The association between atrophic glossitis and protein-calorie malnutrition in old age

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Abstract

Aim: to examine the relationship between atrophic glossitis (absence of papillae in more than 50% of the tongue) and nutritional status.

Design: a randomized population survey.

Setting: the medical department of Aker University Hospital, and people living at home.

Participants: 310 old people recently admitted to hospital and 106 randomly selected elderly people at home.

Measures: the presence of atrophic glossitis and nutritional indices.

Results: atrophic glossitis occurred in 13.2% of men and 5.6% of women at home and in 26.6% of men and 37% of women in hospital. The atrophic glossitis was related to reduced weight, body mass index, triceps skinfold thickness, arm-muscle circumference, muscular strength, activities of daily living and serum concentrations of cholesterol, ascorbic acid, cholecalcidiol and B12, but not to levels of zinc or folate. In a multiple logistic regression model, atrophic glossitis was related only to cholesterol ($P = 0.032$), muscular strength ($P = 0.018$) and activities of daily living ($P = 0.03$).

Conclusion: atrophic glossitis is common in elderly people and is a marker for malnutrition and reduced muscle function.

Keywords: activities of daily living, atrophic glossitis, body mass index, Katz index, muscle strength

Introduction

Atrophic glossitis, the absence or flattening of the filiform papillae, is considered to be a marker of nutritional deficiency. It was found in nearly 5% of the old people in the first US National Health and Nutrition Examination Survey [1]. Atrophic glossitis is common in hospitalized elderly patients. This tongue appearance has been related to vitamin deficiencies [2, 3], but vitamin substitution does not always improve it [4].

In a pilot study, we observed atrophic glossitis in 35 of 104 elderly patients, but did not see cases of magenta or beefy tongue [5]. (A swollen beefy tongue may be present in nicotinic acid deficiency, and magenta tongue in riboflavin deficiency [2].)

Protein-calorie malnutrition is also prevalent in elderly people in hospital [6]. As part of a larger prospective study of malnutrition in elderly hospitalized patients [7], we have investigated the relationship between atrophic glossitis and measures of nutrition.

Methods and subjects

We studied two groups of people aged between 70 and 91 years, all of whom lived in the same area of Oslo. The hospital group comprised 311 subjects (140 men, 171 women) who usually lived independently at home, but had been admitted to Aker University Hospital with an acute disease or exacerbation of a chronic disease. The home group comprised 106 elderly people (54 men, 52 women) living in the same area as the hospital group, randomly selected by the Central Bureau of Statistics. (For details of inclusion criteria see [7].)

Methods

One of us (M.M.) recorded height, weight, triceps skinfold, midarm circumference [8]. The arm-muscle circumference was estimated from triceps skinfold and midarm circumference [9, 10]. Muscle strength was measured in 299 patients [11]. We determined the functional status using the Katz index of independence in activities of daily living [12].
Because of the skew distribution of the anthropometric indices, we set the cut-off point in the home group at close to the 5th percentile for body mass index, triceps skinfold and arm-muscle circumference, and at <35 g/l for serum albumin [7]. We defined undernutrition when the following criteria were fulfilled for men and women respectively: body mass index <20.0 and <19.2 kg/m², triceps skinfold <5.0 and <9.0 mm, arm-muscle circumference <20 and 19 cm, and serum albumin <35 g/l. We defined the presence of one or two measures as moderate malnutrition, and of three or four measures as severe malnutrition.

We defined tongue atrophy as being when more than 50% of the area had atrophic papillae. This was subjectively evaluated (by M.M.). We evaluated tongue changes before making the anthropometric assessment and the rest of the clinical evaluation.

We took blood samples in the hospital group within 24 h of admission, after the patients had fasted overnight. In the home group, one of us (M.M.) took non-fasting blood samples. Serum aliquots were prepared and frozen at −70°C within 2 h of venepuncture. We analysed serum albumin, calcium, magnesium, phosphate, high-density lipoproteins and cholesterol by Hitachi 717 Multianalyzer (Boehringer Mannheim, Mannheim, Germany). We also analysed samples for haemoglobin [13], ascorbic acid [14], carnitine [15], insulin-growth factor 1 [16], calcidiol [17], zinc [18], folic acid and vitamin B₁₂ [19].

**Statistics**

We used Student’s *t*-test for comparison of means between the groups and Fisher’s exact test for comparison between two categories of qualitative data. To study the relationship between atrophic glossitis and the other variables, we used multivariate regression analysis [20]. The level of significance was set at 5% for all analyses.

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**Table 1. The presence of atrophic glossitis in elderly people living at home and those in hospital**

<table>
<thead>
<tr>
<th>Group</th>
<th>No. of subjects</th>
<th>Normal tongue</th>
<th>Atrophic glossitis</th>
<th>Not defined</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hospital</td>
<td>310 (32.2%)</td>
<td>201</td>
<td>100</td>
<td>9</td>
</tr>
<tr>
<td>Men</td>
<td>139</td>
<td>96</td>
<td>37 (26.6%)</td>
<td>6</td>
</tr>
<tr>
<td>Women</td>
<td>171</td>
<td>105</td>
<td>63 (37%)</td>
<td>3</td>
</tr>
<tr>
<td>Home</td>
<td>106</td>
<td>92</td>
<td>10⁴ (9.2%)</td>
<td>4</td>
</tr>
<tr>
<td>Men</td>
<td>53</td>
<td>93</td>
<td>7 (13.6%)</td>
<td>3</td>
</tr>
<tr>
<td>Women</td>
<td>53</td>
<td>49</td>
<td>5 (5.6%)</td>
<td>1</td>
</tr>
</tbody>
</table>

*Significant difference, χ² = 6.4, d.f. = 2, *p* < 0.001.
Hospital group, between sexes *p* = 0.08 (not significant); home group, between sexes *p* = 0.22 (not significant).

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**Table 2. Nutritional indices in elderly subjects with normal tongue and atrophic glossitis**

<table>
<thead>
<tr>
<th></th>
<th>Normal tongue</th>
<th>Atrophic glossitis</th>
<th>Reference</th>
<th><em>P</em></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Mean</td>
<td>SD</td>
<td></td>
</tr>
<tr>
<td>Haemoglobin (g/l)</td>
<td>194</td>
<td>13.1</td>
<td>2.1</td>
<td>98</td>
</tr>
<tr>
<td>Calcium (mmol/l)</td>
<td>189</td>
<td>2.27</td>
<td>0.13</td>
<td>97</td>
</tr>
<tr>
<td>Phosphate (mmol/l)</td>
<td>215</td>
<td>1.1</td>
<td>0.28</td>
<td>63</td>
</tr>
<tr>
<td>Magnesium (mmol/l)</td>
<td>181</td>
<td>0.86</td>
<td>0.12</td>
<td>95</td>
</tr>
<tr>
<td>Cholesterol (mmol/l)</td>
<td>171</td>
<td>5.9</td>
<td>1.5</td>
<td>87</td>
</tr>
<tr>
<td>Serum iron (µmol/l)</td>
<td>176</td>
<td>10.5</td>
<td>7.2</td>
<td>96</td>
</tr>
<tr>
<td>Carnitine (µmol/l)</td>
<td>147</td>
<td>47</td>
<td>16.2</td>
<td>75</td>
</tr>
<tr>
<td>High-density lipoprotein (mmol/l)</td>
<td>169</td>
<td>1.21</td>
<td>0.60</td>
<td>83</td>
</tr>
<tr>
<td>Ascorbic acid (µmol/l)</td>
<td>188</td>
<td>32.3</td>
<td>18.3</td>
<td>98</td>
</tr>
<tr>
<td>1,25-OH vitamin D (nmol/l)</td>
<td>176</td>
<td>41.5</td>
<td>23.4</td>
<td>87</td>
</tr>
<tr>
<td>Insulin growth factor-1 (mmol/l)*b</td>
<td>45</td>
<td>15.0</td>
<td>5.0</td>
<td>31</td>
</tr>
<tr>
<td>Zinc (µmol/l)</td>
<td>173</td>
<td>11.6</td>
<td>2.5</td>
<td>92</td>
</tr>
<tr>
<td>Red cell folic acid (nmol/l)</td>
<td>183</td>
<td>474</td>
<td>235</td>
<td>97</td>
</tr>
<tr>
<td>Serum B₁₂ (pmol/l)</td>
<td>179</td>
<td>294</td>
<td>232</td>
<td>91</td>
</tr>
</tbody>
</table>

*a* Level of significance was tested with Student’s *t*-test.

*b* Studied only in a subsample.
The study was approved by the Norwegian regional ethical committee. Permission was also obtained from the Norwegian Data Inspectorate, the Central Bureau of Statistics and the National Register.

We studied 310 elderly people in hospital and 106 at home. Atrophic glossitis was present in 27% of hospitalized men and 37% of hospitalized women. Among those living at home, the prevalences were 13% and 6% (Table 1). Since the hospitalized subjects had a higher prevalence of atrophic glossitis, we have concentrated on this group in our study of the relationship between atrophic glossitis and nutritional indices.

The serum concentrations of cholesterol, ascorbic acid, calcidiol, iron and haemoglobin, but not erythrocyte folate, were significantly lower in the group with atrophic glossitis than in those with a normal tongue (Table 2). Body weight, triceps skinfold, arm-muscle circumference and Katz index of activities of daily living (in both sexes) and serum albumin concentrations and muscle strength (in men) were all significantly reduced in those with atrophic glossitis (Table 3).

We related the atrophic glossitis to the different nutritional indices by sequential regression analysis, which showed that it associated with cholesterol concentration, muscle strength and Katz index (not shown). Atrophic glossitis was present in 99 of the 297 in the hospital group: 30 who were severely malnourished, 39 with moderate malnutrition and 30 with normal nutrition (not shown). The presence of atrophic glossitis gives a sensitivity, defined according to Yerushalmy [21], for severe malnutrition of \( \frac{30}{52} = 0.57 \) and for severe and moderate malnutrition together of \( \frac{39 + 30}{119 + 52} = 0.43 \). The specificity of atrophic glossitis for malnutrition is \( \frac{198}{297} = 0.67 \).

We found atrophic glossitis in more than one-third of the older people in hospital. Atrophic glossitis was related in bivariate analysis to protein-calorie malnutrition, body weight, body mass index, triceps skinfold, arm-muscle circumference and concentrations of ascorbic acid, cholesterol and calcidiol.

The criteria for atrophic glossitis vary from one investigator to another [2]. We addressed atrophy in a simple way by subjectively evaluating if it affected more than 50% of the tongue. A better correlation with nutritional core indices might have been obtained if we...
had further quantified the degree of the atrophic glossitis. 

We found that atrophic glossitis was related to protein-calorie malnutrition and also to low levels of vitamin C (which has a short half-life) and lipid-soluble vitamin D (with a long half-life). The atrophy of the papillae has previously been related to specific nutritional deficiencies and the changes have reverted upon specific treatment. In some older patients, more than one nutrient may be deficient. Nutrients with a short half-life (e.g. vitamin C and the B vitamins) could be reduced long before the concentration of serum albumin is reduced and before deficiencies of lipid soluble vitamins as A and D have developed. One or more limiting factor(s) might inhibit normal tongue development.

The papillae on the tongue are made up of taste buds. The cells have a half life of 10–10.5 days, making them sensitive to malnutrition [22]. Reduced taste and interest in food occurs before the development of malnutrition [23]. Thus, atrophic glossitis may be a consequence of malnutrition and may also contribute to it.

Key points
- Atrophic glossitis is common in elderly people and is a marker for malnutrition and reduced muscle function.
- More than one-third of our sample of elderly patients who had recently been admitted to hospital had atrophic glossitis.
- Atrophic glossitis is related to general protein-calorie malnutrition and cannot be related to a single nutritional factor.

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References
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