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1 Robertson DM, Foulds LM, Leversha L, *et al.* Isolation of inhibin from bovine follicular fluid. *Biochem Biophys Res Commun* 1985;**126**:220-6.
2 McLachlan RI, Healy DL, Robertson DM, Burger HG, de Kretser DM. The human placenta: a novel source of inhibin. *Biochem Biophys Res Commun* 1986;**140**:485-90.
3 McLachlan RI, Healy DL, Robertson DM, Burger HG, de Kretser DM. Circulating immunoactive inhibin in the luteal phase and early gestation of women undergoing ovulation induction. *Fertil Steril* 1987;**48**:1001-5.
4 Petraglia F, Sawchenko P, Lim ATW, Rivier J, Vale W. Localisation, secretion and action of inhibin in human placenta. *Science* 1987;**237**:187-9.
5 Mayo KE, Cerelli GM, Spiess J, *et al.* Inhibin A-subunit cDNAs from porcine ovary and human placenta. *Proc Natl Acad Sci USA* 1986;**83**:5849-53.
6 McLachlan RI, Robertson DM, Healy DL, Burger HG, de Kretser DM. Circulating immunoreactive inhibin levels during the normal human menstrual cycle. *J Clin Endocrinol Metab* 1987;**65**:954-61.
7 Robertson DM, Tsonis CG, McLachlan RI, *et al.* Comparison of inhibin immunological and in vitro biological activities in human serum. *J Clin Endocrinol Metab* 1988;**67**:438-43.
8 Hobson BM. Further observations on the excretion of chorionic gonadotrophin by women with hydatidiform mole. *Br J Obstet Gynaecol* 1958;**65**:253-9.
9 van Leusden HA. HCG in pathologic pregnancy. *Eur J Obstet Gynecol Reprod Biol* 1973;**3**:137-46.
10 DuBeshter B, Berkowitz RS, Goldstein DP, Cramer DW, Berstein MR. Metastatic gestational trophoblastic disease: experience at the New England Trophoblastic Disease Center, 1965 to 1985. *Obstet Gynecol* 1987;**69**:390-5.
11 Schlaerth JB, Morrow CP, Kletzky OA, Nalick RH, D'Ablaing GA. Prognostic characteristics of serum human chorionic gonadotrophin titer regression following molar pregnancy. *Obstet Gynecol* 1981;**58**:478-82.

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# Tissue response of gastric mucosa after ingestion of fluoride

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Fluoride has been used successfully to prevent dental caries and has also been used to treat osteoporosis. Doses of sodium fluoride of about 50 mg a day have long term beneficial effects on the mineral content of bone and the incidence of fracture.[1] These doses, however, have resulted in gastric disturbances in some patients.[1,2] We studied the response of the gastric mucosa after a single dose of fluoride.

## Methods and results

Twelve healthy volunteers (age range 22-45, four men and eight women) underwent two endoscopies after overnight fasts. One endoscopy was a control and the other was performed two hours after subjects ingested 20 ml sodium fluoride solution containing 20 mg fluoride (53 mmol/l). There was at least two weeks between endoscopies to assure complete recovery of the mucosa in case of iatrogenic injuries from the gastroscope. During the endoscopy the mucosa was graded according to an arbitrary scale (0 to 4), slightly modified from that of Lanza.[3] The stomach was also videotaped and the tape later examined by another gastroenterologist. The results of both examinations were similar ($p<0.01$, Wilcoxon's signed rank test). Two biopsy specimens were taken from the antrum and two from the body of the stomach. The histopathological changes were assessed on an arbitrary scale from 0 to 3.

After taking fluoride all subjects had petechiae or erosions (graded 3 or 4) in the body of the stomach and six had changes (graded 1-4) in the antrum. No petechiae or erosions were recorded in the oesophagus or the duodenum. In four subjects a layer of clotted blood was found over a large part of the gastric mucosa. The table shows the results of the macroscopic and microscopic evaluations. Three components of the gastric mucosa were affected by fluoride: the surface epithelium, the gastric pits, and the superficial stroma. The damaged epithelial cells were smaller than undamaged ones, and the vacuoles containing mucus were reduced in size or had disappeared. The most severely damaged epithelium was disrupted or totally lost. The most characteristic changes in the gastric pits were irregular dilatation and flattening of the epithelial cells. There was also a noticeable loss of mucin.

*Results of macroscopic and microscopic evaluations of gastric mucosa and presence of nausea at control endoscopy and endoscopy after ingestion of 20 mg fluoride*

| Case No | Macroscopic evaluation*: Body of stomach: Control | Macroscopic evaluation*: Body of stomach: Fluoride‡ | Macroscopic evaluation*: Antrum: Control | Macroscopic evaluation*: Antrum: Fluoride‡ | Microscopic evaluation†: Body of stomach: Control | Microscopic evaluation†: Body of stomach: Fluoride‡ | Microscopic evaluation†: Antrum: Control | Microscopic evaluation†: Antrum: Fluoride‡ | Nausea |
|---|---|---|---|---|---|---|---|---|---|
| 1 | 1 | 4 | 0 | 4 | 0 | 2 | 0 | 2 | Present |
| 2 | 0 | 4 | 0 | 2 | 0 | 2 | 0 | 2 | |
| 3 | 0 | 4 | 0 | 2 | 0 | 3 | 0 | 2 | Present |
| 4 | 0 | 4 | 0 | 0 | 0 | 2 | 0 | 2 | |
| 5 | 0 | 4 | 0 | 1 | 0 | 2 | 0 | 1 | |
| 6 | 0 | 4 | 0 | 3 | 0 | 1 | 0 | 2 | Present |
| 7 | 0 | 4 | 0 | 0 | 0 | 3 | 0 | 1 | |
| 8 | 0 | 3 | 0 | 0 | 0 | 1 | 0 | 0 | |
| 9 | 0 | 4 | 0 | 0 | 0 | 2 | 0 | 2 | |
| 10 | 0 | 4 | 2 | 0 | 0 | 1 | 0 | 2 | |
| 11 | 0 | 4 | 0 | 2 | 0 | 1 | 0 | 0 | Present |
| 12 | 0 | 4 | 0 | 0 | 0 | 1 | 0 | 1 | |

*Arbitrary scale: 0=normal, 1=one petechia or erosion, 2=two to five, 3=six to 10, 4=>10.
†Arbitrary scale: 0=normal, 1=either change in surface epithelium with oedema and haemorrhage of stroma or damage to gastric pits, 2=damage to both surface epithelium and gastric pits, 3=as 2 combined with acute inflammatory cellular response.
‡=Significant difference between fluoride and control according to Wilcoxon's signed rank test, $p<0.01$.

## Comment

Our study showed that one ingestion of fluoride at a dose used to treat osteoporosis affects the gastric mucosa. We do not know, however, to what extent repeated doses affect the mucosa, which might adapt after a while, as occurs with regular treatment with aspirin.[3] Our findings confirm data from experiments on animals, which showed that fairly low concentrations of fluoride can damage the surface of the gastric mucosa.[4]

The low pH of gastric juice and the formation of hydrogen fluoride probably caused the mucosal injuries. The uncharged molecule can easily penetrate the lipid cell membranes, enter the cell, and dissociate to fluoride and hydrogen ions, which may have toxic effects on enzyme systems and cause structural damage.

Symptoms like nausea and vomiting are not unusual when fluoride is used to treat osteoporosis.[2] They also occur occasionally when high doses are used for dental prophylaxis.[5] In our study only four subjects developed nausea, which suggests that using nausea as the first sign of fluoride toxicity might not be valid as all our subjects showed mucosal damage.

Finally, our results are also clinically important in dentistry because as much as 30 mg fluoride may be swallowed by children after prophylactic treatment with fluoride gel (1·23% fluoride).[5] If the risk of subsequent gastric injury is as high as our results suggest the use of such large amounts of fluoride in children should be questioned.

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1 Mamelle N, Meunier PJ, Dusan R, *et al.* Risk-benefit ratio of sodium fluoride treatment in primary vertebral osteoporosis. *Lancet* 1988;ii:361-5.
2 Riggs BL, Hodgson SF, Hoffman DL, Kelly PJ, Johnson KA, Taves D. Treatment of primary osteoporosis with fluoride and calcium. Clinical tolerance and fracture occurrence. *JAMA* 1980;**243**:446-9.
3 Lanza FL. Endoscopic studies of gastric and duodenal injury after the use of ibuprofen, aspirin, and other nonsteroidal anti-inflammatory agents. *Am J Med* 1984;77:19-24.
4 Pashley DH, Allison NB, Easmann RP, McKinney RV, Horner JA, Whitford GM. The effects of fluoride on the gastric mucosa of the rat. *J Oral Pathol* 1984;**13**:535-45.
5 LeComte EJ. Clinical application of topical fluoride products—risks, benefits and recommendations. *J Dent Res* 1987;**66**:1066-71.

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# Parents' beliefs about vaccination: the continuing propagation of false contraindications

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Low immunisation rates in England remain a cause for concern. The introduction of the measles, mumps, and rubella vaccine has renewed optimism that the proposed target of 90% uptake of vaccination could be achieved by 1990,[1] but studies in the early 1980s suggested that this target is unrealistic. They showed that parents and health care professionals had a poor understanding of the diseases concerned and commonly believed in mythical contraindications to vaccination. Our study aimed to reassess the importance of these obstacles to vaccination.

## Subjects, methods, and results

The study was conducted at this hospital during six weeks from December 1986 to January 1987. Children aged between 3 months and 4 years who were admitted to the communicable diseases unit and two general paediatric wards were entered into the study. Their immunisation history was sought from one or both parents. If the child had not been fully vaccinated at the correct times the parents were asked their reasons for the failure or delay. If they had been advised against vaccination they were asked for the source of advice and the reasons given. We defined the advice given as appropriate or otherwise according to the Department of Health and Social Security's guidelines of 1984.

During the study period 184 children were admitted, of whom 173 (94%) entered the study. A history of immunisation against measles was taken for the 121 children over 16 months old. No differences were found in any of the study variables between the groups admitted to the communicable diseases unit and the paediatric wards. Uptake of immunisation (diphtheria, tetanus, and polio 89% (154/173); pertussis 64% (111/173); measles 64% (77/121)) was similar to national figures[2] and figures for Wandsworth Health Authority during 1982-6. Altogether 106 children were incompletely vaccinated, and 91 of these had missed vaccinations for inappropriate reasons: in more than a third (39) the reason was parental objection (13) or apathy (26), but two false contraindications—temporary intercurrent infection and a history of atopy—accounted for a further third. Inappropriate advice was equally likely to have come from general practitioners, health visitors, and health clinics.

*Reasons given by parents for failure to immunise their children. Figures in parentheses are numbers of parents citing true contraindications according to Department of Health and Social Security's guidelines of 1984*

| | Pertussis | Measles | Diphtheria, tetanus, and polio | Total |
|---|---|---|---|---|
| Intercurrent illness: | | | | |
| Febrile | 4 (1) | 5 | 1 (1) | 18 (2) |
| Non-febrile | 4 | 3 | 1 | |
| Allergy: | | | | |
| To egg | 1 | 2 (2) | | 17 (2) |
| Atopy | 7 | 5 | 2 | |
| Convulsions: | | | | |
| In child | (3) | 2 | | 8 (5) |
| In first degree relative | (2) | 1 | | |
| In second degree relative | 4 | 1 | | |
| Prematurity: | | | | |
| Handicap | (3) | 1 | | 5 (3) |
| No handicap | 3 | | 1 | |
| Natural infection | 1 | 3 | | 4 |
| Previous reaction to vaccine | (2) | | | (2) |
| Immunosuppression | | (1) | | (1) |
| Apathy and objections | 8 | 18 | 13 | 39 |
| Total | 32 (11) | 41 (3) | 18 (1) | 91 (15) |

## Comment

In the early 1980s several studies examined the reasons for the continuing failure to improve uptake of vaccination.[3-5] Like those studies, ours highlighted serious deficiencies on the part of health care professionals in explaining and promoting immunisation. Most of the parents (96%) reported that they had received advice from a health care professional before deciding about their child's vaccination, and in only 28% of cases was failure to vaccinate the child due to parental inertia. In the remainder it was due to inappropriate advice or parental conviction not refuted by health care professionals. These findings support those of Blair *et al*,[5] who concluded that previous consultation with a health care professional did not significantly correlate with a parent's decision on vaccination.

Improving vaccination uptake is important, but we found that many parents, and apparently some doctors and health visitors, still viewed immunisation as a potential hazard that should be avoided if some excuse could be found. Our most important finding was that of all the cases in which the child had missed vaccinations, 38% could be attributed to either temporary intercurrent infection or atopy. This almost equalled the proportion accounted for by parental apathy and objection (42%). If these two misunderstandings had been specifically targeted uptake of more than 80% might have been achieved.

Much hope is being invested in the new measles, mumps, and rubella vaccine, but the obstacles to full vaccination highlighted in our study clearly reflect deeply entrenched attitudes. A more directed and sustained effort will be needed to change these if we are to improve uptake of vaccination.

1 Begg NT, Noah ND. Immunisation targets in Europe and Britain. *Br Med J* 1985;**291**:1370.
2 Central Statistical Office. *Social trends 18*. London: HMSO, 1988:123.
3 Nicoll A. Contraindications to whooping cough immunisation—myths or realities. *Lancet* 1985;i:679-81.
4 Campbell AGM. Measles immunisation: why have we failed? *Arch Dis Child* 1983;**58**:3-5.
5 Blair S, Shave N, McKay J. Measles matters, but do parents know? *Br Med J* 1985;**290**:623-4.

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