The blood count showed polycythaemia: haemoglobin concentration 171 g/l (normal female range 115-165), packed cell volume 0.548 (0.38-0.47). White cell and platelet counts were normal. Urea and electrolyte concentrations and results of liver function tests were normal except for a low albumin concentration of 33 g/l (35-50) and alkaline phosphatase of 300 IU/l (<160). Analysis of arterial blood while the patient was breathing room air (table) showed pronounced hypoxia and hypocapnia. Urinary excretion of 5 hydroxyindole acetic acid was 740 μ mol (140 mg)/24 h (<109 μ mol (21 mg)/24 h).

Arterial blood gas tensions with varying concentrations of inspired oxygen

	Air (two readings)		50% Oxygen	100% Oxygen
Oxygen tension (kPa)	6.9	6.4	7.1	10.9
Carbon dioxide tension (kPa)	3.5	3.8	4.3	4.1
Bicarbonate (mmol/l)	16	18	20	20
pH	7.40	7.41	7.41	7.43

Conversion: SI to traditional units—Oxygen and carbon dioxide: 1 kPa=7.5 mm Hg. Bicarbonate: 1 mmol/l=1 mEq/l.

A chest x ray film showed hyperinflated lungs, a normal sized heart, and no evidence of pulmonary metastases. A barium enema showed a constant filling defect in the caecum; an isotopic liver scan showed irregular uptake, suggesting metastatic deposits; an isotopic lung scan failed to show any appreciable emboli; and an electrocardiogram was unremarkable. Right heart catheter studies showed a normal mean right atrial pressure of 6 mm Hg and no appreciable gradient across the pulmonary valve (right ventricle 20/3 mm Hg; pulmonary artery 18/4 mm Hg). The pulmonary capillary wedge pressure was 10 mm Hg. Lung function tests showed a total lung capacity of 123% of the predicted value; the forced vital capacity and forced expiratory volume in one second were normal. The carbon monoxide transfer factor, corrected for the polycythaemia, was normal.

The respiratory and cardiovascular findings did not account for the pronounced cyanosis, suggesting the presence of a right to left shunt. High concentrations of inspired oxygen were administered (table). With 100% oxygen the oxygen tension was still abnormally low at 10.9 kPa (82 mm Hg), consistent with a shunt of about 30-40%.² This diagnosis was confirmed by isotopic scanning, in which microspheres of diameter 20-40 μ m labelled with technetium-99m were infused intravenously.³ Normally, all such microspheres are filtered out by the lungs, but in this patient the counts over head and abdomen (which receive about 13% and 43% of the total cardiac output respectively) were 43 000 and 130 000 while the lung fields gave 736 000, giving an estimated shunt of 30%.

Comment

This patient had a carcinoid syndrome associated with a primary tumour, which probably arose from the distal ileum, and hepatic metastases. It was complicated by pronounced cyanosis and dyspnoea with secondary polycythaemia. Blood gas and scanning data indicated a right to left shunt as the principal cardiorespiratory abnormality. Acquired right to left shunts have been associated with pulmonary metastatic deposits from thyroid carcinoma,⁵ but macroscopic secondaries were not visible in this patient's chest radiograph. More probably the shunt was due to microscopic fistulas, comparable with those seen in hepatic cirrhosis.³ A high pulmonary artery pressure might have been expected in the presence of an increased concentration of serotonin, a pulmonary vasoconstrictor, from which the increased urinary 5-hydroxyindole acetic acid presumably derived.¹ The normal value observed may have been due to the opposing action of a vasodilator such as bradykinin or to the presumed shunt.¹

Various drugs are useful in treating some manifestations of the carcinoid syndrome, but this patient declined such treatment.

We thank Drs D Glew, M E Rogerson, and D J S Carmichael for useful discussions and help.

1 Petersdorf RG, Adams RD, Braunwald E, Isselbacher KJ, Martin JB, Wilson JD. *Harrison's principles of internal medicine*. 10th ed. New York: McGraw-Hill, 1983.

2 Nunn JF. *Applied respiratory physiology*. London: Butterworths, 1977:302.

3 Stanley NN, Ackrill P, Wood J. Lung perfusion scanning in hepatic cirrhosis. *Br Med J* 1972;iv:639-43.

4 Wade OL, Bishop JM. *Cardiac output and regional blood flow*. Oxford: Blackwell, 1962.

5 Pierce JA, Reagan WP, Kimball RW. Unusual cases of pulmonary arterio-venous fistulae: with a note on thyroid carcinoma as a cause. *N Engl J Med* 1959;260:901-7.

(Accepted 18 November 1985)

Medical Unit, St Mary's Hospital Medical School, London W2 1PG
GORDON W STEWART, MD, MRCP, lecturer in medicine

Royal Cornwall Hospital (Treliske), Truro, Cornwall TR1 3LJ

SIMON P FREEGARD, MRCP, medical registrar

DAVID H KEELING, MSc, FRCP, consultant physician in nuclear medicine

ANTHONY D PERRETT, MD, FRCP, consultant physician

Correspondence to: Dr Stewart.

Sensitive urine tests and human chorionic gonadotrophin secreted during ectopic pregnancy

The detection of human chorionic gonadotrophin (hCG) secreted by trophoblastic tissue is important in the diagnosis of gynaecological emergencies and acute abdominal pain in women.^{1,2} Various immunoassays using fluorescence, enzymes, and radioactive isotopes have been developed for measurement of hCG in blood. These are highly sensitive but not suitable for use in wards or outpatient departments, where a 24 hour service is required. Thus relatively simple assays without the need for centrifugation or sophisticated equipment are required.³ The advent of monoclonal antibodies and enzyme linked immunoassays with colour endpoint detection has led to the development of urine tests for pregnancy that are sensitive and specific. Despite the widespread availability of these tests few data are available on their suitability for detecting hCG secreted during ectopic pregnancies.

Patients, methods, and results

Sixty patients presenting with clinical signs and symptoms suggestive of chronic or subacute ectopic pregnancy were included in the study. Patients with obvious ruptured ectopic pregnancies were excluded. Paired preoperative serum and urine specimens were submitted to the laboratory for qualitative radioimmunoassay of hCG using a commercial kit (Amersham International, United Kingdom; sensitivity 25 IU/l; second international standard preparation). Ultrasonography was performed in all patients, followed by laparoscopy or laparotomy when indicated. An ectopic pregnancy was shown in 32 patients, a complicated intrauterine pregnancy in 10 (incomplete abortion, septic abortion, molar pregnancy), and no evidence of pregnancy in 18 (pelvic inflammatory disease, ruptured ovarian cyst, etc).

Serum hCG was measured by quantitative radioimmunoassay (Amersham International; sensitivity 4 U/l; second international standard) and a qualitative tube enzyme immunoassay (Model, Monoclonal Antibodies, United Kingdom; sensitivity 25 U/l). Urine hCG was assessed by quantitative radioimmunoassay, an enzyme linked immunosorbent assay (Model, Monoclonal Antibodies; sensitivity 50 U/l), and dipstick testing (Pregnostick, Monoclonal Antibodies; sensitivity 175 U/l). The dipstick test was made more sensitive by changing the reagent volume as recommended by the manufacturer (50 U/l). Units for hCG in the enzyme tests were based on the first international reference preparation; experience in our laboratory suggests that values obtained with the second international reference preparation are two to three times lower than those obtained with the first.

In the 32 patients with ectopic pregnancy all methods for detecting hCG in serum and urine correctly identified the hormone (table). No false negative results were obtained. In the 10 patients with other complications of pregnancy all serum and urine tests gave positive results except for the unmodified dipstick test, which gave a negative result for one urine sample (hCG value 78 U/l). Serum from the 18 patients who were not pregnant was negative for hCG when assessed by quantitative and qualitative radioimmunoassay, but two serum samples gave a positive result on enzyme immunoassay and one urine sample gave a positive result in the modified dipstick test.

Summary of results obtained with different tests for human chorionic gonadotrophin (hCG) in serum and urine

	Serum		Urine		
	Rapid radio-immunoassay (>25 U/l)	Tube ELISA (>25 U/l)	Standard dipstick test (>175 U/l)	Sensitive dipstick test (>50 U/l)	Tube ELISA (>50 U/l)
Ectopic pregnancy:					
Positive	32/32	32/32	32/32	32/32	32/32
Negative	0/32	0/32	0/32	0/32	0/32
Other pregnancy states:					
Positive	10/10	10/10	9/10	10/10	10/10
Negative	0/10	0/10	1/10	0/10	0/10
Non-pregnant women:					
Positive	0/18	2/18	0/18	1/18	0/18
Negative	18/18	16/18	18/18	17/18	18/18
Sensitivity (%)	100	100	97.6	100	100
Specificity (%)	100	89	100	94.4	100
Predictive value of positive result (%)	100	95	100	97.6	100
Predictive value of negative result (%)	100	100	94.4	100	100

ELISA = Enzyme linked immunosorbent assay.

Sensitivity = Proportion of patients who are pregnant with a positive result on testing for hCG.

Specificity = Proportion of patients who are not pregnant with a negative result on testing for hCG.

Predictive value = Proportion of patients whose test result is appropriate to their condition.

When all results were considered together the urine tube immunoassay (Model) gave 100% sensitivity and specificity as well as 100% predictive values for normal and abnormal results. The serum tube enzyme linked immunosorbent assay, while showing 100% sensitivity, was less specific, and the dipsticks were intermediate in value.

Comment

Our results are sufficiently encouraging to suggest that measurement of urinary hCG with ultrasensitive tube or dipstick assays should be the first line investigation in women presenting with non-specific abdominal complaints. Results equivalent to those of qualitative rapid radioimmunoassays may be obtained and appropriate further investigations such as laparoscopy, ultrasonography, and culdocentesis instituted. Qualitative tests do not differentiate ectopic from intrauterine pregnancy but offer a rapid and convenient assessment of secretion of hCG. The current assays may be simplified, and preliminary results using a two minute test (Icon, Hybritech) have been as good as those obtained with the assays described here (paper submitted for publication). These relatively simple, convenient, and commercially available enzyme labelled assays should be widely available in outpatient departments and wards for 24 hour use.

- 1 Seppala M, Kanta T, Tontti K, Stenman U-H, Chard T. Use of a rapid hCG-beta subunit radioimmunoassay in acute gynaecological emergencies. *Lancet* 1980;i:165-6.
- 2 Braunstein GD, Karow WG, Gentry WC, Rasor J, Wade ME. First trimester chorionic gonadotropin measurements as an aid in the diagnosis of early pregnancy disorders. *Am J Obstet Gynecol* 1978;131:25-32.
- 3 Norman RJ, Lowings C, Chard T. Dipstick method for human chorionic gonadotropin suitable for emergency use on whole blood and other fluids. *Lancet* 1985;i:19-20.

(Accepted 26 November 1985)

Department of Chemical Pathology, SA Medical Research Council Pre-clinical Diagnostic Chemistry Research Unit, University of Natal Medical School, PO Box 17039, Congella 4013, Durban, South Africa

R J NORMAN, MRCP, MRC PATH, senior lecturer
K REDDI, MB, CHB, registrar
M KEMP, DIPMEDTECH, technologist
S M JOUBERT, MSc, FRC PATH, professor

Department of Obstetrics and Gynaecology, University of Natal Medical School

F PATEL, MB, CHB, registrar

Correspondence to: Dr Norman, Department of Chemical Pathology, University of Natal Medical School, PO Box 17039, Congella 4013, Durban, South Africa.

Restraint of babies in cars

Adequate restraint considerably reduces death and injury to infant passengers in car accidents.^{1,2} The official recommendation in Great Britain for the restraint of babies aged 0-6 months (weight <9 kg) is that the baby should be laid in a carrycot that is held in the rear seat by straps fixed to suitable anchor points on the car body. We determined the degree of compliance with this recommendation by questionnaire and by observation.

Subjects, methods, and results

During December 1984 and January 1985 public postnatal inpatients in the Princess Anne Hospital were studied with the approval of the consultant obstetricians and Southampton ethical committee. The women were assigned to an interview or a control group according to the postnatal ward of admission; the designation of wards was changed midway through the study. Mothers who did not have access to a car or whose babies stayed in hospital for more than 12 days after delivery were excluded. Those in the interview group were questioned about access to a car, knowledge of the recommendations for carrying babies in cars, and their intended practice. Those in the control group were given a sham interview (breast feeding survey) in which we determined whether they had access to a car; no other reference was made to cars or to safety. Interviews were stopped when 100 had been successfully completed in each group (this required 258 interviews altogether). A follow up questionnaire was sent to all subjects three or four months after the birth of their child. The key question asked was: "When you last took your baby out in a car how did you carry him/her?"

Altogether 138 women replied to the questionnaire. The interview group showed lower compliance with the recommended practice than the control group, and therefore the interview did not artificially improve compliance. Data were pooled to give a total compliance of 55/138 (40 (binomial SD 4)%). The reasons for lack of compliance were elicited by a check list (table). When questioned about the proportion of journeys in the car for which their baby was restrained 67 respondents said that they never used restraints and only 29 that they always used

them. Of 49 mothers in the interview group who had intended to restrain their baby, only 19 had done so on the most recent journey.

Observers waited at the exits of several large supermarket car parks. Of the 295 babies seen in cars, only 129 appeared to be adequately restrained (compliance 44 (36%)). There was good agreement between the results of the questionnaire study and this observational study, which was performed before the follow up questionnaire was administered.

Reasons for lack of compliance with recommended practice for restraint (n = 138; multiple responses allowed)

Car unsuitable	69
Too much bother	36
Too expensive	26
Baby gets fed up on long journey	26
No room in car	24
Baby doesn't like it	21
Lack of knowledge	13
Not worth using on short journey	11
Own two cars, use restraint in only one	8
Don't think they are worth while	0
No reason given	8
Always use restraint	34

Comment

Only about 40% of babies carried in cars in Southampton are adequately restrained. This is much lower than the figures found in observational studies in Australia (70%), New Zealand (66%), and the United States (60%).^{3,5} The reasons for non-compliance (table) may be summarised in three points: (1) inconvenience, cost, and lack of understanding about fitting restraints; (2) lack of room in the car; and (3) lack of information and understanding about the benefits of restraints.

The problems of inconvenience, lack of room in the car, and resistance by the baby could be alleviated by modifying British practice to recommend restraint systems which hold the baby in a semireclining position facing the back of the car. The problem of cost has been overcome in New Zealand by an organisation supported by the government making suitable restraints available at low rental. The problem of education and information is one that should be accepted by the medical profession and other groups as a challenge to be jointly overcome.

We thank the medical and nursing staff of the Princess Anne Hospital; pupils at Richard Taunton College, who helped in the observational study; and Dr K S Cliff for his help.

- 1 Lowne R, Roberts A, Roy P, Hill K, Jones H. *The effect of the UK seat belt legislation on restraint usage by children*. Warrendale, Pa: Society of Automotive Engineers, 1984. (Technical paper series No 840526.)
- 2 Williams AF, Zador P. Injuries to children in automobiles in relation to seating location and restraint use. *Accident Analysis and Prevention* 1977;9:69-76.
- 3 Booth M. *The use of restraint by children in automobiles*. Sydney, Australia: National Road and Motorists' Association, 1983.
- 4 Geddis DC. Children in cars—results of an observational study in New Zealand. *NZ Med J* 1979;90:468-71.
- 5 Goodell-Grivas Inc. *Restraint system usage in the traffic population*. Washington, DC: US Department of Transportation National Highway Traffic Safety Administration, 1983.

(Accepted 20 November 1985)

Chemical Pathology and Human Metabolism, Southampton University Medical School, Southampton SO9 4XY

KAREN PENRY-JONES, medical student
D ROSS BOSWELL, PhD, FRACP, senior lecturer

Richard Taunton College, Southampton

RAYMOND TONGUE, MSc, assistant principal

Correspondence to: Dr Boswell.

Glucomannan and risk of oesophageal obstruction

Glucomannan (glucose/mannose polymer) is considerably hygroscopic and on contact with water swells and becomes a viscous gel. In this form it is a normal Japanese foodstuff. Like guar (galactose/mannose) it has been used to treat diabetes mellitus.¹ Recently, dry, non-expanded glucomannan has been marketed in Australia as an aid to dieting, the claim being that it inhibits the appetite by swelling in the stomach, producing what one