the right lung had collapsed, with pleural effusion; in one of these the effusion amounted to an empyema. Evidence of fluid levels in abscesses was not seen. Cholecystography and barium studies (meal and enema) were used in the search for sources of the abscesses.

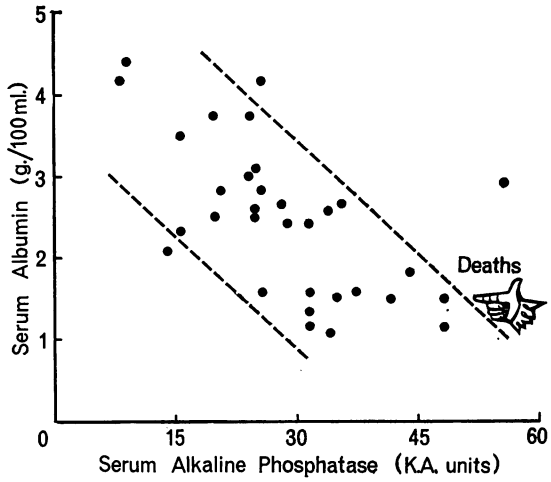

FIG. 2. *Relationship of serum alkaline phosphatase to serum albumin.*

Haematological studies The occurrence of anaemia and leucocytosis has already been mentioned. Those patients with rigors (12) had blood cultures done, but none were positive.

Liver function tests These were done in all cases and the results are summarized in Table V. The relationship of the raised serum alkaline phosphatase level and the falling level of the serum albumin is illustrated in Figure 2. The fatal cases had levels of serum albumin below 2 g/100 ml. Of the liver function tests, the rapidly falling serum albumin level is the most important index of liver abscess. The transaminases are used as an index of hepatocellular damage whilst serum alkaline phosphatase estimation is dependent on liver excretion (Fig. 3.) Serial studies of these in patients with liver abscess may show a degree of parallelism as illustrated in Figure 4.

Liver biopsy This method of investigation was used in 12 patients. In two, repeated biopsy over a

TABLE V

RESULTS OF LIVER FUNCTION TESTS IN LIVER ABSCESS

Test	*Values*
1 Serum bilirubin (normal <0·5 mg/100 ml)	(23)[1] Without jaundice 0·5-1·8 mg/100 ml (8) With jaundice 3·5, 3·8, 4·1, 4·5, 4·9, 5·0, 7·3, 13·5 mg/100 ml
2 Serum alkaline phosphatase (normal < 12 King-Armstrong units/100ml)	8-56 K-A units/100 ml (raised)
3 Serum albumin (normal 4 g/100 ml or more)	1·114·2 g/100 ml (reduced)
4 Serum globulin	Increased, especially gamma fraction
5 Serum transaminase (SGPT) (normal 22-95 King units/100 ml)	99-306 units/100 ml (raised)

[1]No. of cases.

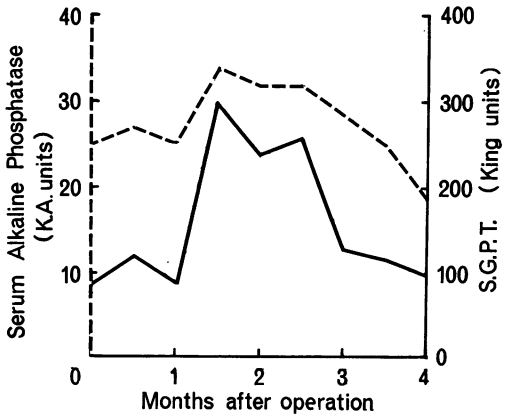

FIG. 3. *Alterations in liver function tests with healing of liver abscess.*

period of six months revealed no abnormality. The abscess cavity was entered in one patient, confirming the diagnosis. In the remaining nine cases, the tissue obtained showed a non-specific hepatitis with inflammatory cells, but no focal necrosis and was interpreted as being in the neighbourhood of an abscess or tumour.

Serum vitamin B_{12} estimations Six patients had these studies. Grossly raised levels (2,000 to 4,000 $\mu\mu$g/ml) were found in five cases. The last patient, although she had an abscess some 9 cm in diameter, had a vitamin B_{12} level of 140 $\mu\mu$g/ml. It may be that the liver stores of vitamin B_{12} are already depleted in the elderly so that the serum level cannot be raised when liver tissue is destroyed.

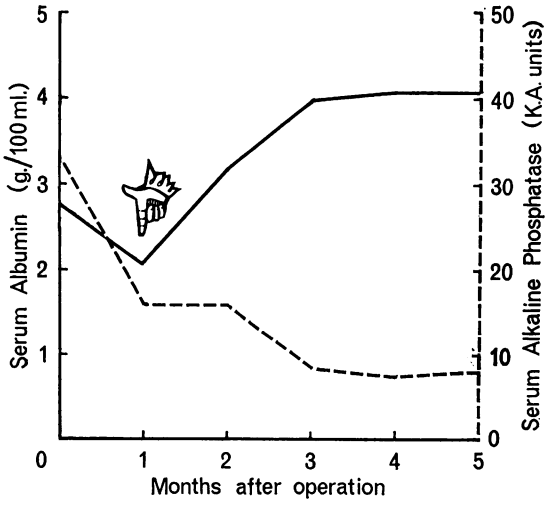

FIG. 4. *Improvement in serum albumin and alkaline phosphatase levels after drainage of liver abscess.*

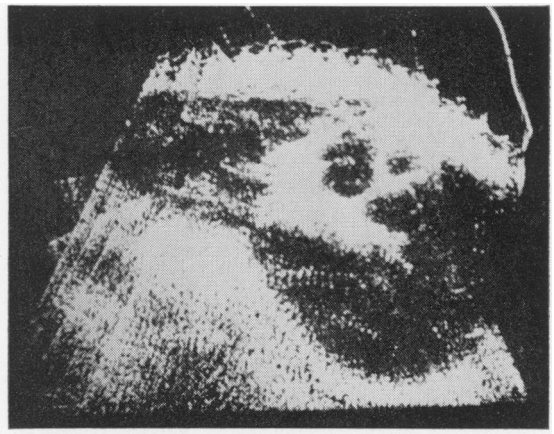

FIG. 5a.

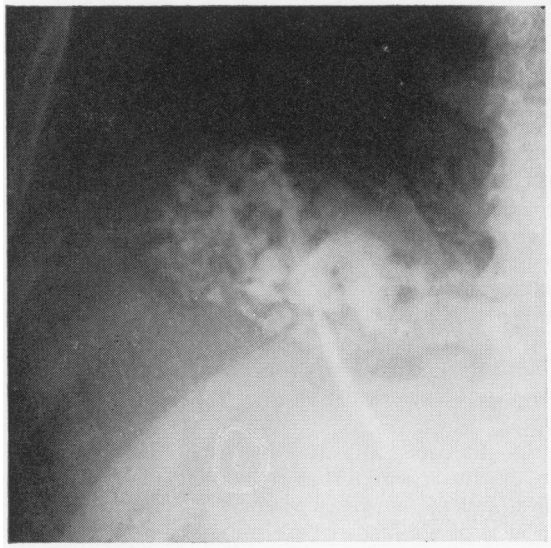

FIG. 5b.

FIG. 5. *Ultrasonic scan (compound B scan) in liver abscess* (a) *and* (b) *radiographic appearance of abscess cavity.*

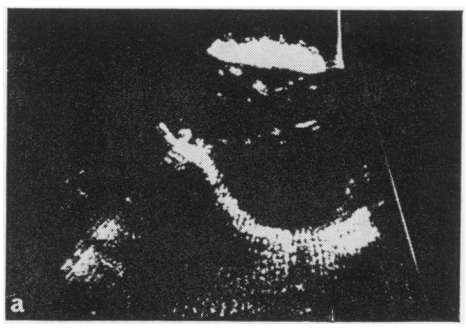

FIG. 6. *Ultrasonic scan of amoebic liver abscess.*

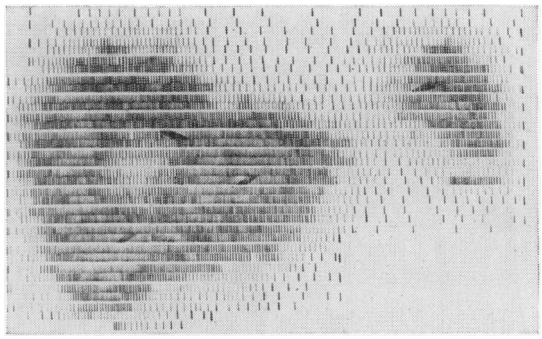

FIG. 7. *Isotope liver scan in liver abscess.*

Ultrasonic scan Ultrasonic B scans (McCarthy, Read, Ross, and Wells, 1967) were carried out on two patients (case 17, Table I, case 31, Table II). In each instance it was possible to say confidently that an abscess or abscesses were present. Scans on a patient with amoebic abscess were equally helpful. Figure 5 shows the ultrasonic liver scan of case 31, and Fig. 5a the appearance of the abscess cavity after drainage. Figure 6 shows the appearance of the patient with amoebic liver abscess.

Isotope scans These were performed on two patients, cases 17 and 31, and showed the presence of localized areas of low count rate. Figure 7 indicates the type of appearance. The isotope used was techetium 99m tagged to a sulphur colloid (Paton, 1966). Scans of a patient with multiple amoebic abscesses also showed localized areas of low uptake.

Of the commonly used investigations, most help in diagnosis was afforded by the falling albumin level and the increased vitamin B_{12} level, especially in view of the fact that there may be no increase in the leucocyte count. The ultrasonic and isotope scans were diagnostic when used.

With reference to the return of liver function tests to normal after an abscess has been drained, this may take from three months to one year, and is illustrated in Figure 3. It is important to stress that the serum albumin level may continue to fall for a period after operation, due to impaired liver function, loss in the exudate, and the catabolic effect of the procedure.

PRIMARY SOURCE OF INFECTION This is the most difficult part of the analysis: although there must be a source in every case, prolonged search may not reveal it. The immediate task of treating the abscess takes priority and in most patients the search for the primary focus follows later. This source may be very small and may have healed before the liver abscess has become manifest. Table VI indicates the probable source in this series.

TABLE VI

SOURCE OF INFECTION IN LIVER ABSCESS IN 31 CASES

Source of Infection	*No. of Cases*
Cryptogenic—no source found	13 (43·3%)
Gallstones/cholangitis	6 (20·0%)
Diverticulitis	4 }
Postoperative (abdominal)	2 }
Actinomycosis (abdominal)	2 } (30% source in portal area)
Pancreatitis	1 }
Crohn's disease	1 }
Lung	2 (6·7% systemic, source outside portal area)

The cryptogenic group may be regarded as 'not proven' but consideration of the bacteriology of these, chiefly coliform organisms, would indicate that they probably have an origin in the portal area. The patients with postoperative abscesses had gastric operations one and four years previously. Following pancreatitis, the liver abscess became apparent after an interval of nine months. In the patients with the source in the lungs, both had proven pneumonia one and three years previously.

ORGANISMS Bacteriological studies in liver abscess are of twofold importance: (1) to control antibiotic therapy by sensitivity tests, and (2) as an aid in identifying the source of the infection. Unusual organisms, not coliform in origin, may point to the biliary tract as the culprit.

Table VII shows the organisms identified in this series. The findings indicate the importance of doing anaerobic and aerobic cultures for bacteria and fungi. It is perhaps of interest to note that only the anaerobic actinomyces are found as commensals in man. In the acute abscesses (type 1) additional organisms were found in one fourth of the patients: *Cl. welchii*, haemolytic streptococci, and coagulase-positive staphylococci.

TABLE VII

BACTERIOLOGY OF LIVER ABSCESSES IN 31 CASES

Escherichia coli alone or with *Strep. faecalis*	16
Anaerobic streptococci	8
Actinomyces (anaerobic)	2
Nocardia (aerobic)	1
Sterile	4

MORTALITY This is influenced by the fact that no surgical intervention can be contemplated in nearly one third of the patients, so grave is their condition. It is evident that the only chance of survival lies in drainage of the abscess. Table VIII gives an analysis of the mortality for the acute (type 1) and the more chronic (type 2), the latter being analysed in more detail. It should be stressed that one in five patients required repeated drainage procedures.

TABLE VIII

MORTALITY IN CASES OF LIVER ABSCESS

Group	*No. of Cases*	*Deaths*	*Mortality (%)*
Type 1	17	9	52·9
Type 2	31	17	53·1
Type 2 only			
No drainage	9	9	100
Drainage	22	8	37·3
Drainage and without metastatic abscesses	12	3	25

At this point, it is worth recapitulating those features of liver abscess which seem to indicate a sinister prognosis: features of gross liver destruction and poor defence mechanisms, severe jaundice, coma, hypotension, and associated diabetes (all three patients with this died), laboratory tests showing serum albumin level below 2 g/100 ml, no leucocytosis, low blood urea (three patients with levels below 12 mg/100 ml all died).

OBSERVATIONS ON TREATMENT

All patients had broad-spectrum antibiotics (tetracycline or penicillin and streptomycin), which were modified when bacterial sensitivity was known. Infusions of blood and triple strength plasma were used when necessary, in particular as a preparation for surgery. On three occasions, mannitol was given during or after operation.

Nine patients were never fit for surgery. Drainage operations, including resection of part of the left lobe of the liver, were performed on 22 patients, seven of whom required drainage of metastatic abscesses. Repeated drainage was necessary in four patients owing to inaccurate siting of the drain and the presence of loculi. All but two were drained via an abdominal approach, the two with thoracic approaches needed further drainage through the abdomen. There was very little choice about the method of approach because localization in the liver had not been determined and there was a need to explore the abdominal viscera. A thoracic approach in the absence of localization does not permit adequate inspection of the liver.

At operation, there may be no visual evidence of the site of the abscess in the liver, but an altered consistency may be palpable. Needle aspiration is usually necessary. In three patients localization was determined before operation, one in whom the abscess was tapped during liver biopsy, and two by ultrasonic and isotope scans. After aspiration, Lipiodol was introduced into the cavity and was followed by *x*-ray studies in different places and positions to reveal the site and dimensions of the cavity.

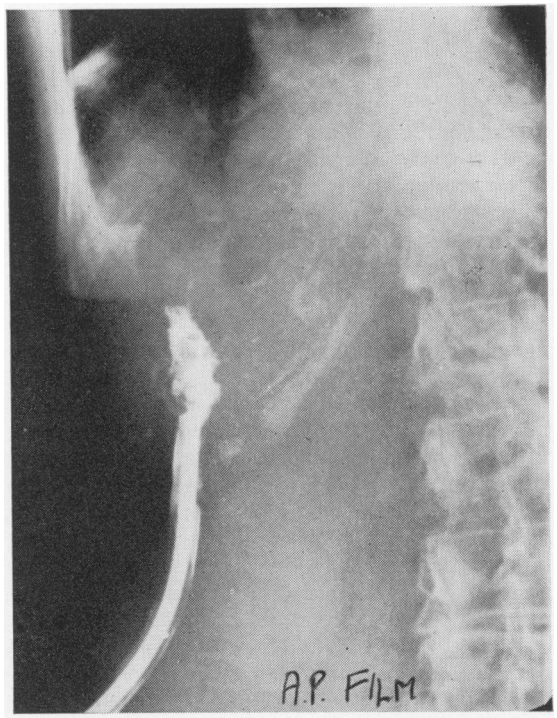

FIG. 8a.

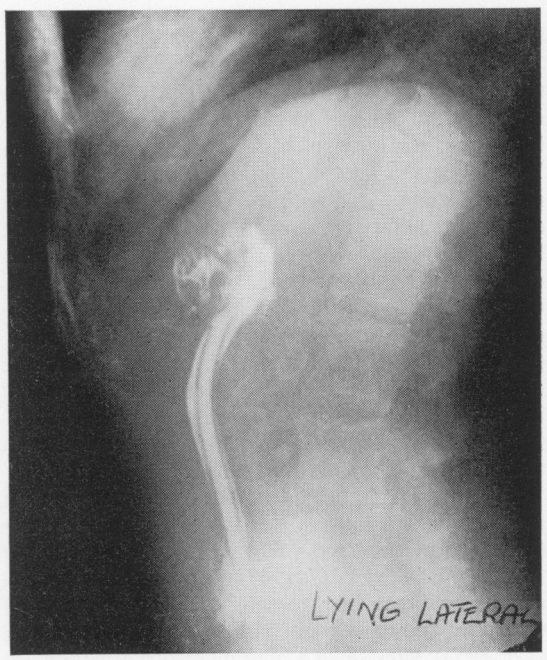

FIG. 8b.

FIG. 8. *Anteroposterior sinogram on which the abscess cavity is not clearly seen* (a) *and lateral view on which the cavity is clearly visible* (b).

When the drainage tube was introduced into the abscess cavity at operation and carefully positioned for dependent drainage, it was left *in situ* until repeated sinograms showed no cavity but only the tube track. It is important that sinography should be done in two planes (anteroposterior and lateral) to be certain that the cavity has been obliterated (Figs. 8a and 8b). Chemotherapeutic cover was continued in this series until drainage was complete and the liver function tests were improving.

DISCUSSION

The classification of liver abscesses adopted in this paper is not the usual one. It is submitted as useful because it stresses two distinct clinical presentations. In type 1, acute multiple abscesses associated with jaundice follow directly on some other primary recognizable pathological process, *ie*, the source is usually obvious from the beginning. Type 2 abscesses, on the other hand, have a more chronic presentation and the cause is obscure at the onset. These abscesses may present a major problem and the main discussion is centred around them. The salient features of this group of abscesses in this series are as follows: The onset is insidious. The abscess is solitary, and has a predilection for the right lobe of the liver. Jaundice is not common. There is a high incidence of metastatic abscesses elsewhere. Often there is no leucocytic response.

The localization of an abscess in the liver is related to its function as a bacterial filter. The predilection for the right lobe is less easily understood on the basis of 'streaming' of blood in the portal system. Nevertheless, a greater volume of blood goes to the right lobe compared with the left and this must play a part in localization. It is of interest to observe that liver abscess is a rarity in cases of ulcerative colitis despite the frequency of bacterial insult that occurs via the portal vein (Brooke and Slaney, 1958). The occurrence of liver abscess in the aged and enfeebled, the frequency of bacteraemic shock and metastatic abscesses, and the lack of leucocytic response indicate a failure in defence mechanisms.

The number of patients in this series is similar to that in most reviews in the literature.

Most series indicated slight preponderances of males compared with females. Rothenberg and Linder (1934), however, recorded a sex ratio M/F of 2·5/1, whilst May *et al* (1967) found an almost equal incidence in men and women. With the exception of the series reported from Hong Kong (McFadzean *et al* 1953), which had a high incidence in young age groups, all the remaining authors recorded a maximal incidence in older people.

The relative frequency of solitary and multiple abscesses seems to vary. Cronin (1961) and May *et al* (1967) found multiple abscesses to be commoner, whereas Block *et al* (1964) and Pyrtek and Bartus (1965) recorded equal numbers of solitary and multiple abscesses. The latter authors observed that 90% of liver abscesses associated with biliary obstruction were likely to be multiple whilst some 95% of abscesses due to systemic or portal invasion were usually solitary. It has been frequently reported that the solitary liver abscess differs from multiple abscesses in that the source of the former was usually obscure (Beaver, 1931; Bourne, 1954; Davidson, 1964; Matheson *et al*, 1964). The present review reinforces these observations.

SUMMARY OF REPORTED SERIES

Series	*No. of Cases*	*Period of Observation (yr)*
Rothenberg and Linden (1934)	24	20
Ochsner, DeBakey, and Murray (1938)	42	10
McFadzean, Chang, and Wong (1953)	14	
Stokes (1960)	8	10
Diffenbaugh, Strohl, and De Padua (1960)	9	
Cronin (1961)	27	15
Block, Schuman, Eyler, Truant, DuSault (1964)	68	40
Pyrtek and Bartus (1965)	42	20
Berke and Pecora (1966)	10	4
May, Lehmann, and Sanford (1967)	21	20
Present series	46	10

The preference of solitary abscesses for the right lobe of the liver is well documented. Rothenburg and Linder (1934) and Berke and Pecora (1966) found that all the solitary abscesses were so situated. McFadzean *et al* (1953) reported 13 of a series of 11 abscesses to be in the right lobe. Pyrtek and Bartus (1965) recorded 17 abscesses in the right lobe and five in the left in 22 cases. Diffenbaugh *et al* (1960) considered the right lobe to be involved eight times more frequently than the left, whilst Hirschowitz (1952) indicated that abscesses are likely to be situated in the right lobe when the source was unknown. According to Pyrtek and Bartus (1965), abscesses following gastric operations are usually in the left lobe, although the examples in the present series were in the right lobe.

The high incidence of metastatic abscesses in lungs and brain—nearly 50% in this series—is an important finding because of its influence on presentation and prognosis. It is also indicative of ready blood dissemination. Block *et al* (1964) reported the need for drainage of abscesses elsewhere, especially in the brain and kidneys, in one third of their patients. In the review by Diffenbaugh *et al* (1960), empyema, abscesses of the lungs and brain, and subphrenic abscesses were reported. Some 10% of cases of subphrenic abscess have intercurrent liver abscesses

(Harley, 1955). Other complications reported include involvement of the pericardium (Azan, 1932; Zodikoff, 1947) and invasion of the inferior vena cava (McKnight, 1928) and of the hepatic veins (Webber and Coe, 1950). A persistent complication, 'haemobilia', due to haemorrhage into the abscess cavity, has been described by Karam and Jacobs (1961) and by Urschel, Skinner, and McDermott (1963). Its importance lies in the fact that resection of the appropriate lobe may be necessary after precise localization. One wonders if this feature is more common than is generally thought by virtue of the severe anaemia, the colour of the pus, and the occurrence of hypotension seen in patients with liver abscess.

With regard to clinical presentation, Rothenberg and Linder (1934) believed liver abscess to be a well defined entity, amenable to surgery and associated with a reasonable prognosis. This is probably true for those very familiar with the problem as exemplified by the report of McFadzean *et al* (1953). The present review, however, is indicative of the opposite point of view and more in keeping with the findings of Cronin (1961) and Block *et al* (1964). It is important to recall the somewhat chastening observations of Ogden *et al* (1961) and Pyrtek and Bartus (1965) that the diagnosis may not be established in more than 60% of patients until necropsy. The non-specific early symptoms and the varied clinical pattern of presentation seen in the present series must be stressed.

The insidious onset is well recognized (Rothenberg and Linder, 1934; McFadzean *et al*, 1953). The frequency of pain varies considerably in reported cases from one in seven of patients (McFadzean *et al*, 1953) to almost two-thirds (Cronin, 1961). There is no doubt that pain is a much more regular and persistent feature of acute multiple abscesses than of solitary ones. A particular observation that is confirmed by the present review is that the pain is not usually accompanied by vomiting (McFadzean *et al*, 1953; Cronin, 1961).

Jaundice occurred in all the patients with type 1 abscess, and in 25% of the 31 patients with type 2 abscess. Cronin (1961) observed jaundice in one of 10 solitary abscesses and in half of the patients with multiple abscesses. Diffenbaugh *et al* (1960) also found it to be a feature of multiple abscesses. In general, it may be said that jaundice is indicative of multiple abscesses, of biliary obstruction, or of diffuse and severe liver destruction. Hepatomegaly has been observed as the commonest physical sign, and it should be noted that the enlargement may be sudden and dramatic (Wyndham, 1945; Diffenbaugh *et al*, 1960).

The investigation of patients with possible liver abscess needs special comment. In particular, the observation that 30% of all the cases, and 50% of the fatal cases, never had a leucocytosis is important. Although indicative of the overpowering nature of the infection, it must be stressed that a normal leucocyte count does not exclude a liver abscess. Abnormalities of the liver function tests in a patient with sepsis do not necessarily incriminate the liver for, as Neale, Caughey, Mollin, and Booth (1966) have shown, general infective processes may alter several of the usual liver function tests. If the function of the liver is depressed by an abscess, then albumin synthesis suffers early and if, furthermore, a large area of liver is occupied or 'knocked out' by the abscess, this leads to a sustained fall in serum albumin levels. If it drops below 2 g per 100 ml, the prognosis is grave. Elevation of the serum levels of vitamin B_{12}, due to liberation of liver stores as hepatocellular destruction proceeds, is probably the most important feature of liver abscess, but levels may not be raised in the very old if the liver stores are already depleted. Low blood urea levels have been mentioned as indices of a poor prognosis.

The radiological findings in this series correspond with those reported in the literature, *ie*, one third to one quarter of the patients may have signs of involvement of the right lung with effusion.

It will be appreciated already that in patients with the chronic type 2 abscess, where the source is not immediately obvious, the abscess will probably be solitary and in the right lobe. Even so, there is no doubt that the great need at the moment is the adoption of special localization techniques, essential for both early diagnosis and accurate drainage. Photo scanning of the liver following the administration of radioactive substances, *eg*, Rose Bengal ^{131}I, radioactive gold (^{198}Au) or Tehnetium—m 99, has been done with promising results (Wagner *et al*, 1961; Nagler, Bender, and Blau, 1963); Block *et al*, 1964; Schuman, Block, Eyler, and DuSault, 1964; Pyrtek and Bartus, 1965). The smallest defect detectable is about 2 cm diameter but nevertheless the overall accuracy is about 77% (Gollin, Sims, and Cameron, 1964). If isotope scanning had been used in all patients in the present series it is likely that most of the abscesses would have been detected as the smallest was 6 cm in diameter. In the two patients in whom the investigation was carried out an early diagnosis was made. Ultrasonic scanning of the liver used on two patients in this series has a major advantage over the isotope scanning in that it can clearly distinguish between solid and fluid-filled lesions thus separating abscess from tumour. The equipment necessary to perform an ultrasonic B scan of the liver is not portable but the A scan equipment is, and this latter equipment is adequate

for the diagnosis of abscess provided that the operator is experienced. Although we have used these techniques in a small number of patients with abscess, in five other patients abscess was excluded by the scan, although clinical suspicion was high.

Transaortic hepatic arteriography and splenoportography have also been used (Urschel *et al*, 1963; Gollin *et al*, 1964) and may be indicated if scanning is not successful. When these techniques have been used, the mortality from liver abscess has been reduced to negligible proportions in a small series of patients.

The probable route of infection is shown in Table VI: 20% via the biliary tract, 30% by the portal vein, and 6·7% by the systemic circulation. In nearly half the series, the source, and hence the route, was uncertain but probably in the portal vein. The high incidence of 'cryptogenic' abscess has been frequently recorded.

It is surprising that cases occurring after abdominal operations are not more common in view of Wilkie's (1911) demonstration of the frequent occurrence of infarcts in the liver after ligature of mesenteric vessels. Liver abscess following infarction due to polyarteritis nodosa has not been seen, but Brittain *et al* (1966) have reported an abscess following liver infarcts due to sickle cell disease.

The bacteriological studies require little comment. All reports show frequent infection by *Esch. coli*, but some authors have stressed the importance of anaerobic infection (Stokes, 1960). Block *et al* (1964) found an approximately equal incidence of aerobic and anaerobic infection. The present series stresses the necessity of both types of culture on all occasions. Sterile cultures, frequently reported, may be a reflection of failure to observe this rule.

The experience of treatment in this series has already been reviewed briefly, with special reference to the operative approach and management of tubes. Early diagnosis and localization by ultrasonic or isotope techniques and the use of the appropriate antibiotic are likely to cause a reduction in the present mortality due to liver abscess. Surgical drainage is probably necessary but the superb results obtained by McFadzean and his colleagues (1953) using aspiration and instillation of antibiotics must be remembered. 'Septic shock', often due to a Gram-negative bacteraemia, must be treated with the appropriate antibiotics and expansion of plasma volume with continuous monitoring of the central venous pressure by means of a polythene catheter in the superior vena cava or right atrium. Hypertensive agents will often be necessary. Isoprenaline may be the drug of choice as it causes increased cardiac output and peripheral vasodilatation thus increasing tissue perfusion (Weinstein and Klainer, 1966). Metaraminol (Aramine) is sometimes helpful. Careful control of acid base balance is necessary. In most reported series, the mortality remains high and corresponds with that found in this review, 25%, even when the liver abscess is uncomplicated. It will be recalled that the initial diagnosis was correct in about 83% of the patients in this series. This is evidence of awareness of the disease and indicates that the critical question in liver abscess may be not so much, 'What is it?' but 'Where is it?'

SUMMARY

A retrospective analysis of 48 patients with liver abscess abmitted to Bristol hospitals in the 10-year period 1957-66 is presented. In view of the high mortality in cases of pyogenic liver abscess, aids to diagnosis are stressed, *eg*, falling serum albumin levels and raised serum levels of B_{12}. Drainage offers the only chance of survival but accurate localization of the abscess by isotopic or ultrasonic scanning is needed.

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