Short Communication

Preliminary Studies on Thyroid Function in Welders

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During welding operation, workers are exposed to welding fumes containing various toxic metals and their oxides, certain gases, radiation, and high temperature. Health hazards and biological effects associated to these exposures have been extensively studied, however, thyroid function has received very little attention. There are a few reports available, which indicate that some metals including aluminium, cadmium, lead, and mercury can alter thyroid function. In addition, exposure to radiation, and high temperature are also known to have their impact on thyroid function. Studies reported earlier from this Institute indicated that metals like manganese, iron, and zinc form the main constituents of welding fumes while chromium, nickel, copper, cadmium, and lead were found in trace amounts; significantly higher levels of these metals including chromium, nickel, copper, and cadmium were also found in blood of welders. Keeping in view the above facts, we have conducted a pilot study to assess thyroid function in welders working in small-scale industrial settings.

Subjects and Methods

Twenty healthy male welders with an average age of 38.4 ± 8.67 yr (mean ± SD), having average occupational exposure of 13.5 ± 5.2 yr (mean ± SD), and performing manual electric arc and/or gas welding participated in the study. Job operation mainly included welding and cutting of iron objects. Simultaneously, an equal number of control subjects, matched with age, sex, socio-economic status and having no previous occupational exposure to welding profession or other chemicals were also studied. All subjects were interviewed for their life-style, and their occupational history was recorded. Intravenous blood samples (6–8 ml) from both the groups were drawn in a morning session. Serum was separated by centrifugation and used for hormonal analysis. Serum thyrotropin (thyroid stimulating hormone, TSH) was estimated by solid phase immunoradiometric assay (TSH/IRMA). Serum total T₄ (TT₄) and total T₃ (TT₃) were measured by radioimmunoassay (RIA). Assay sensitivity (n=5) as determined by the lowest standard, different from zero (t-test), was 0.58 ng/dl for T₄; 0.2 μg/dl for T₃; and 0.03 μIU/ml for TSH, respectively. Intra-assay coefficients of variation (CVs) for reference sera (n=5 each) with T₄ concentrations of 7.5 and 15 μg/dl were 3.4% and 4.8%, respectively. Similarly for T₃ reference sera, (1.3 ng/ml) and TSH reference sera (30 μIU/ml); the values of CVs (n=5 each) were 4.3% and 4.6%, respectively. Statistical analysis was performed using Student’s ‘t’ test.

Results

Levels of TSH were increased significantly (p<0.02) in welders compared with non-welders. The average level of TSH was determined to be 2.61 ± 1.93 μIU/ml (mean ± SD) and ranged from 0.74–7.34 μIU/ml in welders, while it was quite lower (1.71 ± 0.63 μIU/ml) in non-welders and varied in a narrow range (0.81–3.20 μIU/ml). However, total T₄ (TT₄) and total T₃ (TT₃) levels remained almost unchanged.

Based on the individual TSH measurements, 4 of the 20 welders (subjects #3, #5, #12 and #18) had elevated levels of TSH (Fig. 1) which were well above the normal range (0.81–3.2 μIU/ml) determined by us for the reference group (non-welders). The isolated elevated levels of TSH in welder #3 and welder #5 with values of TSH 7.34 μIU/ml and 6.56 μIU/ml, respectively fall away from the 95% confidence limit (CI (-)1.2–6.48 μIU/ml). These welders had relatively low levels of T₄ (6.2 and 5.5 μg/dl) and showed no clinical signs or symptoms associated with thyroid disorders. Welders #12 and #18 had TSH values near to 5 μIU/ml, a value suggested earlier for the onset of sub-clinical hypothyroidism. However, the rest of the welders (80%) had TSH values in a normal range varying from 0.74 to 3.53 μIU/ml indicating no adverse effects of multiple exposure on TSH levels (Fig. 1).

Discussion

Values reported for thyroid function tests in welders are the results of cumulative effects of various exposures. At this stage it is difficult to state the effects of individual exposure factor on thyroid function which was altered in a few welders. However, significantly higher levels of certain metals such as chromium, nickel, copper, cadmium, manganese, zinc and lead in blood of other welders as well as higher concentrations of welding fumes in the work environment of small scale industrial settings were reported earlier by Pandy. This may be, in part, one of the probable causes of TSH elevation in 4 of the 20 welders studied in the present investigation as metals like aluminium, cadmium, mercury and lead, had already reported for thyroid effects. Subjects #3 and #5 with
isolated elevated levels of TSH (7.34 µIU/ml and 6.56 µIU/ml), normal levels of total T₃ and T₄, and no apparent clinical signs and symptoms are suspected to have acquired sub-clinical hypothyroidism; TSH values above 5 µIU/ml and below 10 µIU/ml were described by Klee and Hay (10) for sub-clinical hypothyroidism. Welders #12 and #18 having TSH values near to the 5 µIU/ml are at risk of developing hypothyroidism if TSH levels progress further. The majority of welders (80%) showed no adverse effects of multiple exposure on thyroid function (Fig. 1). TSH levels in some non-thyroidal diseases are also elevated, therefore, other tests such as the presence of thyroid peroxidase antibodies (TPO-antibodies) or the levels of free T₃ or T₄ are desirable to further confirm the differential state of thyroid disorder.

In conclusion, hypothyroidism suspected in two welders may be due to their working environment; however, other confounding factors may also play an important role. A detailed study involving the evaluation of multiple exposure to pinpoint effects on thyroid function in welders is required to further strengthen the present findings.

Table 1. Serum concentration of thyroid hormones in welders and control subjects

<table>
<thead>
<tr>
<th>Subjects</th>
<th>TSH (µIU/ml)</th>
<th>Parameter</th>
<th>T₂ (µg/dl)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Non-welders</td>
<td>1.71 ± 0.63*</td>
<td>1.20 ± 0.27*</td>
<td>8.14 ± 1.59*</td>
</tr>
<tr>
<td>(N=20)</td>
<td>(0.81–3.20)*</td>
<td>(0.8–1.60)*</td>
<td>(5.10–10.0)*</td>
</tr>
<tr>
<td>Welders</td>
<td>2.61 ± 1.93**</td>
<td>1.14 ± 0.25 NS</td>
<td>7.96 ± 1.48 NS</td>
</tr>
<tr>
<td>(N=20)</td>
<td>(0.74–7.34)**</td>
<td>(0.82–1.70)**</td>
<td>(5.50–10.50)**</td>
</tr>
</tbody>
</table>

*p<0.02: values were compared with control (non-welders group). NS=not significant; @ Values represent mean ± SD; a Values in parentheses indicate range.

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