hypercholesterolaemia. Goldstein and Brown's concept of familial hypercholesterolaemia as a group of disorders characterised by deficiencies or abnormalities of LDL receptors does not provide an obvious explanation.¹³ Also if the entire arterial tree and all tissues in all the homozygotes are exposed from an early age to the extremely unfavourable combination of very high concentrations of atherogenic LDL and distinctly low concentrations of anti-atherogenic HDL; how do we explain the variable natural history, the dissociation in severity between the arterial and cutaneous lesions, and the striking predominance of coronary artery disease clinically? Possible explanations include genetic heterogeneity, interactions with other risk factors for arterial disease, and, perhaps most important, the reactivity of the tissues.

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References

- ¹ Wyndham CH. Ischaemic heart disease mortality rates in White South Africans compared with other populations. *S Afr Med J* 1978;**53**:595-601.
- ² Emery AEH. *Methodology in medical genetics*. Edinburgh: Churchill Livingstone, 1976.
- ³ Lipid Research Clinics. *Lipid and lipoprotein analysis, vol 1*. Bethesda: National Institutes of Health, 1974. (DHEW publication (NIH) 75-628.)
- ⁴ Burstein M, Scholnick HR, Morfin R. Rapid method for the isolation of lipoproteins from human serum by precipitation with polyanions. *J Lipid Res* 1970;**11**:583-95.
- ⁵ Fredrickson DS, Goldstein JL, Brown MS. The familial hyperlipoproteinemias. In: Stanbury JB, Wyngaarden JB, Fredrickson DS, eds. *The metabolic basis of inherited disease*. New York: McGraw-Hill, 1978: 604-55.
- ⁶ Motulsky AG. The genetic hyperlipidemias. *N Engl J Med* 1976;**26**:823-7.
- ⁷ Khachadurian AK, Uthman SM. Experiences with the homozygous cases of familial hypercholesterolaemia. *Nutr Metab* 1973;**15**:132-40.
- ⁸ Dean G. *The porphyrias*. London: Pitman Medical, 1971.
- ⁹ Heyl T. Genealogical study of lipoid proteinosis in South Africa. *Br J Dermatol* 1970;**83**:338-40.
- ¹⁰ Beighton P, Davidson J, Durr L, Hamersma H. Sclerosteosis—an autosomal recessive disorder. *Clin Genet* 1977;**11**:1-7.
- ¹¹ Ross R. The 'white' population of South Africa in the eighteenth century. *Pop Studies* 1975;**29**:217-30.
- ¹² Christopher AJ. *Studies in historical geography: South Africa*. Folkestone, England: W M Dawson, 1976.
- ¹³ Goldstein JL, Brown MS. Familial hypercholesterolemia: pathogenesis of a receptor disease. *Johns Hopkins Med J* 1978;**143**:8-16.

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Vomiting as a diagnostic aid in acute ischaemic cardiac pain

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Summary and conclusions

The incidence of vomiting before the administration of analgesics was studied in 109 patients admitted to hospital as emergencies with prolonged ischaemic cardiac pain. In transmural myocardial infarction (58 patients) the incidence was 43% (anterior infarction 58%, inferior infarction 41%). Of the 23 patients with myocardial necrosis but without transmural infarction (that is, those with diffuse or subendocardial necrosis) and the 28 with coronary insufficiency but no necrosis, only one patient in each group experienced vomiting.

When vomiting occurs early in association with cardiac pain transmural infarction may be expected in 90% of patients.

Introduction

Detailed descriptions of the symptomatology of coronary occlusion were available before 1912, but until then they were classified under angina pectoris.¹ Subsequently, Hatcher and Weiss² reported that vomiting often accompanied both coronary

occlusion and angina. More recent reports³⁻⁸ would appear to support this observation, but nobody has carried out a prospective detailed examination of vomiting in the various acute ischaemic cardiac syndromes, although some attempt has been made to identify the role of narcotic drugs in this respect. If there were a significant difference in the incidence of vomiting between acute myocardial infarction and other forms of ischaemic cardiac pain before the administration of analgesics, this would be a useful diagnostic pointer during the initial clinical assessment in general practice and in accident and emergency departments, whose medical staff are often the first to encounter such patients.

The stimulus to vomiting during myocardial ischaemia remains uncertain in man but may be analogous to the van Bezold-Jarisch reflex, which has been extensively studied in experimental animals.⁶⁻⁷ This reflex is mediated through afferent fibres arising in the heart "substance" and travels in the vagus nerve.⁵⁻⁷ Since autonomic instability is a common early feature of myocardial infarction, vomiting induced via this pathway might be expected to be associated with other evidence of vagal activity—for example, sinus bradycardia, sweating, and hypotension. Other factors previously thought to be related to vomiting include the site⁶ and size⁸ of infarction. We carried out a study in which we investigated the incidence of vomiting in various acute ischaemic cardiac syndromes and the relation of the above factors to vomiting.

Patients and methods

One hundred and nine consecutive patients admitted to the coronary monitoring unit of this hospital with acute ischaemic myocardial pain were allocated into three groups: those with proved transmural myocardial infarction (58 patients), those with myocardial

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Relation between vomiting after acute myocardial infarction, peak activity of serum aspartate transaminase, site of infarction, and history of coronary artery disease and gastrointestinal symptoms

	Mean ($\pm$ SD) peak serum aspartate transaminase (IU/l)	Site of infarction			Previous coronary artery disease	Previous gastrointestinal symptoms
		Anterior	Inferior	Posterior		
Patients who vomited (n = 25)	218.36 $\pm$ 106.79	15	9	1	18	8
Patients who did not vomit (n = 33)	286.94 $\pm$ 409.81*	11	22	—	18	8

*One patient had a peak enzyme activity of 2480 IU/l; excluding this patient from this group would give a mean peak activity of 218.41 $\pm$ 115.63 IU/l.

necrosis without localised infarction (23), and those with acute coronary insufficiency (28).

The diagnosis of acute transmural anterior and inferior myocardial infarction was based on the electrocardiographic criteria of the World Health Organisation.⁹ The recommendations of Perloff¹⁰ were used to define posterior infarction. Myocardial necrosis without transmural infarction (diffuse or subendocardial damage) was diagnosed in those patients with raised serum enzyme activities (serum aspartate transaminase activity > 40 IU/l) who also developed persistent ST-segment and T-wave changes, other causes of raised serum enzyme activities and electrocardiographic abnormalities having been excluded. Acute coronary insufficiency was diagnosed in the presence of typical but prolonged (> 20 minutes) ischaemic cardiac pain without electrocardiographic or enzyme evidence of recent infarction or necrosis.

Before the electrocardiographs were evaluated the presence or absence of spontaneous vomiting (occurring within two hours of the onset of pain and before the administration of a narcotic or analgesics) was recorded in each patient. The following were also noted: age, sex, history of coronary artery or gastrointestinal disease, smoking habits, and regular treatment with beta-blockers or digoxin. Blood pressure on admission, the lowest systolic blood pressure recorded during the subsequent 12 hours, heart rate on admission, the presence or absence of sweating and nausea, and the development of pericarditis were also recorded. The site of infarction and the peak activity of serum aspartate transaminase were added to each set of data.

Data were analysed for significance of differences using paired Student's *t* tests.

Results

Twenty-five (43%) of the 58 patients with proved acute myocardial infarction vomited before they received analgesic drugs. The remainder (57%) with proved infarctions did not vomit, but 17 of them (50%) experienced nausea. Only one (4.3%) of the 23 patients with myocardial necrosis and one (3.6%) with acute coronary insufficiency vomited. Seven (30%) with myocardial necrosis and nine (32%) with coronary insufficiency suffered nausea. The difference in the incidence of vomiting after acute myocardial infarction when compared with that in the other two groups of patients is highly significant ($p < 0.001$).

Patients who had experienced anterior infarction were more likely to vomit than those who had experienced inferior infarction ($p < 0.05$). No significant relation was found between the incidence of vomiting and the size of recent infarction (peak activity of serum aspartate transaminase), the development of pericarditis, or a history of coronary heart disease or gastrointestinal symptoms (table). Likewise, no correlation was found between vomiting and previous smoking habits or drug treatment (in particular beta-blockade and treatment with digoxin).

Only two patients in the series had systolic blood pressures of less than 100 mm Hg, and none had a profound bradycardia (heart rate < 50 /minute).

Discussion

The reported incidence of vomiting associated with the acute phase of myocardial infarction varies between 28% and 59%.³⁻⁵ In these studies, however, only scant attention was given to prior treatment with narcotic or analgesic drugs, or both, or digoxin. Our study yielded an incidence of vomiting of 43%. This closely approaches Bean's figures³ when they are corrected to take account of patients who had received morphine or large doses of digitalis. Wright,⁵ on the other hand, found no significant difference between treated (unspecified) and control

groups, the incidence of vomiting being 29% and 31% respectively.

In the present study only two patients in the non-infarction (necrosis and insufficiency) groups vomited. This finding is highly significant ($p < 0.001$) and means that when early spontaneous vomiting is associated with acute ischaemic cardiac pain over 90% of such patients have sustained transmural myocardial infarction.

Oram⁸ suggested that vomiting is more commonly associated with "large" infarcts. Our data, with the peak serum activity of aspartate transaminase being used as an index of infarct size, failed to support this observation.

Vomiting has been thought to be particularly associated with inferior myocardial infarction.^{6,7} A recent study by Darsee¹¹ showed that the desire to belch (labelled "eructoneogenesis" and assumed to be vagally mediated "gastric distress") in association with cardiac pain due to coronary disease "always indicated inferior-wall myocardial infarction," this symptom being absent in anterior infarction. Our study, however, shows that 58% of patients with anterior infarction vomit compared with only 29% of patients with inferior infarcts; of all patients who vomited, 60% had sustained anterior infarction. These findings are significant ($p < 0.05$), and therefore we question Darsee's observation.

Preceding ischaemic heart disease does not seem to protect patients from vomiting during infarction. This observation is supported by Bean's finding³ that the incidence of vomiting is the same during first and second infarctions. Likewise, no association between smoking and vomiting was found.

Treatment with beta-blockers before infarction does not lessen the stimulus to vomiting during infarction.

Although our findings fail to explain the cause of vomiting after myocardial infarction, the clear-cut relation with transmural necrosis suggests that the vomiting reflex, if such exists, might arise as a consequence of damage to the subpericardial tissue.

References

- Hamman L. The symptoms of coronary occlusion. *Bulletin of the Johns Hopkins Hospital* 1926;**38**:273-319.
- Hatcher RA, Weiss S. Reflex vomiting from the heart. *JAMA* 1927;**89**:429-32.
- Bean WB. Infarction of the heart. II. Symptomatology of acute attack. *Ann Intern Med* 1938;**11**:2086-108.
- Yater WM, Traut AH, Brown WG, Fitzgerald RP, Geisler MA, Wilcox BB. Coronary artery disease in men eighteen to thirty-nine years of age. *Am Heart J* 1948;**36**:334-72, 481-526, 683-722.
- Wright IS, Marple CD, Beck DF. *Myocardial infarction. Its clinical manifestations and treatment with anticoagulants*. New York: Grune and Stratton, 1954.
- James TN. Anatomy of the conduction system of the heart. In: Hurst JW, Logue RB, Schlaut RC, et al, eds. *The heart*. London: McGraw Hill, 1974:57.
- James TN. The coronary circulation and conduction system in acute myocardial infarction. *Prog Cardiovasc Dis* 1968;**10**:410-49.
- Oram S. *Clinical heart disease*. London: Heinemann, 1971:442.
- World Health Organisation. Hypertension and coronary heart disease. *Technical Report Series*. No 168. Geneva: World Health Organisation, 1959.
- Perloff JK. The recognition of strictly posterior myocardial infarction by conventional scalar electrocardiography. *Circulation* 1964;**30**:706-18.
- Darsee JR. Eructoneogenesis with inferior myocardial infarction. *N Engl J Med* 1978;**298**:221-2.

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