Liver abnormalities and liver membrane autoantibodies in systemic lupus erythematosus

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**Summary** The hepatic involvement of 57 patients with systemic lupus erythematosus (SLE) was studied with special reference to liver membrane autoantibody (LMA). Liver abnormalities were found predominantly in patients with active SLE (27/48 (56%) in active SLE v 3/20 (15%) in inactive SLE). They were, however, rather mild or moderate and tended to disappear as the disease activity of SLE decreased. In this respect the liver abnormalities observed in this study differed from those in patients with lupoid hepatitis. The incidence of LMA in active SLE (8/11 (73%)) was significantly greater than that in inactive SLE (4/12 (33%)). The mean LMA index value in active SLE was 8.3, which was also greater than the 2.9 in inactive SLE. Furthermore, in active SLE the mean LMA titre was significantly higher in patients with liver abnormalities than in those without. These results suggest that LMA may be associated with the activity of SLE and may be one of the factors which cause transient liver abnormalities.

It is well known that systemic lupus erythematosus (SLE) often presents various clinical features owing to multiple organ involvement. For example, lesions in the kidney, lung, or central nervous system have been widely investigated and commonly called lupus nephritis, lupus pneumonitis, and central nervous system lupus respectively. On the other hand, clinical or aetiological aspects of hepatic involvement have not been seriously studied, though a relatively high incidence of some liver abnormalities has been observed—20–70% in cases of SLE.

Liver membrane autoantibody (LMA) was first detected in man by Hopf et al. in 1976 and has been found predominantly in patients with autoimmune chronic active hepatitis or lupoid hepatitis. To our knowledge, however, little is known about the role of LMA in the liver abnormalities occurring in patients suffering from SLE.

In this study we investigated the incidence and clinical features of liver abnormalities and the significance of LMA in association with SLE.

Patients and methods

**Patients**
Fifty seven patients with SLE, one male and 56 female, seen at Kyushu University Hospital between 1978 and 1987, were enrolled in this study. They fulfilled the 1982 revised criteria for the classification of SLE as proposed by the American Rheumatism Association. The patients’ mean age was 32.5 years (range 15–64). The patients were divided into four groups based on their state—that is, with or without SLE activity and with or without liver disease. From these 57 patients, 68 samples (three different serum samples from one patient and two from nine patients) were examined.

**The disease activity of SLE**
SLE activity was assessed according to a statistically validated lupus activity criteria count. The presence of any two or more of the following nine features or groups of features constitutes active SLE: (a) arthritis; (b) laboratory abnormalities, namely positive LE cell preparation or white cell count <4×10^9/l or decreased CH50 or C3, or presence of DNA antibodies; (c) rash or mucous membrane ulcers or alopecia; (d) pleuritis or pericarditis; (e) seizures,
psychosis, organic brain syndrome, or headache due to SLE; (f) vasculitis; (g) haematuria.

With these criteria the SLE activity was classified as active or inactive.

**Assessment of Liver Abnormalities**

As the liver abnormalities in most patients were rather short term and transient, evaluations of liver abnormalities were made by four serum enzymes: serum aspartate transaminase (AST), serum alanine transaminase (ALT), serum alkaline phosphatase, and lactic dehydrogenase. When two or more enzymes, including at least one of the transaminases, were increased liver abnormalities were considered to be present. Other causes of increased enzyme activities, especially heart or muscle disease, were excluded. Previous experience was used to define serum enzyme increases as follows: serum AST >45 IU/l (normal range 0-40), serum ALT >40 IU/l (0-35), serum alkaline phosphatase >120 IU/l (30-110), and lactic dehydrogenase >280 IU/l (120-250).

**Assay of Liver Membrane Autoantibody**

Liver membrane autoantibody titres were assayed in 38 serum samples obtained from 33 patients with SLE. In addition to the normal controls, four patients with hepatitis B surface antigen (HBsAg) positive chronic active hepatitis, which had been histologically diagnosed, were also examined.

LMA titres were measured using rat liver cell coating plates, according to the radioimmunoassay techniques of Kronborg et al. Fresh rat liver cell coating plates (2×10⁵ cells/well) were fixed with 3% paraformaldehyde solution. Serum samples (50 µl) were added to each well with 500 µl of TRIS buffered saline (50 mM TRIS; 2% bovine serum albumin; 20 mM EDTA-2Na; 0.05% Tween; 10% sheep serum; 0.05% NaCl; pH 7.5), and the plates were incubated for 16 hours at 25°C on the shaker. The plates were washed three times with 0.05% Tween-saline, then 500 µl of 125I labelled protein A in phosphate buffered saline (PBS) (10^5 cpm) was added to each well, followed by one hour's incubation at 25°C on the shaker. The plates were then washed three times with 0.05% Tween-saline, 500 µl of 0.5 M acetic acid was added to each well, and free 125I labelled protein A was removed. Finally, each well was counted for radioactivity. The LMA titre was expressed as an index value (IV), which was defined by the formula: (sample counts - normal control counts)×10/normal control counts, and the LMA was judged as + (IV≥2.0), ± (2.0>IV≥1.0), or - (IV<1.0). Fourteen serum samples from healthy persons were used as controls.

**Liver Membrane Autoantibody Detection by Immunofluorescence**

Fresh rat liver cells were cultured on cover glasses in wells (2×10⁵ cells/well) for two days at 37°C. The cover glasses were washed with PBS, fixed with acetone for 10 minutes, and then dried. Serum samples, diluted 1:10 with PBS, were then placed on the cover glasses and incubated in a 100% moisturised plastic box for one hour at 37°C. The cover glasses were washed with PBS, dried, and then filled with 1:5 diluted fluorescein isothiocyanate conjugated goat antihuman immunoglobulin (MBL, Nagoya, Japan). They were again incubated in a 100% moisturised plastic box for one hour at 37°C. Thereafter, they were washed with PBS and mounted with 50% glycerin-PBS for observation by a fluorescence microscope. For immunofluorescence in living hepatocytes, suspended cells (1×10⁸) were incubated with 100 µl serum diluted 1:10 at 4°C. After 30 minutes of incubation the cells were washed three times with PBS, then incubated with 50 µl of 1:50 dilution of fluorescein isothiocyanate conjugated goat antihuman immunoglobulin at 4°C for 30 minutes, and washed three times with PBS. The final cell pellets were suspended in 20 µl of 50% glycerin-PBS, mounted on slide glasses, and examined by fluorescence microscopy.

**Statistical Analysis**

A χ² test was used to assess the differences in the incidence of liver dysfunction and that of LMA. Student's t test was used to assess the differences in mean LMA titre among the groups. Results are expressed as means (SD).

**Results**

**Incidence of Liver Abnormalities**

Sixty eight serum samples from 57 patients with SLE were evaluated for liver functions. Liver abnormalities were seen in 29 of 48 (60%) samples from patients with active SLE and in six of 20 (30%) inactive SLE samples. Two patients in the former group and one in the latter were found to have fatty liver and two patients in the latter were diagnosed as having drug induced hepatitis. When these samples were excluded the incidence of liver abnormalities probably due to SLE was 27 of 48 (56%) in the group with active SLE and three of 20 (15%) in the inactive SLE group. These results suggested that liver abnormalities were found predominantly in patients with active SLE (p<0.005). In most of our patients liver abnormalities developed at the onset or during the exacerbation of SLE. Furthermore, none of the patients took non-steroidal anti-
inflammatory drugs, including aspirin. We gave immunosuppressive drugs to some patients, two of whom developed obvious drug induced liver dysfunctions as mentioned above. We used no other drugs that were supposed to induce liver abnormalities. Hence these liver abnormalities were considered to be associated with the SLE itself and not with drugs.

Liver enzyme values in active SLE with liver abnormalities

Of the 27 patients with liver abnormalities and active SLE, increases of serum AST, serum ALT, lactic dehydrogenase, and serum alkaline phosphatase were generally mild or moderate (mean (SD): serum AST 278 (314) IU/l, serum ALT 201 (189) IU/l, lactic dehydrogenase 428 (159) IU/l, serum alkaline phosphatase 165 (173) IU/l). Only five serum samples presented with serum AST>500 IU/l, and only one serum sample showed serum ALT>1000 IU/l. The number of cases with serum ALT>500 IU/l was only two. In 24 of the 27 cases (89%) increases of transaminases were transient and decreased in parallel with the inactivation of SLE by treatment. Figure 1 shows the changes in serum AST and serum ALT values as the SLE changes from active to inactive. No patient had jaundice or hyperbilirubinaemia.

Liver membrane autoantibody titres

Thirty eight serum samples from 33 patients with SLE were assayed for LMA (Table 1 and Fig. 2). We found LMA in 21/25 (84%) samples from active SLE and in only 5/13 (38%) from patients with inactive SLE (p<0.005). In active SLE samples LMA was found in 13/14 (93%) of those with liver abnormalities and in 8/11 (73%) of those without abnormalities, but the difference was not statistically significant. On the other hand, the incidence of LMA in inactive SLE without liver abnormalities was 4/12 (33%), significantly lower than that of active SLE samples (p<0.05). In addition, as shown

Table 1 Incidence of liver membrane autoantibody in patients with or without disease activity of systemic lupus erythematosus and liver abnormalities

<table>
<thead>
<tr>
<th>State of SLE†</th>
<th>No (%) of LMA† positive samples</th>
<th>Total No (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>With liver abnormalities</td>
<td>Without liver abnormalities</td>
</tr>
<tr>
<td>Active (n=25)</td>
<td>13/14 (93)</td>
<td>8/11 (73)*</td>
</tr>
<tr>
<td>Inactive (n=13)</td>
<td>1/1 (100)</td>
<td>4/12 (33)</td>
</tr>
</tbody>
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*p<0.05 compared with inactive SLE without liver abnormalities; **p<0.005 compared with inactive SLE.
†SLE=systemic lupus erythematosus; LMA=liver membrane autoantibody.

Fig. 1 Changes of (a) serum aspartate transaminase (AST) and (b) serum alanine transaminase (ALT) values as the systemic lupus erythematosus (SLE) changes from active to inactive during a period of two to 12 months.
In Fig. 2a, the mean LMA index value in active SLE samples was significantly higher than that in inactive SLE (p<0.05). It was also found that among patients with active SLE the LMA index value was significantly higher in patients with liver abnormalities than in those without (p<0.05) (Fig. 2b). The four patients with HBsAg positive chronic active hepatitis all showed a negative test for LMA (data not shown).

Figure 3 shows that the LMA titre is inversely correlated with the CH$_{50}$ value, which is one of the indices of disease activity. This result may support the above mentioned relation between LMA and disease activity of SLE. Moreover, in five patients whose SLE was initially active LMA titre fell as the disease activity of SLE decreased during a period of two to 12 months (Fig. 4). These results indicate that LMA may be associated with the disease activity of SLE and, if not entirely, then partly, with the liver abnormalities in SLE.

**RELATION BETWEEN LIVER MEMBRANE AUTOANTIBODY AND ANTINUCLEAR ANTIBODIES**

As antinuclear antibodies are found in the serum samples of most patients with SLE there was a strong correlation between LMA and antinuclear antibodies (r=0.42, p<0.001). Figure 5 shows that the LMA titre is inversely correlated with the CH$_{50}$ value, which is one of the indices of disease activity. This result may support the above mentioned relation between LMA and disease activity of SLE. Moreover, in five patients whose SLE was initially active LMA titre fell as the disease activity of SLE decreased during a period of two to 12 months (Fig. 4). These results indicate that LMA may be associated with the disease activity of SLE and, if not entirely, then partly, with the liver abnormalities in SLE.
investigated.

No LMA treatment.3 

Kofman et al observed hyperbilirubinaemia in 27% 
and jaundice in 12% of 25 patients with SLE.16

In patients with SLE histologically non-specific 
and mild liver changes are common, but severe 
damage is rare.8 16-19 Benner et al, analysing 375 
cases of SLE with hepatic involvement in 18 
publications, concluded that the liver damage was 
not severe and would never be the cause of death.19

On the other hand, in several papers severe 
liver damage in SLE has been reported.5 20 but its 
difference from cases of autoimmune hepatitis is still 
controversial.21-25 There seem to be no clear criteria 
for distinguishing hepatic involvement in SLE from 
autoimmune hepatitis. Although we did not 
examine our patients histologically, we found no 
clinical evidence of chronic active hepatitis. Thus 
there seems to be a type of liver abnormality 
in patients with SLE which is clinically distinct from 
lupoid or autoimmune hepatitis because of its 
transiency, mild or moderate transaminase increase, 
or absence of an increase in total bilirubin. Liver 
abnormalities of this type in SLE may be identical to 
"hepatic lupus", first named by Mackay et al.18 which 
means a mild liver dysfunction found in SLE which 
is clinically and histologically different from lupoid 
hepatitis.

Autoantibodies to liver membranes are 
commonly classified into two types. One is the antibody 
to liver specific membrane lipoprotein26 27 and the 
other is LMA.9 Some studies have shown that these 
antibodies are each directed against different 
anti-gens of liver membranes.10 28 Although antibodies 
to liver specific membrane lipoprotein have been 
detected in both acute and chronic hepatitis 

dependently of HBsAg,26-29 LMA has been found 
predominantly in patients with autoimmune chronic 
active hepatitis.11 12 30 So far, 40-70% of patients 
with autoimmune chronic active hepatitis have been 
reported to be positive for LMA.11 12 30 Frazer et al 
reported that LMA titres correlated with the activity 
of autoimmune chronic active hepatitis.11 The 
pathogenetic significance of these autoantibodies is 
still unsettled, but some investigators consider that 
antibody dependent, cell mediated cytoxic 
reaction is a major effector mechanism.31 32

It seems, however, that not very much attention 
had been paid to LMA in association with SLE or 
hepatic involvement of SLE. In the limited number 
of publications available the incidence of LMA in 
patients with SLE has been reported to be low; 
Frazer et al found no difference in LMA titres of 14 
patients with SLE and normal individuals,11 and 
Wiedmann et al rarely observed LMA in patients

Discussion

In this study we investigated the hepatic involve-
ment in SLE and the association of LMA with the 
disease activity of SLE and liver abnormalities.

Rothfield reported raised liver enzyme activities 
in about 30% of patients with SLE at the time of 
diagnosis when active disease was evident and found 
that they returned to normal with corticosteroid 
treatment.9 Morito et al also observed a coincidental 
transaminase increase in 11/23 patients during an 
exacerbation of SLE.7 In our study liver abnormali-
ties not due to drugs, but probably due to SLE, were 
found in 27/48 (56%) patients with active SLE and 
in only 3/20 (15%) of those with inactive SLE, which 
is compatible with previous reports. The increase of 
serum transaminase concentration was mild or

Fig. 6 Relation between liver membrane autoantibody (LMA) index values and antinuclear antibody (ANA) titres.
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with SLE.12 They scarcely discussed the role of LMA in SLE. In contrast, we showed a high incidence of LMA in patients with active SLE, and also showed that LMA titres fell in parallel with the decrease of SLE activity in five patients. It was also found that LMA titres correlated inversely with CH50. These results suggest that LMA may be associated with the disease activity of SLE. Moreover, the titres of LMA were significantly higher in patients with SLE with liver abnormalities than in those without them, indicating that LMA may be involved in the liver damage observed in SLE. LMA was negative in all four patients with HBsAg positive chronic active hepatitis. This is compatible with other reports, which showed a tendency for LMA to be less commonly detected in patients with HBsAg positive chronic active hepatitis than in those with autoimmune chronic active hepatitis.12 13 30 For example, Toda et al reported that LMA was detected more often in patients with HBsAg negative liver cirrhosis than in those with the HBsAg positive form (six of 13 v two of 11).30

When the serum samples of LMA positive patients with SLE were used fluorescence staining was observed more brightly on the surface and cytoplasm of fixed rat hepatocytes and the surface of living rat hepatocytes than in the nucleus. This staining pattern confirmed the results obtained by radioimmunoassay, which indicated that LMA is against the antigen of the membrane rather than against the nucleus of hepatocytes. These facts exclude the possibility that LMA obtained by radioimmunoassay may reflect antinuclear antibodies, which most patients with SLE possess.

In general, various autoantibodies, such as antinuclear antibody, rheumatoid factor, or platelet associated IgG, appear in association with hypergammaglobulinaemia in active SLE. LMA may also be one of them. As there was statistical significance between the LMA titres of patients with and without liver abnormalities, however, we suggest that LMA is an autoantibody which appears during the active phase of SLE and which participates, if not entirely, then partly, in the autoimmune pathogenesis of the hepatic involvement in SLE. The results obtained here also indicate that the liver abnormalities due to SLE may share the same cause as lupoid or autoimmune hepatitis, though their clinical features are clearly distinct. Further studies are needed to clarify the clinical significance and the basal mechanism of LMA.

References


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