The association between aneurysm of the abdominal aorta and peptic ulceration

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SUMMARY In a survey of 7,044 necropsies there were 99 cases of aneurysm of the abdominal aorta and 523 cases of peptic ulceration. The incidence of peptic ulceration in the general necropsy population was 7·2% whilst in cases with aneurysm it was 22·6%.

There was a significant increase in duodenal ulceration in males with abdominal aortic aneurysms. The possible causes for this increased incidence are discussed.

An association between abdominal aortic aneurysms and peptic ulceration has not been previously described. It was noted by one of us (K.B.) that there appeared to be an increased incidence of symptoms of peptic ulceration in patients presenting with aneurysms of the abdominal aorta. As a result of this observation we decided to carry out a retrospective survey of necropsy material to investigate the possibility of such an association.

Method and Results

METHOD
The necropsy reports of a general teaching hospital for the years 1954-1966 inclusively were examined and all cases of abdominal aortic aneurysm and established peptic ulceration were extracted. The age, sex, reason for admission to hospital, and principal causes of death were noted in each case. Since aneurysms frequently present in conjunction with other diseases such as hypertension and ischaemic heart disease, and as these other diseases might be the reason for admission to hospital or might be significant factors in producing an apparent association between aneurysm and peptic ulcer, it was decided that the incidence of any associated disease which occurred frequently should also be noted. The number of necropsies per year and the distribution of aneurysms and peptic ulcers are given in Table I, together with the annual and overall incidence. During this 13-year period there were 99 aneurysms and 553 peptic ulcers. In the ulcer group 30 people had both a gastric and duodenal ulcer thus making 523 cases of peptic ulceration in all.

ANEURYSM
The majority of the aneurysms were situated below the level of origin of the renal vessels with some of them also involving the aortic bifurcation. As far as could be ascertained, all the aneurysms, except for that in one woman aged 28, were atherosclerotic in type. None of the cases showed macroscopic or histological evidence of syphilis nor was there any evidence of a primary aortitis, and there were no mycotic aneurysms. Three cases were associated with an aneurysm of the descending thoracic aorta and in five cases there were associated aneurysms of the iliac arteries.

As has been shown in previous reports, abdominal aortic aneurysms are lesions dependent on age, and this is borne out in the present survey where 96% of the cases were over the age of 50. The highest incidence of aneurysms in males is in the eighth decade, and in females in the ninth decade. The distribution of the aneurysms by age and sex is shown in Table II.

The reasons for admission to hospital of the
The incidence of peptic ulcers and abdominal aortic aneurysms in the necropsy material in 1954-66

The total number of gastric and duodenal ulcers was 553.

Distribution of aneurysms by age and sex

Anatomy group are shown in Table III. Forty-eight of the 99 cases (48%) were admitted expressly for surgical treatment of the aneurysm. The principal causes of death in patients with aneurysms is shown in Table IV. As might be expected, 54 of the 99 patients (54%) died as a result of the aneurysm while a further 20 (20%) died of ischaemic heart disease. Six (6%) died as a result of peptic ulceration. There were in addition two cases of gastric carcinoma. In one (a male, aged 65) there was an associated chronic duodenal ulcer.

There was a high incidence of ischaemic heart disease and hypertension in the aneurysm population: 28 of the 78 males (35%) and 10 of the 21 females (47%) suffered from ischaemic heart disease, and 47 of the males (60%) and 10 of the females (47%) had a significant left ventricular hypertrophy. The prevalence of these conditions compared with the general necropsy population has not been exactly estimated, but from a survey of the year 1966 the figures for males of a similar age are not strikingly different. In contrast, the females with aneurysms appear to have approximately double the incidence of ischaemic heart disease and hypertension compared with the general necropsy population. There was a very high incidence of rupture of the aneurysms in females in the ninth decade, when four out of six cases presented with rupture compared with a much lower rate in the rest of the aneurysm population.

Peptic Ulcer
The distribution of peptic ulcer by age, sex, and type is shown in Table V. All ulcers of a superficial erosive type were excluded; most ulcers were of an established chronic nature. The overall incidence of peptic ulceration was 7.4%, which is a considerably lower incidence compared...
with that of some other published necropsy series. Watkinson (1960) found an incidence of 21% in males and 11% in females in his series. The difference in ulcer incidence between the two series is mainly due to the fact that Watkinson had a high incidence (65%) of ulcer scars. In the present series, although the exact incidence of ulcer scars was not specifically estimated, it formed approximately 10% of the total cases. Thus the incidence of active chronic ulcers is comparable in the two series. It should be noted that when a previous gastrectomy or gastro-enterostomy had been performed and where there was information available regarding the nature of the lesion requiring operation, this was included in the appropriate columns.

Eighty-nine of the cases with duodenal ulcer and 88 of the cases with gastric ulcer were admitted as a result of ulcer symptoms, making a total of 177 (33.7%). It can be seen from Table V that the greatest prevalence of ulcers occurs in the seventh decade. But if the percentage incidence of ulcers is calculated for each decade the highest incidence occurs in the eighth decade, apart from the occurrence of gastric ulcers in females in whom the highest incidence is in the ninth decade. Males show a higher incidence of peptic ulceration than females; this sex difference is particularly marked in the case of duodenal ulcers. Of the 523 ulcer patients, 186 (35%) died as a direct result of the ulcer or following surgical treatment for the ulcer. In the remaining 337 cases (65%) the ulcers were an incidental finding at necropsy.

ASSOCIATED ABDOMINAL AORTIC ANEURYSMS AND PEPTIC ULCERS

Twenty-two of the aneurysm cases were associated with a peptic ulcer. The age and sex distribution of this subgroup is shown in Table VI.

In addition to these 22 patients, a 66-year-old male with an aneurysm gave a history of a perforated duodenal ulcer which had required surgery 15 years before death. This case is not included in the series as no duodenal ulceration or scarring was seen at necropsy. The reason for admission to hospital of this group of cases with peptic ulcers and associated aneurysms and the immediate cause of death is shown in Table VII. One patient was admitted to hospital for gastrectomy for a large gastric ulcer but died after operation from rupture of an unsuspected aneurysm, and another patient was admitted having had a haematemesis, and at necropsy a ruptured aortic aneurysm and a bleeding duodenal ulcer were found.

It can be seen from Table VII that 17 of the 22 patients (77%) of the group with aneurysms and ulcers were admitted to hospital because of aneurysm or ulcer symptoms: 10 cases (45%) were admitted for aneurysm symptoms compared with 48% in the aneurysm group as a whole, the remaining seven cases (32%) were admitted because of ulcer symptoms compared with 34% in the total ulcer group. Eight of the 20 males (40%) had ischaemic heart disease and 10 males (50%) and one female had left ventricular hypertrophy. The incidence of symptoms and disease processes in this subgroup is very similar to that noted in the general aneurysm population.

The incidence of peptic ulcers in patients without aneurysms is tabulated in Table VIII, and similarly the incidence of peptic ulcers in patients with abdominal aortic aneurysms is set out in Table IX. Since the majority of aneurysms occur in patients over the age of 50, the incidence of ulcers has been calculated for this subgroup as well as for the total necropsy population. The incidence of peptic ulcers in males and females without aneurysms is 9.1% and 4.7% respectively, whilst in those with aneurysms it is 25.6% and 9.5% respectively. In persons over
the ages of 50 these percentages are slightly, but not significantly, increased. Thus there is between a two- and threefold increase in the incidence of peptic ulceration in males over the age of 50 and a twofold increase in females in the same group, although the number of cases is very small in the latter group.

Using the $\chi^2$ test there is a significant association in males between aneurysm and peptic ulcer ($p < 0.001$) but not in females ($0.3 < p < 0.4$).

To exclude the factor of selection which occurs in a hospital necropsy population (many of our cases were admitted to hospital for ulcer or aneurysm symptoms) it was decided to investigate separately those cases of ulcers which were found by chance and those in which death was attributable to the ulcer (ulcer deaths). Similarly the aneurysm population was divided into those cases where the aneurysm was identified by chance and aneurysm deaths. The ulcer cases were further subdivided into those with gastric or duodenal ulcers (Table X). The females were not analysed since the two females with ulcers and aneurysms both had gastric ulcers and both died as a result of the aneurysm. The distribution of the male population in the subgroups is shown in Table XI.

A further factor which must be considered is the difference in age and sex distribution of the populations at risk. In order to allow for this factor in the series the expected numbers of cases with combined ulcers and aneurysms was calculated using a modification of the method used by Watkinson (1958). In this method the incidence of aneurysm in the groups without ulcers and of ulcers in the population without aneurysms was calculated for each group and used as controls. From these figures the expected numbers per decade were calculated for the subgroups of chance ulcers and ulcer deaths and chance aneurysms and aneurysm deaths, these groups being further subdivided into cases with gastric and duodenal ulcers.

Since the expected numbers of such cases per decade are small it was considered inaccurate to do a statistical analysis by decade. Instead the expected numbers for each decade were totalled and these are compared with the observed numbers and the degree of significance in Tables XII and XIII. It can be seen that the expected number never exceeds the observed number and that while the numbers with gastric ulcers and aneurysms are up to twice the expected value this is without statistical significance. But for duodenal ulcers the observed numbers are up to five times the expected value, and this is highly significant ($p < 0.001$) for duodenal ulcer cases in chance aneurysm cases, and similarly for aneurysms in chance duodenal ulcer cases.

The association between duodenal ulcer and aneurysm can thus be demonstrated both ways. This technique does have the advantage of balancing the selectivity factor which invariably occurs in a hospital necropsy series.

### Discussion

An association between peptic ulceration and abdominal aortic aneurysm has not been recorded previously, although two patients in the series of abdominal aortic aneurysms described by Schatz, Fairbairn, and Juergens (1962) died as a result of bleeding duodenal ulcers. The present series is based on necropsy figures and as such is open to the criticism that these figures are neither representative of the hospital population nor of

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**Table X** Types of ulcers in patients with aneurysm and peptic ulcer

<table>
<thead>
<tr>
<th>Type of Ulcer</th>
<th>Male</th>
<th>Female</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Active ulcers</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Duodenal</td>
<td>11</td>
<td>—</td>
<td>11</td>
</tr>
<tr>
<td>Gastric</td>
<td>4</td>
<td>2</td>
<td>6</td>
</tr>
<tr>
<td>Aneurysm</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Duodenal</td>
<td>1</td>
<td>—</td>
<td>1</td>
</tr>
<tr>
<td>Gastric</td>
<td>1</td>
<td>—</td>
<td>1</td>
</tr>
<tr>
<td>Previous gastric operation</td>
<td>2</td>
<td>—</td>
<td>2</td>
</tr>
<tr>
<td>Duodenal</td>
<td>1</td>
<td>—</td>
<td>1</td>
</tr>
</tbody>
</table>

**Table XI** The incidence of aneurysm deaths and chance aneurysms in males with duodenal and gastric ulcers subdivided into chance ulcers and ulcer deaths

<table>
<thead>
<tr>
<th></th>
<th>Expected</th>
<th>Observed</th>
<th>Significance</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total number of ulcers in chance aneurysms</td>
<td>3.5</td>
<td>11</td>
<td>—</td>
</tr>
<tr>
<td>Number of duodenal ulcers in chance aneurysms</td>
<td>1.7</td>
<td>9</td>
<td>$p &lt; 0.001$</td>
</tr>
<tr>
<td>Number of gastric ulcers in chance aneurysms</td>
<td>1.6</td>
<td>2</td>
<td>$p = 0.479$</td>
</tr>
<tr>
<td>Number of ulcers in aneurysm deaths</td>
<td>4.4</td>
<td>9</td>
<td>—</td>
</tr>
<tr>
<td>Number of duodenal ulcers in aneurysm deaths</td>
<td>2.1</td>
<td>5</td>
<td>$p = 0.057$</td>
</tr>
<tr>
<td>Number of gastric ulcers in aneurysm deaths</td>
<td>2.0</td>
<td>4</td>
<td>$p = 0.138$</td>
</tr>
</tbody>
</table>

**Table XII** Expected and observed number of ulcers in chance aneurysms and aneurysm deaths in males

<table>
<thead>
<tr>
<th></th>
<th>Expected</th>
<th>Observed</th>
<th>Significance</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total number of aneurysms in chance ulcers</td>
<td>40</td>
<td>14</td>
<td>—</td>
</tr>
<tr>
<td>Number of aneurysms in chance duodenal ulcers</td>
<td>1.9</td>
<td>9</td>
<td>$p &lt; 0.001$</td>
</tr>
<tr>
<td>Number of aneurysms in chance gastric ulcers</td>
<td>2.5</td>
<td>5</td>
<td>$p = 0.119$</td>
</tr>
<tr>
<td>Total number of aneurysms in ulcer deaths</td>
<td>2.3</td>
<td>6</td>
<td>—</td>
</tr>
<tr>
<td>Number of aneurysms in duodenal ulcer deaths</td>
<td>1.6</td>
<td>5</td>
<td>$p = 0.037$</td>
</tr>
<tr>
<td>Number of aneurysms in gastric ulcer deaths</td>
<td>1.0</td>
<td>1</td>
<td>Not significant</td>
</tr>
</tbody>
</table>

**Table XIII** Expected and observed numbers of aneurysms in chance ulcers and ulcer deaths in males

<table>
<thead>
<tr>
<th></th>
<th>Expected</th>
<th>Observed</th>
<th>Significance</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total number of aneurysms in chance ulcers</td>
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<td>14</td>
<td>—</td>
</tr>
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<td>9</td>
<td>$p &lt; 0.001$</td>
</tr>
<tr>
<td>Number of aneurysms in chance gastric ulcers</td>
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<td>5</td>
<td>$p = 0.119$</td>
</tr>
<tr>
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<td>1.0</td>
<td>1</td>
<td>Not significant</td>
</tr>
</tbody>
</table>
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...the population at large. Indeed a patient suffering from two such serious complaints is more liable to be admitted to hospital. While in some of the present cases this may be so, it must be noted that our series was drawn from three separate groups: those patients admitted to hospital with an aneurysm and subsequently found to have an ulcer; those patients with a peptic ulcer subsequently found to have an aneurysm; and a third group of patients admitted for some other reason but later found (usually at necropsy) to have both an aneurysm and an ulcer. The group of patients having both an aneurysm and an ulcer has been investigated to see if there are any special features which distinguish them, but so far as can be ascertained they do not differ in any way from the main aneurysm or ulcer population in severity or type of disease. The occurrence of such an association can be accounted for as a direct causal relationship or could be the result of some other aetiological factor common to both conditions.

Non-syphilitic abdominal aortic aneurysms are usually held to be the result of atherosclerotic degeneration, although there is no definite evidence to prove this (Pickering, 1963), and these changes may merely represent a localized increase of the arterial dilatation which occurs with aging irrespective of the extent to which the artery is diseased (Mitchell and Schwarz, 1965). Aortic ectasia or aneurysm formation can occur as the result of a primary aortitis (Marquis, Richardson, Ritchie, and Wigle, 1968) but there was no evidence that any of the present series fell into this category.

Although there does not appear to be any significant association between ulcer deaths and the severity of aortic atheroma (Montenegro and Strong, 1968), Hauser as early as 1883 suggested that there was an association between peptic ulceration and atheroma (Hauser, 1883). Elkeles (1964) has shown an association (in persons over the age of 50) between radiological calcification of the abdominal aorta and its branches and chronic gastric ulcer, and suggested that the ulcers occurred as a result of ischaemia. Some authors (Brooks, Sandweiss, and Long, 1963; Watkinson, 1958) have investigated the incidence of peptic ulceration in ischaemic heart disease and have shown a slight but significantly increased incidence of peptic ulcers, particularly of duodenal ulcers.

Another association between lesions of the stomach and the aorta is the increase in incidence of infected abdominal aortic aneurysms, particularly by organisms of the Salmonella group, in patients with achlorhydria or in patients who have had a partial gastrectomy (Zak, Strauss, and Saphra, 1958; Black, Kunz, and Swartz, 1960a and b). Another case has recently been recorded (Bliss, Maini, and Scott, 1968). In some of these cases it is difficult to ascertain whether these are true myotic aneurysms or infections of an old 'atherosclerotic' aneurysm. Somerville, Allen, and Edwards (1959) have described the differences. However, in the present series there was no evidence that any of the aneurysms were infected. The reason for the increased incidence of infection is possibly due to the reduced antibacterial action of gastric secretions following gastrectomy (Meynell, 1955). It may be that patients with abdominal aortic aneurysms have an increased incidence of peptic ulceration which requires surgery, and following such treatment there is an increased liability to infection of the aneurysm. It is to be noted that seven cases (7%) of the present series had had a gastrectomy or gastroenterostomy.

There is evidence to suggest a non-causal relationship between peptic ulceration and abdominal aneurysm. A possible common factor could be cigarette smoking. A significant relationship between the severity of atheroma and cigarette smoking has been shown by Sackett, Gibson, Bross, and Pickren (1968), and the evidence for a significant relationship between smoking and peptic ulceration has been summarized in the report 'Smoking and health' (1964). Although we have no data on the smoking habits of the present series, further studies would clearly be of interest.

The association to which we are drawing attention can be of clinical importance. One needs to be aware of the possibility of a patient with an aortic aneurysm having an associated ulcer for it may present difficulties of diagnosis, and the stress of operating on an aneurysm may aggravate an ulcer already present.

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References

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