

PAPERS AND SHORT REPORTS

Fractures on the chest radiograph in detection of alcoholic liver disease

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Abstract

The presence of fractures seen on routine chest radiography was assessed in patients with liver disease to see whether it might provide a useful marker of alcoholism. Chest radiographs taken at the time of liver biopsy were examined in 149 patients—72 with alcoholic liver disease (32 (44%) cirrhotic) and 77 with various forms of non-alcoholic liver disease (15 (19.5%) cirrhotic)—and in 149 controls.

Fractures (85 rib, two clavicular) were much more common in patients with alcoholic liver disease (20 subjects; 28%) than in patients with non-alcoholic liver disease (1; 1.3%) or controls (10; 6.7%). In alcoholic liver disease rib fractures were significantly more likely to be bilateral or multiple (more than two) or both ($p < 0.01$). Of patients with alcoholic liver disease, those with fractures were significantly older than those without, but there was no difference in sex, social class, the proportion with cirrhosis, or the proportion known to be alcoholic at the time of the radiograph.

In liver disease fractures on the chest radiograph diagnosed alcoholism with 95% specificity and 28% sensitivity. These often overlooked or ignored findings in the chest radiograph may have a wider role in the detection of alcoholism.

Introduction

Alcohol consumption in Britain has almost doubled over the past 20 years¹ and many problem drinkers go unrecognised. We were interested to see whether fractures visible on routine chest radiographs might help in recognising alcoholism in patients with liver disease. Chest radiography is widely available and is

performed on most hospital inpatients and many patients who attend casualty and outpatient departments. We have compared the prevalence of fractures detected on routine chest radiography in patients with alcoholic and non-alcoholic liver disease and controls matched for age and sex.

Patients and methods

Patients—This retrospective study included all patients who had undergone liver biopsy on a single medical firm over five years and in whom routine posteroanterior chest radiography had been performed within three months of biopsy. Clinical information (including history of alcohol consumption and social class determined from the Registrar General's classification of occupations) was available on all 155 patients who had undergone liver biopsy. In six patients, however, no chest radiograph was available, and this report is therefore confined to the remaining 149. Of these patients, 72 (48.3%) had a final diagnosis of alcoholic liver disease based on the findings of liver biopsy and a history of prolonged (over 12 months), excessive alcohol consumption (over 80 g/day for men and 40 g/day for women). The remaining 77 patients (51.7%) had various non-alcoholic liver diseases. The alcoholic liver disease group comprised 50 men (mean age 53.5 ± 13.8 years) and 22 women (mean age 55.1 ± 9.7 years) and the non-alcoholic liver disease group 36 men (mean age 49.2 ± 19.6 years) and 41 women (mean age 53.1 ± 14.7 years). Cirrhosis was present in 32 (44.4%) and 15 (19.5%) of the patients in the two groups respectively.

Controls—In our radiology department radiographs are filed according to date of birth, which allowed us to select at random controls matched for age and sex with each of the 149 patients. Controls included inpatients, outpatients, and casualty and general-practitioner referrals. No clinical or laboratory information was obtained on the controls.

Assessment of chest radiographs—Each chest radiograph was reviewed by two trained radiologists (who were unaware of the clinical, laboratory, or liver biopsy information). The presence or absence of rib or other fractures was agreed by both observers. The side, rib number, and position (anterior, lateral, or posterior) of each rib fracture were recorded. Subsequently the routine departmental chest radiograph report was reviewed to see whether fractures, if present, had been noted and if so whether any specific interpretation had been made. Radiological findings were then analysed in the light of the clinical and histological classification as alcoholic liver disease, non-alcoholic liver disease, and control.

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Statistics—Student's unpaired *t* test was used for comparison of normally distributed data. Differences between proportions were assessed by the χ^2 test with Yates's correction.

Results

Prevalence of fractures found on chest radiography—Table I shows the number of rib and other fractures detected in patients with alcoholic liver disease and non-alcoholic liver disease and controls. There was a 20-fold difference in the prevalence of rib fractures between patients with alcoholic liver disease and those with non-alcoholic disease (18 cases (25%) *v* 1 (1.3%)), and the difference was even more pronounced when clavicular fractures seen on the chest radiograph were taken into account. More rib fractures were present in controls (10 cases; 6.7%) than in patients with non-alcoholic liver disease, but this difference was not statistically significant. In patients with rib fractures the average number of fractures was significantly higher in alcoholics than in the combined control and non-alcoholic liver disease groups (3.7 *v* 1.6; *p* < 0.01).

Site of fractures—Rib fractures showed no significant preference for side in any group. The sixth to 10th ribs were the most commonly affected and accounted for 86.4% of the rib fractures in the alcoholic liver disease and 94.4% in the non-alcoholic liver disease and control groups. Rib fractures did not show a significant predilection for an anterior, lateral, or posterior site in either the alcoholic liver disease or control group.

Comparison of patients in alcoholic liver disease group with and without fractures—The mean age of alcoholics with rib or clavicular fractures (60.7 \pm SD 11.5 years) was significantly higher than that of alcoholics without detectable fractures (51.7 \pm 12.3 years) (*p* < 0.01). There was no difference between these groups, however, in (a) the proportion with cirrhosis, (b) social class (manual *v* non-manual), or (c) the ratio of men to women (table II). To assess the usefulness of these radiological findings as markers of alcoholism we ascertained from the notes whether alcoholism had been suspected or unsuspected before the admission during which a definitive biopsy diagnosis had been established. Of the 18 patients with fractures, 10 (56%) had not been thought to be alcoholic at the time of the chest radiograph; and of the 54 without fractures, 36 (67%) had not been thought to be alcoholic. This difference was not statistically significant.

Specificity and sensitivity of fractures in diagnosis of alcoholic liver disease—Table III shows the specificity and sensitivity of various radiological criteria in the detection of alcoholic liver disease from a chest radiograph. The most specific radiological marker for alcoholism was three or more rib fractures or bilateral rib fractures. Of all 72 patients with alcoholic liver disease, 18 had rib fractures and, of these, 12 satisfied one or other criterion (six patients satisfied both). In the

TABLE I—Comparison of prevalence and number of fractures seen on chest radiograph in patients with alcoholic liver disease, non-alcoholic liver disease, and controls

	Alcoholic liver disease	Non-alcoholic liver disease	Controls
No of patients	72	77	149
No (%) with rib fractures	18 (25.0)	1 (1.3) ***	10 (6.7) ***
Mean No of rib fractures per case with rib fractures	3.7	2.0†	1.6**
No (%) of patients with any fracture seen on chest radiograph	20 (27.8)	1 (1.3)***	10 (6.7)***

Significance of difference from group with alcoholic liver disease: ***p* < 0.01; ****p* < 0.001.

† One case only.

TABLE II—Comparison of patients with alcoholic liver disease with and without any fracture seen on chest radiograph

	Mean age (years)	% Male	% Non-manual	% Cirrhotic	% Alcoholism unsuspected
With fractures	60.7	72	66	55	56
Without fractures	51.7	69	65	41	77
<i>p</i>	<0.01	NS	NS	NS	NS

NS = Not significant.

TABLE III—Specificity and sensitivity of fractures seen on chest radiograph in diagnosis of alcoholic liver disease

	Criterion		
	Bilateral and/or >2 rib fractures	Any rib fracture	Any fracture seen on chest radiograph
% Sensitivity, alcoholic liver disease	16.7	25.0	27.8
% Specificity, alcoholic liver disease <i>v</i> non-alcoholic liver disease	100.0	98.7	98.7
% Specificity, alcoholic liver disease <i>v</i> controls	100.0	93.1	93.1

combined non-alcoholic liver disease and control groups 11 of 226 patients were found to have rib fractures but only one had more than two fractures which also happened to be bilateral. This patient was a control for the non-alcoholic liver disease group and therefore does not appear in the sensitivity and specificity calculations. The 10 other subjects had unilateral and two or fewer fractures each. Thus the strict criterion of bilateral or multiple (more than two) rib fractures, or both, detected alcoholic patients with a specificity of 100% and a sensitivity of 16.7%. With less stringent criteria (any rib fracture or any fracture seen on the chest radiograph) the specificity of radiological findings decreased slightly but their sensitivity in detecting patients with alcoholic liver disease improved to between 25% and 28%.

Routine detection and interpretation of rib fractures—To assess the normal reporting rate of rib fractures on chest radiographs we examined the routine departmental reports of all subjects with rib fractures. In only 13 out of 29 cases were the rib fractures reported, and in none of these was any interpretation volunteered. To investigate the importance attached to the chance finding of rib fractures we conducted a pilot survey among clinicians inquiring what clinical significance, if any, they would attach to the following report on a chest radiograph in an adult: "The heart size is normal and the lungs are clear. Old bilateral rib fractures are noted." Of the 21 who replied, 16 did not associate the possibility of alcoholism with this report.

Discussion

This study shows that rib fractures seen on a chest radiograph, particularly when bilateral or multiple (more than two), are a highly characteristic finding in patients with alcoholic liver disease. Using the radiological criterion of bilateral or multiple (more than two) rib fractures, or both, we diagnosed alcoholic liver disease with a specificity of 100%—that is, all patients with this pattern of fractures on the chest radiograph had alcoholic liver disease—and a sensitivity of 16.7%—that is, this radiological criterion detected only 16.7% of all patients with alcoholic liver disease. When the criterion was relaxed to include any fracture visible on the chest radiograph (in our series this included two clavicular fractures) the specificity was reduced slightly to about 95%, but the small increase in false-positive results was compensated by increased sensitivity of detection of the disease to 28%. It would therefore seem sensible to use the latter criterion to optimise case detection and exclude any false-positive results on the basis of history or other investigations.

We considered whether the fractures observed in alcoholic patients might have been "cough" fractures. Alcoholics have an increased risk of pneumonia and bronchitis,² and excessive drinking is often accompanied by heavy smoking.^{3,4} Review of 237 cases from three studies⁵⁻⁷ on cough fractures showed that in 84% the fractures were in the sixth to 10th ribs, which is closely similar to the proportion (86.4%) in our series. Cough fractures, however, were predominantly axillary (93% in one series),⁸ bilateral in only 9.7% of patients (combined data as above), and multiple (more than two) in only 15.2% of cases,⁵ whereas in alcoholic liver disease they were axillary in 40%, bilateral in 38.9%, and multiple in 61.1% of cases. Thus although cough fractures may have contributed to our findings in alcoholic liver disease, these pattern differences suggest that they were not a major factor.

Both osteomalacia and osteoporosis have been described in alcoholic liver disease.⁸ The part that metabolic bone disease might have played in producing rib fractures, however, has not been examined in detail. Various findings suggest that it did not make an important contribution. Bone pain was not a feature in any patient with alcoholic liver disease, and the radiographic appearances of the fractures were not those of Looser zones seen in osteomalacia. The very low prevalence of fractures (1.2%) in non-alcoholic liver disease suggests that liver-related bone disease on its own was unlikely to have accounted for the very high prevalence (28%) seen in alcoholic liver disease. More detailed studies are required to determine whether osteoporosis or osteomalacia contributes to the increased prevalence of rib fractures in alcoholic liver disease.

An association between alcoholism and accidental injury is well recognised. Fractures have been reported as being four times more common in alcoholics than in non-alcoholic subjects, and alcoholism is an important contributory factor in fractures of the upper end of the humerus and femoral neck.⁹ Of patients presenting to a fracture clinic and found to have three or more fractures in different chronological stages of healing, 62% were alcoholic, and the term "battered alcoholic syndrome" has been coined to describe this group.¹⁰ Though most of the chest fractures that we observed were probably due to trauma, the alcoholic patients in our series rarely volunteered a history of relevant injury. Moreover, in only two out of 10 cases was there clear evidence that the fractures were of different ages. Interestingly there was also no social class difference in the prevalence of fractures. These might have been expected to be more frequent in manual workers, in whom spree drinking and acute intoxication is common¹¹ and might be expected to result in an increased risk of self-injury.

In clinical practice recognising problem drinkers is often dependent on using specially designed questionnaires¹²⁻¹⁶ or on using haematological and biochemical markers, the most useful being serum γ -glutamyltranspeptidase activity and red cell mean corpuscular volume.^{13 17-20} Scrutiny of routine chest radiographs might provide a useful adjunct to these methods in recognising alcoholism. In this respect the chest radiograph has certain advantages over conventional screening procedures. Whereas structured questionnaires are rarely applied in day-to-day clinical practice for various reasons, including lack of time and availability, chest radiography is a commonly available and routinely performed examination. Some biochemical tests need a high index of clinical suspicion of alcoholism before they are applied (γ -glutamyltranspeptidase activity); furthermore, increases in γ -glutamyltranspeptidase activity or mean corpuscular volume fall towards normal after a period of abstinence,¹⁹ while rib fractures commonly persist as permanent markers.

Though patients in the alcoholic liver disease group with rib fractures were older than those without fractures, there was no significant difference between the two groups in the proportion with cirrhosis or in the numbers already considered to be alcoholic at the time of chest radiography before definitive diagnosis by biopsy. Thus the (earlier) detection of fractures could have made a positive contribution both to diagnosis and to the prevention of irreversible liver disease. Fewer than half of the cases we detected with rib fractures, however, had been reported by radiologists, and in those cases where old fractures had been noted on the chest radiograph no interpretation was offered. Also our survey of hospital clinicians indicated that only about a quarter associated rib fractures with alcoholism. These findings are perhaps not surprising, since the association does not appear to be widely recognised (and is not mentioned in standard texts on radiology or liver disease or in recent reviews on the detection of alcoholism). When the chest radiograph has features which we consider suggestive of alcoholism, radiological under-reporting and clinical unawareness would result in only one in eight possible cases being detected on the basis of an abnormal chest radiograph.

The above association may well apply to alcoholism other than in liver disease, and we suggest that all fractures noted on chest

radiographs should be reported and the possibility of alcoholism considered.

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ROCK SAMPHIRE grows up with a tender green stalk about half a yard, or two feet high at the most, branching forth almost from the very bottom, and stored with sundry thick and almost round (somewhat long) leaves of a deep green colour, sometimes two together, and sometimes more on a stalk, and sappy, and of a pleasant, hot, and spicy taste. At the top of the stalks and branches stand umbels of white flowers, and after them come large seed, bigger than fennel seed, yet somewhat like it. The root is great, white, and long, continuing many years, and is of an hot and spicy taste likewise.

It grows on the rocks that are often moistened at the least, if not overflowed with the sea water. And it flowers and seeds in the end of July and August.

It is an herb of Jupiter, and was in former times wont to be used more than now it is; the more is the pity. It is well known almost to every body, that ill digestions and obstructions are the cause of most of the diseases which the frail nature of man is subject to; both which might be remedied by a more frequent use of this herb. If people would have sauce to their meat, they may take some for profit as well as for pleasure. It is a safe herb, very pleasant both to taste and stomach, helps digestion, and in some sort opening obstructions of the liver and spleen: provokes urine, and helps thereby to wash away the gravel and stone engendered in the kidneys or bladder. (Nicholas Culpeper (1616-54) *The Complete Herbal*, 1850.)