Loctite) was applied to the end of a rigid 5-mm OD plastic tube, which was then rapidly passed down the Roberts pharyngoscope and pressed firmly on to the stone, meanwhile applying countertraction with the inflated Foley catheter, which had been re-introduced. The stone was then extracted by withdrawing plastic rod, catheter, and pharyngoscope as one (see figure). The patient made a rapid uneventful recovery without oesophageal perforation.

Comment

Oesophageal foreign bodies should be removed as a matter of urgency²; cyanoacrylate adhesive, with its ability to form rapidly a strong bond even between moist surfaces,³ extends the range of endoscopic extraction techniques. High tensile strength can be achieved by this method, provided the presence of gross blood and mucus does not interfere, and a "peeling" action, which is effective in separating bonded tissues,⁴ is avoided.

In this case a large stone impacted in the oesophagus could not be removed using conventional techniques. Our method rendered removal possible without recourse to major surgery.

¹ Bonfils-Roberts, E A, *et al*, *Annals of Thoracic Surgery*, 1975, **19**, 196.

² *British Medical Journal*, 1975, **4**, 368.

³ De Fonseca, C P, *British Medical Journal*, 1976, **3**, 234.

⁴ O'Sullivan, D J, *British Medical Journal*, 1976, **2**, 109.

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Interpretation of serum total thyroxine concentration in patients with abnormal thyroxine-binding proteins

The free thyroxine index (FTI), the ratio of serum total thyroxine concentration (T4) to the unsaturated thyroid hormone binding capacity (THBC), may be misleading in patients with abnormal concentrations of binding proteins,¹ although designed to compensate for such abnormalities.² In euthyroid patients with a wide range of THBC we found a "zero error" in THBC (Thyopac-3). We have solved this problem by a simple modification of FTI.

Patients, methods, and results

We have studied 200 clinically euthyroid patients with a wide range of THBC values comprising 59 pregnant women, 57 non-pregnant women, 19 patients with nephrotic syndrome, 27 with chronic liver disease, and 38 members of families with inherited abnormalities of thyroxine-binding globulin (TBG). Dr W A Burr and his colleagues in Birmingham kindly supplied the primary data for 34 of the patients in this last group. Serum T4 (nmol/l) was measured by Thyopac-4 (Amersham) except for the Birmingham patients, in whom it was measured by radioimmunoassay. THBC was measured as per cent of mean normal by Thyopac-3 (Amersham). The 200 euthyroid patients had conventional FTI values which fitted neither a Gaussian nor a logarithmic distribution and which ranged from 8 to 217 (normal 45-145).

The figure shows that, as T4 decreased, THBC approached values near 50% rather than zero. Thus calculation of the simple ratio (FTI) is inappropriate. The spread of THBC values made subtraction of a constant from THBC unsatisfactory. The simplest solution was to determine an optimum negative intercept on the T4 axis to calculate a modified FTI. This value was -80 nmol/l. The modified FTI values, calculated as $(T4 + 80) \times 100 / THBC$, fitted a logarithmic distribution closely. Independent data from 199 euthyroid adults and 123 euthyroid geriatric patients gave logarithmic means and standard deviations which did not differ from the values for our patients ($P > 0.3$). As expected, 5% of our 200 patients fell outside the modified FTI range (118-235), whereas 16% fell outside the conventional FTI range.

Measurements made on specimens from 2023 patients by Thyopac methods in six months were searched for discordant classification by the conventional and modified FTI. By definition 95% reference ranges produce

Relation between T4 and THBC in 200 euthyroid patients with a wide range of values for THBC. Dotted lines are 95% limits of conventional FTI and continuous lines 95% limits of modified FTI.

▲ = Inherited abnormalities of TBG. ○ = Nephrotic syndrome. ■ = Chronic liver disease. □ = Non-pregnant women. ● = Pregnant women.

Conversion: SI to traditional units—Serum thyroxine: 1 nmol/l $\approx$ 0.08 μ g/100 ml.

5% of "abnormal results" in healthy populations. We looked for patients who fell within the 95% limits of one reference range—that is, clearly normal—and outside the 97% limits of the other—that is, much more likely to be abnormal. Only 18 patients (0.9%) gave such a discordant classification. The clinical records, including treatment and subsequent course, and other biochemical data (serum thyrotrophin and triiodothyronine concentrations and repeat measurements of FTI) suggested that the modified FTI was more likely to be correct in 11 patients and the conventional FTI in four. There was insufficient evidence in the remaining three.

Comment

Over 99.9% of T4 in serum is protein bound, and the concentrations of binding proteins are affected by a wide variety of factors.^{3,4} Both THBC and TBG have been used to allow for changes in protein binding. Burr *et al*⁵ found that the ratio of T4 to TBG correlated better with thyroid state than the conventional FTI, but euthyroid patients with low values of THBC were not investigated. The T4:TBG ratio makes no allowance for changes in the other two binding proteins, thyroxine-binding prealbumin and albumin, which together bind about 30% of serum T4, and it cannot be used when TBG is absent. Further investigation is required to determine whether the T4:TBG ratio or our modification of the FTI provides the better discriminant for the evaluation of thyroid function in patients with abnormal binding proteins.

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¹ Goolden, A W G, Gartside, J M, and Sanderson, C, *Lancet*, 1967, **1**, 12.

² Clark, F, and Brown, H J, *British Medical Journal*, 1970, **2**, 543 and 672.

³ Oppenheimer, J H, *New England Journal of Medicine*, 1968, **278**, 1153.

⁴ Ingenbleek, Y, *et al*, *Clinica Chimica Acta*, 1975, **63**, 61.

⁵ Burr, W A, *et al*, *British Medical Journal*, 1977, **1**, 485.

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