Hypothyroidism, thyroxine treatment, and the heart

Hypothyroidism is a common condition; surveys indicate that approximately 1% of the general population and 4% of people 60 years and older are prescribed thyroxine long term. Hypothyroidism has cardiovascular consequences resulting from both direct influences of thyroid hormone deficiency on the heart, and adverse effects on circulating lipid concentrations. Furthermore, with the advent of improved tests of thyroid function, it has become clear that even when patients with hypothyroidism are treated with thyroxine long term, about half have serum thyrotrophin concentrations above or below the normal range, indicating a degree of under or over treatment with thyroxine. Although little importance has been attached to these minor biochemical abnormalities, recent evidence suggests that they may have considerable clinical significance.

Cardiovascular effects of untreated hypothyroidism
Hypothyroidism is associated with sinus bradycardia, 24 hour ambulatory studies revealing decreases in resting, mean, and maximal heart rates. These reductions in heart rate and atrioventricular conduction blocks are the only dysrhythmias recognised to be associated with hypothyroidism, which may itself reduce the likelihood of ventricular dysrhythmias. An increase in diastolic blood pressure is also well described in hypothyroidism, and may be present in as many as 20% of subjects. This diastolic hypertension is in turn associated with an increase in peripheral vascular resistance. Myocardial contractility is impaired with a reduction in resting left ventricular ejection fraction; diastolic function may also be impaired, contributing to a reduction in cardiac output, and in a few cases to the development of heart failure. Pericardial effusions, demonstrated by echocardiography, are frequent in marked thyroid hormone deficiency, although tamponade is rare. Untreated hypothyroidism is associated with hyperlipidaemia, specifically with increases in circulating concentrations of total and low density lipoprotein cholesterol, and decreases in high density lipoprotein cholesterol. It is often stated that ischaemic heart disease is more frequent in patients with hypothyroidism; this may be the case, but evidence in support of this view is scanty. A necropsy study demonstrated more coronary atherosclerosis in hypertensive hypothyroid patients than in hypertensive euthyroid subjects, but no difference was found between normotensive hypothyroid and euthyroid groups. A further necropsy study reported more "severe" coronary atherosclerosis in hypothyroid than euthyroid subjects, but neither study demonstrated a difference in prevalence of myocardial infarction. This suggests that hypothyroidism may protect against myocardial ischaemia, a view which in the past led to the use of radiodiine in the treatment of angina.

Effects of thyroxine treatment
Many of the cardiovascular abnormalities of hypothyroidism are corrected by thyroxine replacement therapy. Increases in heart rate occur within days of beginning thyroxine therapy. A fall in diastolic blood pressure is found in many, and abnormalities of ventricular systolic and diastolic function are also corrected by thyroxine replacement.

Despite these clear benefits, it is well known that angina and myocardial infarction may be precipitated by the initiation of thyroxine replacement treatment (even in low dose) in those with underlying coronary artery disease (whether this is evident clinically or electrocardiographically)—this association was described more than 70 years ago. For this reason, a recent United Kingdom consensus statement for good practice in the management of hypothyroidism recommends that in older patients, especially those with ischaemic heart disease, the initial dose of thyroxine should be 25 μg and increased every three to four weeks to 25 μg increments. There is little evidence that triiodothyronine treatment is better than thyroxine in patients with ischaemic heart disease, although there is a theoretical benefit should angina worsen and thyroid hormone replacement be stopped because the half life of triiodothyronine is shorter than that of thyroxine. While it is reported that up to 15% of patients starting thyroxine therapy will sustain a myocardial infarction within two years, it is also clear that chest pain improves or resolves in up to half of patients with this problem. Nonetheless, 40% of patients with angina are unable to tolerate full replacement doses of thyroxine. It has been shown that the presence of untreated or partially treated hypothyroidism does not affect adversely the outcome of coronary artery surgery or angioplasty, so there should be a low threshold for proceeding to angiography. In those considered unsuitable for surgery or angioplasty, adequate doses of thyroxine may not be achieved, even if the daily dose of thyroxine is 25 μg or less, with gradual incremental increases every few weeks.

Significance of minor abnormalities of thyroid function
Prevalence studies have shown that "subclinical" thyroid dysfunction (defined biochemically as increases or decreases in serum thyrotrophin concentrations in association with normal circulating thyroxine concentrations) is common in the general population, especially in people older than 60. Abnormal serum thyrotrophin concentrations are also reported in about half of those in the community prescribed thyroxine long term. We have previously demonstrated that 20% of patients in the community taking thyroxine have a serum thyrotrophin concentration above the normal range, indicating either poor compliance or inadequate dose prescription; a similar pro-
Thyroid status and cardiovascular morbidity and mortality

There have been few epidemiological studies of the long term cardiovascular consequences of hypothyroidism and its treatment with thyroxine, especially in doses which reduce serum thyrotrophin to below normal. A study of 29 women treated long term with thyroxine indicated no difference in rates of cardiovascular mortality compared with controls. A larger study of 1180 patients treated with thyroxine (about half of whom had low serum thyrotrophin) revealed an increased risk of hospital admission for ischaemic heart disease among those younger than 65 years, but no difference among those with normal and suppressed thyrotrophin. The findings from the latter study do not clearly establish that mild thyroid hormone excess was itself the cause of an increase in ischaemic heart disease, not least because half of the subjects included in the study had a previous history of overt hyperthyroidism, which may itself have represented the main risk factor. Nonetheless, these findings, and those summarised above, indicate the need for further epidemiological investigation of the consequences of hyperthyroidism and its treatment on cardiovascular risk.

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Hypothyroidism, thyroxine treatment, and
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Heart 1997 77: 189-190
doi: 10.1136/hrt.77.3.189

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