Endoscopic local injection of ethanolamine oleate and thrombin as an effective treatment for bleeding duodenal ulcer: a controlled trial

M Moretó, M Zaballa, M-J Suárez, S Ibáñez, E Ojembarrena, J-M Castillo

Abstract
The injection of a mixture of ethanolamine oleate and thrombin as an effective treatment for bleeding duodenal ulcer was evaluated in 38 patients entered in a randomised prospective controlled trial. After a one week observation period, 1/19 (5-3%) treated patients and 11/19 (57-9%) control patients had suffered further bleeding (p<0.005; CI = 22-74%). Emergency surgery was required in 1/19 in the treated group compared with 8/19 in the untreated group (CI = 13-61%; p<0.05). The mean (SD) transfusion requirement in the treated group was 1-9 (0-5) U blood compared with 5-3 (0-7) U in the control group. No significant differences related to mortality were detected. In conclusion, local injection therapy is an effective means of haemostasis in patients with bleeding duodenal ulcer who are at risk of further bleeding.

Although endoscopy mediated procedures based on thermal therapy (mono- or bipolar electrocauogulation, laser therapy, heater probe) have been considered as successful tools in haemostasis,1 technical difficulties have considerably limited their use. Endoscopic haemostasis by means of monopolar electrocoagulation has been shown to be effective but it is a particularly difficult procedure to undertake in the duodenal cap. In a clinical trial,2 we were obliged to restrict its use to bleeding gastric ulcer patients. Thus, an alternative endoscopic method for treating duodenal bleeding was required.

Thrombin has been used either topically as a spray3 or injected locally,4 with seemingly good results. Local injection of several other substances – adrenaline,5 polidocanol,6 absolute ethanol7 – has proved to be as effective in immediate haemostasis in several uncontrolled trials, but controlled trials have been few,8,9 albeit hopeful.

Comparative studies of different injected substances for bleeding peptic ulcers are lacking, so selection depends greatly on subjective views and partly reflects experience with variceal sclerotherapy. Ethanolamine oleate has been extensively used in variceal sclerosis, mainly in Commonwealth countries. However, we have not been able to find any reference to its use as a sclerosant in bleeding gastroduodenal ulcers. Kitano et al found polidocanol responsible for a greater frequency of complications than ethanolamine.10 Sodium tetradeyl sulphate has been used experimentally in deep ulcers.11 Finally, Sarin found absolute ethanol more effective than ethanolamine, with no differences in respect of complications,12 although in an experimental study absolute ethanol resulted in more necrosis than polidocanol13.

We undertook this controlled clinical trial to evaluate the local injection of thrombosclosants, employing a mixture of a sclerosing agent – ethanolamine oleate – and thrombin as a procoagulant in order to achieve haemostasis in selected patients with bleeding duodenal ulcers.

We decided to combine both substances according to our usual practice in variceal sclerotherapy because ethanolamine plus thrombin is more effective than ethanolamine alone as a haemostatic agent in oesophageal varices.14

Methods

PATIENTS

All patients admitted to hospital with upper gastrointestinal haemorrhage underwent endoscopy as soon as possible, and in every case within 16 hours. Patients with a duodenal ulcer diagnosed as the source of the haemorrhage, in whom active bleeding was present or in whom a non-bleeding vessel was visible, and who had received three or more units of blood at the time of the diagnosis were included in the trial provided that they gave informed consent. According to our endoscopic classification of bleeding ulcer signs (Table I), we included all 1a1 patients and some 1a2 patients. When a clot adhering to the base of the ulcer was found we tried to remove it by means of gentle aspiration. If this was not possible, the patients was not included in the study.

When criteria for inclusion were fulfilled, and if visibility was judged acceptable for thromboscclerosis, a sealed envelope was taken out and

TABLE I Classification and frequencies of bleeding duodenal ulcer, according to endoscopic signs, during the trial

<table>
<thead>
<tr>
<th>Group I: Patients with stigmata of bleeding (211 (95.5%))</th>
<th>Group II: Patients without stigmata of bleeding (10 (4.5%))</th>
</tr>
</thead>
<tbody>
<tr>
<td>1a With a visible vessel (65 (29.4%))</td>
<td>1c1 Oozing (15 (5.9%))</td>
</tr>
<tr>
<td>1a1 Bleeding vessel (30 (13.6%))</td>
<td>1c2 Non-bleeding (84 (38%))</td>
</tr>
<tr>
<td>1a2 Non-bleeding vessel (17 (7.6%))</td>
<td></td>
</tr>
<tr>
<td>Ib Base covered by an unremoved clot (49 (22.2%))</td>
<td></td>
</tr>
<tr>
<td>1b No visible vessel (97 (43.9%))</td>
<td></td>
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<tr>
<td>Total: 221 bleeding episodes</td>
<td></td>
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</tbody>
</table>
the patient was assigned to either the thombo-
sclerosant was administered. Patients were given a
mean of 7.7 ml (range 4–15 ml) of ethanolamine
EXCLUSIONS
Five patients who seemed to meet the inclusion
criteria were excluded because excessive blood collection in the du-
num or duodenal deformity, or both, made
treatment highly problematic and unsafe for
technical reasons. One of them had alcoholic cirrhosis of the liver with suspected untreated hepatocellular carcinoma. Another patient pre-
sented in severe respiratory failure and had a pacemaker. (Exceptionally, he was given thombo-
sclerosis treatment, out of protocol, in very
difficult conditions). Both these patients con-
tinued to bleed and died a few days later. Two patients had to be operated on because of persist-
tent haemorrhage. The remaining patient fol-
lowed an uneventful course, and bleeding stopped spontaneously.

Another patient who presented had suffered a
cerebral stroke which made him highly uncol-
laborative. He was excluded from the study and followed an uneventful course.

MONITORING
An elementary questionnaire, with registration of basic haemodynamic data, was routinely com-
pleted at our unit before the endoscopic pro-
cedure was carried out. After endoscopy a form was filled in, including clinical and endoscopic data. Both groups of patients were treated by gastroenterologists not related to the trial, who were unaware of the applied therapy. They were only informed about the haemorrhagic activity at the end of the endoscopic procedure. Routine medical treatment included standard doses of H2
antagonists (cimetidine and ranitidine).

Evaluation of the effectiveness of treatment was undertaken over a seven day period and included the following: rebleeding, need for emergency surgery, and transfusion require-
ments. Rebleeding was defined as an episode of haematemesis or melaena, or both, with signs of shock or confirmative upper endoscopy, or both. Emergency surgery was defined as surgery carried out during the observation period. Transfusion requirements were measured separately for pre- and postendoscopy periods.

To determine whether there was any worsen-
ing of the ulcer secondary to sclerosant treatment, a control upper endoscopy was routinely under-
taken at the end of the evaluation period in patients treated with thrombospheresis.

ENDOSCOPIC TECHNIQUE
Thrombospheresis of bleeding ulcers was carried out by gastroenterologists who specialised in
endoscopy. An initial dose of 5 ml of 5% ethanolamine oleate (Evans, UK) and 50 U of bovine thrombin diluted in 5 ml of 50% hyper-
tonic glucose was selected. Some 1 ml of each (firstly ethanolamine, then thrombin) was in-
jected alternatively in four to five spots around the
vessel and then on the vessel itself. If the haemorrhage did not stop, a further dose of

<table>
<thead>
<tr>
<th>Age (mean (SD)) (yrs)</th>
<th>Thrombospheresis group (n=19)</th>
<th>Control group (n=19)</th>
</tr>
</thead>
<tbody>
<tr>
<td>54.1 (21)</td>
<td>57.3 (21)</td>
<td></td>
</tr>
<tr>
<td>Sex (M/F)</td>
<td>19/0</td>
<td>16/3</td>
</tr>
<tr>
<td>Ulcer size (mean (SD)) (mm)</td>
<td>9.4 (7)</td>
<td>10.5 (5)</td>
</tr>
<tr>
<td>Hours elapsed before endoscopy (mean (SD)) (hrs)</td>
<td>30.5 (25)</td>
<td>51.9 (27)</td>
</tr>
<tr>
<td>Systolic blood pressure (mean (SD)) (mm Hg)</td>
<td>129 (22)</td>
<td>122.9 (34)</td>
</tr>
<tr>
<td>Blood required (mean (SD)) (U)</td>
<td>2.1 (2)</td>
<td>2.7 (2)</td>
</tr>
</tbody>
</table>

Haemorrhagic activity

-\- Spurring: Spurring 10 6
-\- Oozing: Oozing 5 1
-\- Non-bleeding 1 5

Associated diseases

-\- Ischaemic cardiopathy 1 2
-\- Liver cirrhosis 1 1
-\- Neoplastic disease 1 1
-\- Renal transplantation 1 0
-\- Diabetes 1 2
-\- Respiratory failure 1 2
Rebleeding 1(5-3%) 11(57-9%) 0.19-9(0.01) having registered in advanced cirrhosis drug (0-7) hepatitis of with this known confounding factor ‘I injection, particularly local adrenaline and this drug has been suggested as a natural haemostatic effect of local adrenaline in haemostasis, but this does seem to be the mechanism of action of adrenaline in haemostasis. Added thrombin could potentiate the haemostatic effect of inflammatory substances. In considering the effect of adrenaline in haemostasis, the facts that spontaneous haemostasis occurs with a variable frequency in all series dealing with a bleeding peptic ulcer and visible vessel, including our own experience, and that adrenaline plus polidocanol are more effective than adrenaline alone could be taken into account. It is hard to believe that simple transitory vasoconstrictive agents or mechanical compression could, by themselves, achieve definitive haemostasis when severe disruption of the vessel integrity has occurred.

The requirement for blood transfusion as one of our inclusion criteria is based on reported data according to which transfused blood is directly related to emergency surgery needs. Our control patients experienced a high index of recurrence or persistence of haemorrhage (57.9%), confirming the validity of our criteria as unfavourable prognostic indicators. Taking all this into account, we need larger series to confirm wider prognostic clinical parameters. Although the inclusion of more restrictive criteria makes it easier to obtain positive results with smaller samples, it could easily be argued that some patients who did not meet the criteria could have benefited from thrombosedierosis treatment. As can be seen in Table I, only around 16% of patients with bleeding duodenal ulcer were included in the trial. An apparent additional limitation is that few patients with non-bleeding vessels were included. Most of these patients were not entered because they did not meet the additional clinical criterion concerning transfusion needs. Because our endoscopy unit is available on a 24 hour basis (emergencies are managed by ‘on-call’ system) our bleeding samples are endoscoped early. This explains why few patients lacked stigmata of bleeding and why most of those with a non-bleeding visible vessel had come to the unit before receiving more than two units of blood. On the other hand, some actively bleeding patients entered in the trial only when a haemorrhagic recurrence had taken place, having been previously endoscoped and not included in the trial because a non-bleeding vessel had been identified and less than three units of blood had been administered at the first endoscopy.

Because local injection techniques have emerged at the same time as thermal haemostasis devices are being accepted more and more, it is mandatory to compare both methods. Thrombosedierosis has the advantage of simplicity and applicability, even in the duodenal cap, but there

<table>
<thead>
<tr>
<th>COMPLICATIONS</th>
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<tbody>
<tr>
<td>No serious complications occurred in the trial. Epigastric pain was not induced by the application of thrombosedierosis, nor was it evident during the observation period. The control upper endoscopy undertaken on the seventh day did not show any sign of ulcer width or depth, with the exception of one of the thrombosedierosis patients who experienced a 5 mm increase in ulcer size.</td>
</tr>
</tbody>
</table>

**Discussion**

Mortality secondary to a bleeding duodenal ulcer is considered to be around 12%. About 30% of these patients will need some 5 U of blood during their hospital stay. When emergency surgery is indicated, mortality increases threefold in respect of patients who are not operated on, and this justifies the search for a therapeutic endoscopic procedure to meet these patients' needs.

Our results suggest that thrombosedierosis is effective as emergency treatment for duodenal bleeding ulcer in patients selected according to the criteria we have outlined. We did not take into account the later clinical course of these patients because several subsequent treatments were prescribed, including surgery, which would have introduced bias to our analysis.

The effectiveness of local injection of a peptic bleeding ulcer is generally accepted, but there is no agreement over the proposed mechanism of its action. Some variables, such as ulcer size and site, have been proposed as influencing the effectiveness of the procedure. Some authors have suggested that this treatment works through the compressive action of fluid deposits around bleeding vessel, while others state that action on vascular endothelium with subsequent thrombosis and necrosis are the natural haemostatic course. The diversity of injected agents adds to the confusion over the therapeutic mechanism of local injection, particularly since studies comparing administered substances are lacking. In some studies patients were treated with adrenaline, with apparently good results, despite the lack of any known inflammatory or coagulative action of this substance on bleeding vessels. In others a mixture of adrenaline and hypertonic saline, adrenaline and polidocanol, or isolated polidocanol were used. Absolute ethanol is becoming one of the most common agents, with an apparent success rate of more than 90%. Some authors have added local injection to other haemostatic methods such as laser or monopolar electrocoagulation. According to a study on the course of ulcer bleeding, a transverse vessel should be found at the ulcer base showing arteritis and pseudoaneurysmatic changes. It has been suggested that ethanol and sodium tetralysulphate act by inflammatory mediated protracted coagulation, but this does seem to be the mechanism of action of other substances. 

**TABLE III Analysis of results**

<table>
<thead>
<tr>
<th></th>
<th>Thrombosedierosis group (n=19)</th>
<th>Control group (n=19)</th>
<th>p value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rebleeding</td>
<td>1(5.3%)</td>
<td>11(57.9%)</td>
<td>0.005</td>
</tr>
<tr>
<td>Surgery required</td>
<td>1(5.3%)</td>
<td>8(42.1%)</td>
<td>0.051</td>
</tr>
<tr>
<td>Blood requirements</td>
<td>9 (0.5)</td>
<td>5 (0.7)</td>
<td>0.002</td>
</tr>
<tr>
<td>Deaths</td>
<td>0</td>
<td>2</td>
<td>NS</td>
</tr>
</tbody>
</table>
have been very few comparative trials at the present time. Some reports have used absolute ethanol, comparing it with multipolar electrocoagulation, without apparent difference, but it should be less effective than heat probe. A single report compares Nd YAG laser, adrenaline, and polidocanol. Adrenaline plus laser should be as effective as adrenaline plus polidocanol. Obviously, more trials are needed to reach a definite conclusion.

Another topic to be discussed is that related to endoscopic technical aspects. We selected ethanolamine oleate on the basis of our lengthy experience with this agent in sclerotherapy of oesophageal varices. We have been impressed by the rarity of complications, especially stenosis or deep necrotic features. Ethanolamine should induce thrombosis and necrosis phenomena at intra- and perivascular levels. Thrombin has not been shown to increase the effectiveness of epinephrine in ulcer sclerotherapy, but we have not found similar studies combining sclerosing agents and thrombin. We have administered large doses of ethanolamine, without apparent necrotic complications clinically or at follow up under endoscopy on day 7. Obviously, however, we cannot exclude a similar or greater effectiveness of other sclerosing agents or combinations of agents. Only larger series or multicentre trials will be able to answer these questions.

Finally, poor visibility frequently hindered the treatment, as has also been pointed out by others. Studies on bolus administration of vasoactive drugs may be indicated to circumvent this problem by momentarily lessening the blood flow, in spite of the current poor acceptance of these substances as definitive treatment for gastrointestinal bleeding.

In conclusion, thrombosclerosis does seem to be a useful tool in managing a bleeding duodenal ulcer in selected patients.

17 De Buck G, Sackett DL. When was a 'negative' clinical trial big enough? How many patients you needed depends on what you found. Arch Intern Med 1985; 145: 709–12.
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