therefore more inclined to believe that smaller softer boluses are the problem rather than solely poor masticatory function although it remains possible that both factors may operate together.

We do not fully understand the last point in their letter. It seems unlikely that severe oesophagitis is associated with lesser symptoms.

D G MAXTON AND R P H THOMPSON

The Rayne Institute,
St Thomas Hospital,
London SE1 7EH

Essential fatty acids and peptic ulcer disease

Sir,—The recent proposal by Hollander and Tarnawski on the relationship between essential fatty acids and peptic ulcer disease is not only interesting but also has some practical therapeutic implications. The criticisms made by Gibney on this hypothesis and the rejoinder by Hollander and Tarnawski made interesting reading. In this connection, we wish to add the following.

There are two families of essential fatty acids (EFAs), n-6 polyunsaturated fatty acids (PUFAs) derived from linolenic acid (LA), and the n-3 PUFAs derived from alpha-linolenic acid (ALA). Essential fatty acids cannot be synthesised by the body, but the body can desaturate and elongate EFAs provided by the diet. Linolenic acid is desaturated to form gamma-linolenic acid (GLA), which in turn is elongated to form dihomo-GLA (DGLA), the precursor of 1 series prostaglandins (PGs). Dihomo-gamma-linolenic acid can also be desaturated by delta-5-desaturase to arachidonic acid (AA), the precursor of 2 series PGs. Alpha-linolenic acid is desaturated and elongated by the same set of enzymes to give rise to eicosapentaenoic acid (EPA), the precursor of 3 series PGs. The activities of the desaturase enzymes are under hormonal and nutritional control.4

Prostaglandins administered exogenously,5 or synthesised endogenously6 can prevent the formation of mucosal ulceration induced experimentally by aspirin, alcohol, bile acids, and even boiling water.6 In a recent review, Hawkey and Walf7 summarised the data available on PGs and peptic ulcer and pointed out that PG analogues did not appear to heal peptic ulcers better than would be predicted from their ability to inhibit acid secretion. In this connection, it is worth noting that the main thrust of the hypothesis by Hollander and Tarnawski is that EFAs are responsible for the marked decrease in the incidence and virulence of peptic ulcer disease as they can be rapidly converted to PGs by the gastro-duodenal mucosa.13 We suggest here that this may only be part of the answer and propose that EFAs themselves may have the ability to enhance ulcer healing and possess cytoprotective properties.

Ethanol can inhibit delta-6-desaturase (d-6-d) activity which is necessary for the conversion of LA to GLA and chronic ethanol consumption induces decreased production of PGE1.16 Similarly dexamethasone is not only a PG-synthesis inhibitor but also a blocker of d-6-d activity.11 Thus, it can be suggested that both ethanol and steroids are ulcerogenic in nature as a result of their action on EFA and PG metabolism. In this context, it is interesting to note that Hollander and his colleagues12 13 and others14 noted the protective effect of arachidonic acid and PGs against ethanol induced gastric mucosal damage which obviously bypass the blocking effect of alcohol on d-6-d activity. It would have been interesting to study the effect of LA in comparison with that of GLA or AA in preventing the ulcerogenic action of alcohol, steroids, and non-steroidal anti-inflammatory drugs.

In a recent study, Diel15 showed that GLA can protect rats from ethanol induced haemorrhagic gastric erosions. In a preliminary study, we observed that oral evening primrose oil (3-0 g/day) can heal ulcer. In a study of six patients, we found that duodenal ulcer (5 to 10 mm in size) had completely healed endoscopically within a period of four to six weeks with no side effects (unpublished data, details of which will be published elsewhere). It may be mentioned here that evening primrose oil contains about 70% LA, and 9% GLA and we believe that probably GLA is more active than LA in augmenting peptic ulcer healing, though this remains to be substantiated by further testing. Other PUFAs like eicosapentaenoic acid (EPA) may also have a role in peptic ulcer disease. Peptic ulcer is very rare in Eskimos whose diet is rich in EPA. It is interesting to note that EPA is known to compete with AA and displace it and inhibit synthesis of 2 series PGs.17 We have recently shown that both n-3 and n-6 PUFAs can kill tumour cells selectively and that this action is not dependent on their conversion to PGs.18 19

These evidences indicate that EFAs/PUFAs may have a more direct role in peptic ulcer disease and other conditions and that their conversion to PGs may not always be necessary to bring about their actions.

U N DAS, D N REDDY, P N RAO, AND V RADHA

Department of Clinical Pharmacology and Medical Research Unit
Department of Gastroenterology,
The Nizam’s Institute of Medical Sciences,
Punjagutta,
Hyderabad – 500 482,
India.

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**Reply**

SIR.—We thank Dr Das and colleagues for their letter concerning our publication (Dietary essential fatty acids and the decline in peptic ulcers disease—a hypothesis. *Gut* 1986; 27: 239–42). Our main thesis is that the marked decline in peptic ulcer incidence and virulence could be because of the concomitant increase of more than 200% in the ingestion of linoleic acid by the population in the USA and Great Britain. The reasons we proposed this hypothesis are that we have demonstrated that linoleic1 or arachidonic2 acid administration to animals can protect against mucosal injury. Moreover, it is well established that the gastroduodenal mucosa can convert these dietary essential fatty acids into prostaglandins of the E-1 or E-2 variety.4

Dr Das and colleagues propose that essential fatty acids themselves could perhaps be protective without conversion to prostaglandins. We disagree.

To support their contention, Dr Das et al report the use of evening primrose oil in six patients with duodenal ulceration, who ‘healed completely’ after four to six weeks of therapy. Evening primrose oil contains 70% linoleic acid and 9% gammalinolenic acid (GLA). Both substances are rapidly converted by the gastroduodenal mucosa to prostaglandins. Thus, all that can be reasonably concluded from this information is that the oral administration of prostaglandin precursor fatty acids was associated with healing of duodenal ulceration. There is nothing in this information that would suggest that the fatty acids have a direct cytoprotective or healing property not due to their conversion to prostaglandins. We are not aware of any information that would suggest that dietary essential fatty acids have a prostaglandin independent cytoprotective action. In fact, in our own experiments, we have been able to abolish much of the protective effect of arachidonic acid by pretreating the animals with the cyclooxygenase inhibitor-indomethacin.

We must disagree with another point made by Das and colleagues. They stated that they ‘believe that probably gamma linolenic acid is more active than linoleic acid in augmenting peptic ulcer healing.’ We are not aware of any experimental evidence that shows this claim. Our own studies of alcohol injury in the rat showed that on a molar basis, arachidonic acid is more potent in preventing alcohol injury than linoleic acid.4 We have not however, examined gamma linolenic acid as a cytoprotective agent nor has any one else to our knowledge.

We thank Dr Das et al for their comments which call attention to the biological and therapeutic implications of our hypothesis.

DANIEL HOLLANDER AND ANDRZEJ S TARNAWSKI
Essential fatty acids and peptic ulcer disease.

U N Das, D N Reddy, P N Rao and V Radha

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