angioplasty for renal artery stenosis occurring early after renal transplantation. We do suggest, however, that the procedure be seriously considered for patients with late and localized renal artery stenosis who have refractory hypertension or declining renal function that cannot be explained by other causes, or both. The procedure should, of course, be carried out only by angiographers experienced in the technique.

References

1. GRÜNTZIG A, VETTER W, MEIER B, et al: Treatment of renovascular hypertension with percutaneous transluminal dilatation of a renal-artery stenosis. *Lancet* 1: 801, 1978
2. MAHLER F, KRNETA A, HAERTEL M: Treatment of renovascular hypertension by transluminal renal artery dilatation. *Ann Intern Med* 90: 56, 1979
3. KATZEN BT, CHANG J, LUKOWSKY GH, et al: Percutaneous transluminal angioplasty for treatment of renovascular hypertension. *Radiology* 131: 53, 1979
4. MILLAN VG, MAST WE, MADIAS NE: Nonsurgical treatment of severe hypertension due to renal-artery intimal fibroplasia by percutaneous transluminal angioplasty. *N Engl J Med* 300: 1371, 1979
5. WEINBERGER MH, YUNE HY, GRIM CE, et al: Percutaneous transluminal angioplasty for renal artery stenosis in a solitary functioning kidney. An alternative to surgery in the high-risk patient. *Ann Intern Med* 91: 684, 1979
6. ATHANASOULIS CA: Therapeutic applications of angiography (second of two parts). *N Engl J Med* 302: 1174, 1980
7. GRÜNFELD JP, KLEINKNECHT D, MOREAU JF, et al: Permanent hypertension after renal homotransplantation in man. *Clin Sci Mol Med* 48: 391, 1975
8. BACHY C, VAN YPERSELE DE STRIHOU C, ALEXANDRE GPJ, et al: Hypertension after renal transplantation. *Proc Eur Dial Transplant Assoc* 12: 461, 1976
9. RAO TKS, GUPTA SK, BUTT KMH, et al: Relationship of renal transplantation to hypertension in end-stage renal failure. *Arch Intern Med* 138: 1236, 1978
10. SMELLIE WAB, VINIK M, HUME DM: Angiographic investigation of hypertension complicating human renal transplantation. *Surg Gynecol Obstet* 128: 963, 1969
11. MORRIS PJ, YADAV RVS, KINCAID-SMITH P, et al: Renal artery stenosis in renal transplantation. *Med J Aust* 1: 1255, 1971
12. LACOMBE M: Arterial stenosis complicating renal allotransplantation in man: a study of 38 cases. *Ann Surg* 181: 283, 1975
13. SCHRAMEK A, ALDER O, HASHMONAI M, et al: Hypertensive crisis, erythrocytosis, and uraemia due to renal-artery stenosis of kidney transplants. *Lancet* 1: 70, 1975

Increased requirement for thyroid hormone after a jejunoileal bypass operation

DUNCAN J. TOPLISS,* MB, BS, FRACP; JOHN A. WRIGHT,† MD, CCFP; ROBERT VOLPÉ,‡ MD, FRCP[C]

A jejunoileal bypass operation can result in metabolic disturbances, various vitamin deficiencies and fatty degeneration or cirrhosis of the liver.[1] It has also recently been reported to cause thyroid hormone malabsorption, at least in one patient.[2] We describe herein a patient in whom a fourfold increase in the daily dose of thyroxine (T_4) was necessary for euthyroidism after a jejunoileal bypass operation.

From the department of medicine, the Wellesley Hospital, Toronto, and the University of Toronto

*Recipient of the Beecham Travelling Fellowship of the Royal Australasian College of Physicians and the Edward Christie Stevens Fellowship of the department of medicine, University of Toronto

†Chief, department of family medicine and general practice, Owen Sound General and Marine Hospital, Owen Sound, Ont.

‡Physician-in-chief, the Wellesley Hospital, and professor of medicine, University of Toronto

Reprint requests to: Dr. Robert Volpé, Department of medicine, The Wellesley Hospital, Rm. 112 D, Jones Building, 160 Wellesley St. E, Toronto, Ont. M4Y 1J3

Case report

A severely obese woman (maximum weight 127 kg, height 154 cm) was found to be hypothyroid at the age of 25 years. She failed to lose weight taking levothyroxine, 0.2 mg/d orally, as hormone replacement therapy, but the symptoms and signs of hypothyroidism cleared. Her obesity remained a persistent serious problem. As a last resort a jejunoileal bypass operation was performed when she was 39 years old: the jejunum was divided 10 cm beyond the ligament of Treitz, and the proximal portion was anastomosed end to side to the terminal ileum 14 cm from the ileocecal valve.

Over the next 8 months she defecated about five times daily and lost 55 kg. The levothyroxine therapy was continued, but fatigue, cold intolerance, bloating, and dry hair and skin developed; she recognized these as symptoms of recurrent hypothyroidism. The serum levels of T_4 and triiodothyronine (T_3) were low and the level of thyrotropin was high (Table I). Liver function tests, including measurement of the serum levels of aspartate aminotransferase, alanine aminotransferase and albumin as well as the prothrombin time, gave normal results, but the serum alkaline phosphatase level was 121 IU/l (normal range 25 to 90 IU/l).

Despite an increased dose of T_4 the serum thyrotropin level remained high. The medication was changed to T_3, and a daily dose of 300 μg (75 μg every 6 hours) was finally achieved. At this daily dose the serum level of T_3 was 100 ng/dl 3 hours after a dose of T_3

was given. Treatment with T_4 was resumed with the daily dose gradually increased; clinical and biochemical euthyroidism was finally achieved at the very high daily dose of 0.8 mg. She has subsequently felt well.

Discussion

Before the jejunoileal bypass operation the patient stayed euthyroid by taking 0.2 mg of T_4 daily; following the bypass procedure, however, she required as much as 300 μg of T_3 or 0.8 mg of T_4 daily to remain euthyroid. This strongly suggests that thyroid hormone malabsorption was a consequence of the bypass procedure, although accelerated thyroid hormone degradation is another possible explanation. Azizi, Belur and Albano[2] recently documented impaired absorption of thyroid hormones labelled with radioactive isotopes in a patient who had undergone the same procedure.

It has been demonstrated that about 60% (range 35% to 90%) of orally administered T_4 is absorbed in healthy persons,[3-5] and experiments in animals have shown that the time course for absorption is comparable in all segments of the small and large intestine.[6] T_3 is absorbed more quickly[7] and more completely[8] than T_4. Although no consistent effect on thyroid hormone absorption of either cirrhosis or hypothyroidism has been found,[5] pancreatic steatorrhea impairs T_4 absorption,[9] and the fecal excretion of T_4 is directly related to the fecal mass.[10]

Our patient required a fourfold increase in the daily dose of T_4 for euthyroidism after the jejunoileal bypass operation; this indicated serious impairment of thyroid hormone absorption. Therefore, in patients requiring thyroid hormone therapy who undergo this operation, and in patients with intact jejunoileal bypasses who subsequently become hypothyroid, a much higher daily dose of thyroid hormone for adequate replacement is to be expected. T_4 therapy seems preferable to T_3 as it avoids the large and rapid changes in serum levels of thyroid hormones, specifically T_3, related to the administration of a tablet several times a day.

References

1. DeWind LT, Payne JH: Intestinal bypass surgery for morbid obesity. Long-term results. *JAMA* 236: 2298, 1976
2. Azizi F, Belur R, Albano J: Malabsorption of thyroid hormones after jejunoileal bypass for obesity. *Ann Intern Med* 90: 941, 1979
3. Oddie TH, Fisher DA, Rogers C: Whole-body counting of 131-I-labeled thyroxine. *J Clin Endocrinol Metab* 24: 628, 1964
4. Van Middlesworth L: Thyroxine requirement and the excretion of thyroxine metabolites, in *Clinical Endocrinology*, vol 1, Astwood EB (ed), Grune, New York, 1960, p 103
5. Hays MT: Absorption of oral thyroxine in man. *J Clin Endocrinol Metab* 28: 749, 1968
6. Chung SJ, Van Middlesworth L: Absorption of thyroxine from the intestine of the rat. *Am J Physiol* 212: 97, 1967
7. Idem: Absorption of thyroxine from the small intestine of rats. *Endocrinology* 74: 694, 1964
8. Hays MT: Absorption of triiodothyronine in man. *J Clin Endocrinol Metab* 30: 675, 1970
9. Hiss JM jr, Dowling JT: Thyroxine metabolism in untreated and treated pancreatic steatorrhoea. *J Clin Invest* 41: 988, 1962
10. Héroux O, Petrovic VM: Effect of high- and low-bulk diets on the thyroxine turnover rate in rats with acute and chronic exposure to different temperatures. *Can J Physiol Pharmacol* 47: 963, 1969

Table I—Effect of jejunoileal bypass operation on the serum concentrations of thyroxine (T_4), triiodothyronine (T_3) and thyrotropin (TSH) in a hypothyroid patient taking T_4 or T_3 orally

Date	Thyroid hormone given, daily dose	Serum value [normal range] Total T_4 (μg/dl) [4–11]	Free thyroxine index* [4–11]	Total T_3 (ng/dl) [90–210]	TSH (mIU/ml) [0–10]
Sept. 1971	T_4, 0.1 mg	2.5	1.9	–	–
Feb. 1972	T_4, 0.2 mg	6.5	6.1	–	–
Sept. 1977			Jejunoileal bypass operation		
May 1978	T_4, 0.2 mg	3.3	2.7	–	>80
	T_4, 0.4 mg	3.7	3.2	–	80
July 1978	T_4, 0.4 mg	4.2	3.7	72	78
			T_3 therapy begun†		
Sept. 1978	T_3, 10–20 μg				80
Oct. 1978	T_3, 40 μg	1‡	1	–	49
Nov. 1978	T_3, 125 μg	1	1	–	66
Feb. 1979	T_3, 200 μg	1	1	–	27
Mar. 1979	T_3, 300 μg	1	1	100	3.5
Nov. 1979	T_4, 0.8 mg	8.3	9.4	105	4

*The total serum T_4 level times the T_3 uptake expressed as a percentage of the reference standard.
†T_3 was given in four divided doses a day.
‡A low serum T_4 level is to be expected with T_3 therapy.

BOOKS

continued from page 723

LE DIAGNOSTIC PRÉNATAL. Cahier de Bioéthique. 2. Collection publiée par le Centre de bioéthique de l'Institut de recherches cliniques de Montréal. 281 pp. Illust. Les Presses de l'Université Laval, Québec, 1980. $14, broché. ISBN 2-7637-6914-4

FAMILY MEDICINE. A Guidebook for Practitioners of the Art. David B. Shires and Brian K. Hennen. 512 pp. Illust. McGraw-Hill Book Company, New York, 1980. $15.95, paperbound. ISBN 0-07-056920-7

INTERVENTIONAL DIAGNOSTIC AND THERAPEUTIC PROCEDURES. Barry T. Katzen. 155 pp. Illust. Springer–Verlag New York Inc., New York, 1980. $22.50. ISBN 0-387-90390-9

LEAD TOXICITY. Edited by R.L. Singhal and J.A. Thomas. 514 pp. Illust. Urban & Schwarzenberg, Inc., Baltimore; the Macmillan Company of Canada Limited, Toronto, 1980. $49.50. ISBN 0-8067-1801-3

LUNG DISEASE. State of the Art. 1978–1979. Edited by John F. Murray. 463 pp. Illust. American Lung Association, New York, 1980. $12.50. ISBN 0-915116-04-4

MANUAL OF ANTIMICROBIAL THERAPY AND INFECTIOUS DISEASES. Mickey S. Eisenberg, Clifton Furukawa and C. George Ray. 282 pp. Illust. W.B. Saunders Company Canada, Ltd., Toronto, 1980. $15.55, spiralbound. ISBN 0-7216-3348-X

MANUAL OF ECHOCARDIOGRAPHIC TECHNIQUES. Betty J. Phillips and Vincent E. Friedewald, Jr. 276 pp. Illust. W.B. Saunders Company Canada, Ltd., Toronto, 1980. $29.95. ISBN 0-7216-7219-1

continued on page 770