Patients who are functionally impaired are more likely to have emotional disorder, to believe in an infectious cause for their illness, to avoid alcohol, and to be members of a patient self help organisation. Prospective studies are required to determine the aetiological importance of these associations.

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Association between postpartum thyroid dysfunction and thyroid antibodies and depression

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Abstract

***Objective*—To define the relation between mood and autoimmune thyroid dysfunction during the eight months after delivery.**

***Design*—Double blind comparison of the psychiatric status of women positive and negative for thyroid antibodies. Clinical examination and blood sampling for free triiodothyronine and thyroxine, thyroid stimulating hormone, and thyroid antibody concentrations at four weekly intervals. Psychiatric assessment at six, eight, 12, 20, and 28 weeks post partum.**

***Setting*—Outpatient department of district hospital.**

***Patients*—145 antibody positive women and 229 antibody negative women delivering between August 1987 and December 1989.**

***Main outcome measures*—Thyroid status. Number of cases of mental ill health by the general health questionnaire, research diagnostic criteria, Hamilton 17 item depression scale, hospital anxiety and depression scale, and Edinburgh postnatal depression scale.**

***Results*—Six weeks after delivery the general health questionnaire showed 62 (43%) antibody positive women and 65 (28%) antibody negative women had mental ill health ($\chi^2=8{\cdot}18$, $p<0{\cdot}005$). Follow up of 110 antibody positive and 132 antibody negative women showed significantly greater depression by research diagnostic criteria in antibody positive women (47%) than antibody negative women (32%) regardless of thyroid dysfunction. Antibody positive women showed higher mean scores for depression on the Hamilton (6·01 *v* 3·89, $p=0{\cdot}0002$), Edinburgh (7·45 *v* 5·92, $p=0{\cdot}031$), and hospital depression scales (4·95 *v* 3·79, $p=0{\cdot}003$).**

***Conclusion*—Depressive symptoms are associated with positive thyroid antibody status in the postpartum period.**

Introduction

Transient postpartum thyroid dysfunction associated with autoimmune thyroiditis was first reported in 1976 when Amino *et al* described six cases in women presenting three to four months after delivery with signs of mild hypothyroidism.[1] The symptoms included swelling of the neck, cold extremities, and weight gain. Profiles of serum thyroid hormone concentrations showed the women to have hypothyroidism accompanied by raised titres of thyroid antibodies. A larger prospective study of over 500 women presenting for delivery showed the commonest clinical conditions to be mild hypothyroidism, hyperthyroidism, and occasionally hyperthyroidism followed by hypothyroidism.[2] Other studies have confirmed this,[3-6] and since thyroid disorders are associated with mood disorders,[7-10] transient thyroid dysfunction could possibly be associated with postnatal depression.

Postnatal depression occurs in 10% to 20% of women in the postpartum year.[11-14] Although there is overwhelming evidence that factors such as marital disharmony, lack of a confiding relationship, previous psychiatric illness, housing problems, and other socioeconomic problems are strongly associated,[12,13] a subgroup of women may have a hormonal basis for their depression.[12,15] Anecdotal support for this has been provided by the finding that the mood of some women with post partum thyroid dysfunction mimics that of "depressive psychosis."[2] Hayslip *et al* found that women positive for thyroid antibodies

with thyroid dysfunction reported more depressive symptoms than euthyroid antibody positive women.[5] In a controlled study of 147 women at six weeks post partum, 65 of whom were positive for thyroid antibodies, a weak but significant association of depression with thyroid dysfunction was reported.[16] However, most cases of postpartum thyroid dysfunction occur later than the puerperium,[4 6 17 18] suggesting that any association with depressed mood would also be detectable at that time. We assessed antibody positive and antibody negative women for affective disorder over the first eight months post partum.

Subjects and methods

This study received ethical approval from Mid Glamorgan Health Authority. Women presenting sequentially at 16 weeks' gestation at the Caerphilly and District Miners' Hospital were admitted to the study after giving informed consent. They came from a working class population and mainly belonged to social groups III-V. We took blood samples to determine thyroid antibody status antenatally (at 16 weeks) and postnatally (within a day of delivery). A thyroid microsomal antibody concentration of 525 U/ml or above at either time point was taken to indicate positive thyroid antibody status. Women were excluded from the study if they had a known thyroid disorder, had a stillbirth, or lived in geographically remote areas.

We screened 1248 women. All 145 women positive for thyroid antibody were recruited into the study. We aimed at recruiting two antibody negative women matched for age (within five years) for each positive woman. This ensured that at least one control woman completed the study. A total of 229 of the remaining 1103 eligible antibody negative women were included in the study. Although the women were not specifically matched for parity, the aim was to achieve no significant difference between the two groups in this respect.

THYROID FUNCTION

Women were seen at four weekly intervals for eight months after delivery for thyroid assessment, and on each occasion blood was taken to measure free triiodothyronine and thyroxine, thyroid stimulating hormone, and thyroid antibody concentrations. Patients who failed to attend were visited at home by a research nurse, who took a blood sample.

PSYCHIATRIC SURVEY

At six to eight weeks post partum the 30 item general health questionnaire[19] was administered to all women. We used a cut off point of 7—that is, omitting the scores for the two questions unsuitable for women with a new baby "restless nights" and "getting out of the house" as validated by Nott.[20]

To obtain roughly equal numbers of women with positive and negative thyroid antibody status 110 antibody positive and 132 antibody negative women (age matched) were assessed at eight, 12, 20, and 28 weeks by a psychiatrist (BH, JAD, or GJW). The women were sampled so that about 50% in each group had a positive score on the general health questionnaire for maximum informativeness. When women did not attend for their assessments they were contacted by telephone and a home visit was arranged. If a home visit was not possible, self completion questionnaires were sent to the women with a stamped addressed envelope for return. The psychiatrists were not aware of the thyroid status of the women. Women were not specifically informed of their thyroid antibody status by any of the investigators. If they were aware of their status they were requested not to disclose this information to the psychiatrists.

After a short unstructured probe concerning the woman's current mental health each interview proceeded with an assessment according to research diagnostic criteria for depression (definite major, probable major, definite minor, probable minor).[21] After this the woman was rated on the Hamilton 17 item scale for depression (cut off score ≥ 15).[22] The interview at eight weeks post partum was concluded by completing the life events schedule devised by Paykel *et al* which covered the previous 12 months.[23] Women also completed the following self rating scales: the Edinburgh postnatal depression scale (cut off score ≥ 13)[24] and the hospital anxiety and depression scales (≥ 11).[25]

During the puerperium and subsequent months special care is needed in assessing depression because of many confusing factors. Sleeplessness, for example, could be due to depression or to the demands of a new baby. The research diagnostic criteria were used therefore as the standard and the other questionnaires to rate the severity of the depression. The general health questionnaire, for example, is highly sensitive and identifies all categories of research diagnostic criteria depression. The Hamilton rating scale contains within it questions which are specific to biological changes such as severe weight loss. A further aim therefore was to compare the abilities of the various questionnaires to identify the categories of research diagnostic criteria depression.

LABORATORY METHODS

After separation serum samples were stored at -20°C until analysed. Free triiodothyronine and free thyroxine concentrations were measured by using radiolabelled analogues (Amerlex M, Amersham International, Amersham). The coefficients of variation for free triiodothyronine were 3·2% and 5·6% at 10·8 and 22·9 pmol/l respectively. Between batch precision of free thyroxine assays was 4·5% at 12·7 pmol/l and 5·8% at 42 pmol/l. Thyroid stimulating hormone was measured by an in house radioimmunoassay.[26] The precision of the assay was 10% over the range 0·5 to 30 mU/l of the hormone. The limit of detection was 0·1 mU/l. Results were log transformed.

Autoantibodies were measured with an enzyme linked immunosorbent assay (ELISA).[27] Laboratory normal ranges were used that were based on the values obtained from a group of normal subjects who showed no evidence of thyroid dysfunction. The upper 95% reference limit of the normative series for thyroglobulin antibody was 250 U/ml and for microsomal antibody 525 U/ml.

Hyperthyroidism was defined as a raised free triiodothyronine or thyroxine concentration and suppressed thyroid stimulating hormone concentration ($<0{\cdot}2$ mU/l) or raised free triiodothyronine and thyroxine concentrations and normal thyroid stimulating hormone concentration. Hypothyroidism was defined as raised thyroid stimulating hormone and lowered free triiodothyronine or thyroxine concentrations or thyroid stimulating hormone concentration >10 mU/l even if free triiodothyronine and thyroxine concentrations were normal. We defined postpartum thyroid dysfunction as the presence of thyroid dysfunction at any time between 0 and 32 weeks after delivery.

STATISTICAL METHODS

Reference ranges for thyroid hormones were determined by a Gaussian model (log Gaussian for thyroid stimulating hormone). Analysis of variance was used to test time dependence of thyroid hormone concentrations. Statistical evaluation of free triiodothyronine and thyroid stimulating hormone results obtained from subjects who showed no evidence of thyroid disease at any time during the postpartum period showed that there was no significant deviation of the

values obtained at each time point from the pooled mean values for these hormones (by analysis of variance). Thus a single 95% reference range was derived for each of these biochemical parameters. However, a significant trend of increasing free thyroxine concentrations in the six months post partum was detected in the data obtained for free thyroxine in antibody negative women with normal thyroid function ($p<0·001$). For this reason separate 95% reference ranges were determined at each time point for thyroxine, based on a fitted quadratic model.

We calculated that about 100 antibody positive and 100 antibody negative women needed to be assessed to estimate the proportion of each group showing "any depression" according to research diagnostic criteria within 10% with a 95% confidence interval. With the attained sample sizes (110 and 132) a 23% difference between the percentages in each group with depression is detectable with a power of 95% at a 5% level of significance.

The sampling of women for psychiatric assessment was deliberately weighted towards the maximal ascertainment of women with positive results on the general health questionnaire and more limited sampling of those with negative results, particularly of women who were also antibody negative. Consequently analyses evaluating the relation of psychometric scales to antibody status and thyroid dysfunction incorporated weighting to correct for this. These weighted analyses used Mann-Whitney tests and χ^2 tests. Estimated means, proportions, and confidence intervals for differences in proportions also incorporated weighting. For example, the crude proportion of antibody negative women with any depression according to research diagnostic criteria was 50/126 or 40%, but only 72 (57%) of these women had negative results on the general health questionnaire. The incidence of depression in women with negative results (13/72, 18%) was much lower than that in those with positive results (37/54, 69%). Accordingly, we estimated that among all 229 antibody negative women, of whom 164 (72%) had negative results on the general health questionnaire, the proportion depressed should be reduced to 32·4%. In the antibody positive group, for whom the degree of underrepresentation of women with negative results on the questionnaire in the group assessed psychiatrically was less extreme, the effect of weighting was less strong: the crude proportion exhibiting depression was 50·5%, the corresponding adjusted proportion was 47·3%. Full details of the analyses can be obtained from the authors.

The methods used did not explicitly incorporate the individual matching of control(s) to each case because of the complexity of the design. Firstly, the number of controls obtained per case was variable. Secondly, the case and her matched control(s) would not necessarily be in the same subgroup defined by general health questionnaire results. Though age and parity are of some importance as matching factors, their relation to the main factors under study was not judged sufficiently close to make its incorporation in the analysis obligatory; individual matching was used only to produce two reasonably comparable groups.

Input characteristics of case and control groups were compared by Mann-Whitney and χ^2 tests as appropriate.

TABLE I—*Weighted mean psychometric scores* by antibody status and thyroid dysfunction*

Rating scale	Antibody negative (n=132)	Antibody positive (p value)† (n=110)	Antibody positive with thyroid dysfunction (p value)† (n=62)	Antibody positive without thyroid dysfunction‡ (n=48)
Edinburgh	5·92	7·45 (0·031)	7·80 (0·015)	7·15
Hamilton	3·89	6·01 (0·0002)	6·05 (0·00003)	5·91
Hospital anxiety	5·62	6·35 (0·114)	6·49 (0·115)	6·30
Hospital depression	3·79	4·95 (0·003)	5·15 (0·003)	4·77

*Mean of values at four visits adjusted to account for timing and missing values.
†Compared with antibody negative women.
‡Differences between antibody positive women with and without thyroid dysfunction all $p>0·05$.

Results

PATIENT POPULATION

The 145 women positive for thyroid antibody and 229 negative for antibody did not differ significantly in age (positive women mean 26·6 (range 18-42) years; negative women 25·9 (16-40) years), parity (median 2 (1-5); 2 (1-9)), marital status, and smoking habits. Similarly, the 110 antibody positive women and the 132 antibody negative women who had further psychiatric assessment did not differ significantly in terms of age (27·5 (18-42); 26·1 (17-40) years), parity (2 (1-5); 2 (1-6)), marital status, and smoking habits. The numbers of life events occurring in the past 12 months in these two groups were not significantly different (mean 2·81; 2·69). Since assessments began at six weeks post partum the phenomenon of maternity blues (which occurs in the 10 days or so after delivery) was not observed. In addition, during the study no cases of full psychosis were seen.

Failure to carry out an observer rated assessment was not a major problem—for example, for the first full psychiatric interview only six women were not assessed. Women who were not assessed tended to be slightly more depressed on the self rated scales than those who were interviewed, but not significantly so. We carried out about 3500 patient assessments (both medical and psychiatric), of which 500 were home assessments. No difference was found in the proportion of antibody positive and antibody negative women requiring home visits.

THYROID AND PSYCHIATRIC STATUS

One hundred and ten of the 145 antibody positive women and 132 of the 229 antibody negative women had psychiatric assessment. Sixty two (43%) of the antibody positive women and 65 (28%) of the antibody negative women scored seven points or higher on the general health questionnaire ($\chi^2= 8·18$, $p<0·005$). Sixty two of the antibody positive women developed episodes of thyroid dysfunction according to the defined criteria: 24 had hyperthyroidism and hypothyroidism, 11 had hyperthyroidism alone, and 27 hypothyroidism alone. None of the antibody negative women developed post partum thyroiditis. Thyroid microsomal antibody concentrations rose significantly over the six months post partum in the antibody positive group. The ranges of antibody concentrations (proportions with values of 525 U/ml or above) were 100 to 14 540 U/ml (65%) at four weeks; 100 to 15 620 U/ml (70%) at 12 weeks; and 100 to 16 910 U/ml (75%) at 20 weeks. The geometric means were 1112 (95% confidence interval 828 to 1493) U/ml at four weeks, 2455 (1820 to 3310) U/ml at 12 weeks, and 4295 (3410 to 5410) U/ml at 20 weeks. The corresponding levels in the antibody negative group were 140 (120 to 161), 137 (118 to 159), and 144 (124 to 166) U/ml.

Table I compares the psychometric scores. Among antibody positive women there were no significant differences in psychometric scores between those who did and those who did not have postpartum thyroid dysfunction. However, both of these groups scored higher on the three scales for depression than did the antibody negative group.

The proportions of women scoring above the cut off points for the various questionnaires were also compared between groups (table II). Although higher proportions of antibody positive women tended to score above the cut off points for each scale this reached

TABLE II—*Percentages of women rated positive on psychometric scales* and research diagnostic criteria according to thyroid antibody status and thyroid dysfunction (weighted analyses)*

Rating scale	Antibody negative (n=132)	Antibody positive (p value)† (n=110)	95% Confidence interval for difference between antibody positive and negative groups (%)	Antibody positive with thyroid dysfunction (p value)† (n=62)	Antibody positive without thyroid dysfunction‡ (n=48)
Research diagnostic criteria:					
Any depression	32	47 (0·009)	3·7 to 26·1	55 (0·0014)	40
Definite major depression	11	16 (0·283)	−3·7 to 12·7	12 (0·946)	21
Edinburgh	27	39 (0·026)	1·5 to 22·6	40 (0·040)	38
Hamilton	13	18 (0·279)	−3·9 to 13·4	15 (0·749)	22
Hospital anxiety	30	34 (0·475)	−7·0 to 14·9	40 (0·144)	28
Hospital depression	17	22 (0·321)	−4·4 to 13·5	21 (0·517)	23

*Positive score on one or more of four assessments.
†Compared with antibody negative women.
‡Differences between antibody positive women with and without thyroid dysfunction all p>0·05.

significance for only the Edinburgh questionnaire and for research diagnostic criteria for any depressed state. No significant differences emerged between any of the groups in terms of anxiety, whether assessed by mean scores or proportions exhibiting positive results.

Women who developed hypothyroidism with clear symptoms were treated with thyroxine 0·1 mg a day. Treatment was for at least three months or until the end of the trial, whichever was the longer. Women who showed clear evidence of depression, as clinically assessed by a psychiatrist, were given lofepramine 70-140 mg a day. Thirteen women required thyroxine and 20 antidepressant therapy.

The prevalence of positive thyroid antibody status was 11·6% in the total study population (1248). However, the estimated antibody prevalence in depressed women (any depression on research diagnostic criteria) was significantly higher (16·1%, 95% confidence interval 12·1 to 19·8) than that in women without depression (9·3%).

Discussion

Our results confirm the finding of an earlier pilot study[16] and of others[2 3 5] that there is an excess of depressive symptoms and cases of depression overall (but not major depression) in women who are thyroid antibody positive in the eight months after delivery. This was true for all women with positive antibody status regardless of whether they developed thyroid dysfunction according to the defined criteria. The validity of this finding is supported by noting that the psychiatric abnormality was shown by observer as well as self rating scales. In addition, antibody positivity was not related to anxiety (as judged by the hospital anxiety scale) but just to depression. Although some patients may have known their positive antibody or thyroid status no difference in anxiety related symptoms was observed when they were compared with control women. Other confounding variables, including social class, were excluded as far as possible. Furthermore, in subgroups of our patients there were no differences in psychiatric status between different thyroid states.

CAUSE OF ASSOCIATION

There are several possible explanations for the results. Firstly, the symptoms of general malaise associated with rising antibody concentrations may have been detected as well as actual depressive symptoms. As antibody concentrations rise after delivery cytokines are released during the immune response. These may have an effect on the brain, mediating non-specific behavioural responses such as malaise, fatigue, sleep disturbance, anorexia, apathy, and irritability.[28] A recent review pointed out that emotional disturbance and psychological symptoms may be signs of alterations in central nervous system functions caused by alterations in immune function.[29] Another possibility relates to the observation that thyroid function in many of the women was changing rapidly—for example, from hyperthyroid to hypothyroid states (11 women in our study). The cause of the change could be autoimmune thyroid follicular cellular destruction, and a blood sample taken at a particular point in time may record normal thyroid hormone concentrations, although they are in a state of flux.

Others have noted depressive symptoms accompanying thyroid dysfunction.[2 3] The symptoms are often ascribed to problems such as the demands on the mother and subsequent tiredness. Such depressive symptoms can occur with both hyperthyroid and hypothyroid states. Anxiety symptoms have also been recorded, usually anecdotally.[3] We attempted to record and measure anxiety symptoms systematically and found no significant excess in antibody positive women or those with thyroid dysfunction.

Depression was usually mild (although incapacitating), and this confirms the finding of Stewart *et al*[30] that autoimmune thyroid disorders are not associated with more serious psychiatric disease in women admitted to hospital in the postpartum period.

A possible explanation for the overall phenomenon is that it is associated with changes in corticosteroid concentrations. Corticosteroids have an immunosuppressive effect, and during pregnancy cortisol concentration rises to three or four times the normal level. After delivery the concentration returns to normal within two weeks. Although most of the cortisol is bound to cortisol binding globulin, free (biologically active) cortisol concentration also rises,[31] and this may suppress thyroid autoimmune dysfunction during pregnancy. Falling corticosteroid concentrations after delivery could account for a flare up of thyroid autoimmunity.

IMPORTANCE OF THYROID RELATED DEPRESSION

About 12% of childbearing women are positive for thyroid antibodies.[32] Half of these will develop features of a depressive syndrome—that is, 6% of the total population. However, a third of this 6% (that is, 2%) would have developed depression regardless of thyroid status (table II), leaving 4% with depression with a probable basis in autoimmune thyroid disease.

The postpartum mood disorder is an organic mood syndrome[33-35]—that is, a specific organic factor is aetiologically related to the mood disturbance[36] and is responsible for a small subgroup within the total number of women developing a depressive disorder in the postpartum year, the distribution of which is known to be skewed.[37 38] Treatment would be expected to resolve the symptoms of mood disorder.[39 40]

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Contamination of skin and clothing of accident and emergency personnel

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There is a striking contrast between clothing worn by medical staff working in resuscitation rooms of British accident and emergency departments—traditionally white coats over personal clothing—and the theatre-style suits and gowns worn by resuscitation teams in North American centres.[1] We do not know how often personal clothing or uniforms worn by accident and emergency personnel are spattered by blood and other body fluids and the protection afforded. There is, however, a definite risk of infection with various transmissible agents during patient contact. A case report of HIV infection in an accident and emergency health care worker after skin contamination with blood from a seropositive patient having cardiopulmonary resuscitation emphasised the need for suitable protective clothing.[2] We attempted to assess the risk of clothing soilure and skin contamination during the daily work of accident and emergency staff in a busy teaching hospital accident and emergency department.

Methods and results

During 1-30 November 1991, 7402 patient attendances were recorded. Medical and nursing staff were asked to check their clothing and exposed skin after each patient contact and if there was definite soilure to clothing to check for visible evidence of underlying skin contamination. Two hundred forms were completed on 212 splash incidents.

Although 2·2% of patients (n=169) presenting to the department were treated within the resuscitation room, 36·3% of splash incidents (77) occurred there. Altogether 16·5% of splashes (35) occurred in the examination room mainly as a result of wound management (22·6% of splashes (48)). A total of 28·8% of splashes (61) occurred during venous or arterial puncture, but contamination was recorded during 20 other procedures ranging from undressing the patient to last offices. Some 47·6% of splashes (101) resulted in skin contamination, and 28·7% of these (29) occurred despite the area being covered by personal clothing or a uniform. Personal clothing was soiled in 41·0% of incidents (87) and uniforms in 62·3% (132). A total of 71·2% of splashes (151) were with patients' blood, though splashes of vomitus, sputum, saliva, pus, faeces, and urine were documented.

Comment

The accident and emergency department operates a policy of "universal precautions,"[3] and medical and nursing staff receive guidance in appropriate barrier procedures when contact with blood or other body fluids is anticipated. Despite the appropriate use of gloves, masks, face shields, gowns, and plastic aprons splashes on clothing and skin contamination may occur. Nursing uniforms do not protect the legs or arms, and white coats do not protect against spattering of personal clothing. White coats have been shown to be a potential source of cross infection, especially when worn in accident and emergency departments.[4] The soilure of personal clothing is both unacceptable and unhygienic. Contamination of skin despite wearing a