Estimation of the risk for nutritional state degradation in patients with cancer: development of a screening tool based on results from a cross-sectional survey

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Background: In routine practice, the evaluation of the nutritional status of patients with cancer is not always performed although there is frequent modification as disease progresses. The validated screening and evaluation tools currently available are time-consuming and costly. In this study we analysed factors that could be used to identify patients likely to need nutritional surveillance or intervention.

Patients and methods: A cross-sectional survey was carried out for 2 weeks in June 2006 on 477 patients with cancer.

Results: 30.2% of the patients had lost more than 10% of their body weight since the start of the illness. After adjustment, the factors significantly associated with weight loss were: depressive state (OR = 3.49; P = 0.002), digestive or ENT tumours (OR = 3.20; P < 0.001), chemotherapy (OR = 2.66; P = 0.011), male gender (OR = 2.30; P = 0.001) and professional status (OR = 2.08; P = 0.02). Using a logistic model, we calculated the risk of weight loss as a function of the presence of the identified predictive factors.

Conclusion: We report a simple screening tool, which will not replace the available evaluation methods but will enable targeting of the patients most likely, after a specific evaluation, to benefit from nutritional intervention. This remains to be validated in further prospective studies.

Key words: cancers, cross-sectional study, nutritional status assessment, risk factors, weight loss

introduction

Modification of the nutritional status is a frequent complication in patients with cancer [1]. Its prevalence is variable, depending on the malnutrition criteria used and the population studied [2]. Its prevalence is estimated to be between 15% and 80%, depending on the localization of the tumour and its extension [3–6]. The principle symptom of cancer-related malnutrition is weight loss, which can be more or less important. In the absence of suitable treatment, this can result in cancer cachexia, a complex syndrome seen as a loss of muscular mass, fatty tissue loss, anorexia and other specific metabolic disturbances [1,6–9]. Malnutrition can be a symptom revealing the presence of a cancer but it can also appear afterwards, during cancer treatment [10]. Resection of tumours is an essential step in the management of patients with cancer, but patients with malnutrition have a higher risk of postoperative complications and increases postoperative morbimortality. Malnutrition also alters the immune status and reduces the body’s defence against infectious diseases [11]. It can also lead to a poorer response to treatment [12]. In patients with malnutrition it can be necessary to reduce the doses, and even to interrupt the treatment. In digestive cancers, it has been found to be associated with a reduction in the duration of complete remission, overall survival and the response rate to chemotherapy [12]. In addition, malnutrition is an independent risk factor for quality of life [13–15]. Malnutrition is a poor prognostic factor and as such should be prevented or detected as early as possible.

There are several criteria, more or less complex to measure, that have been proposed to evaluate the nutritional status [8,16–19]. However, the current validated tools are difficult to use by healthcare professionals because of limitations of time, practical organization or cost [20]. It has been reported that the evaluation of nutritional risk cannot be undertaken systematically in routine practice [8] and, therefore, it is sometimes undertaken too late, reducing the chances of successful treatment [21]. If it were possible to target patients at risk for malnutrition it might be possible to implement preventive actions or early treatment during the treatment and evolution of the cancer.

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**Table 1.** Weigh loss and body mass index (BMI) of patients as a function of their primary cancer site

<table>
<thead>
<tr>
<th>Site</th>
<th>Weight loss ≥10%</th>
<th>BMI* &lt;18.5 or &lt;21 if over 75 years old</th>
</tr>
</thead>
<tbody>
<tr>
<td>Stomach (n = 9)</td>
<td>8 (88.9)</td>
<td>1 (11.1)</td>
</tr>
<tr>
<td>Oesophagus (n = 9)</td>
<td>7 (77.8)</td>
<td>2 (22.2)</td>
</tr>
<tr>
<td>Pancreas (n = 24)</td>
<td>14 (58.4)</td>
<td>6 (25.0)</td>
</tr>
<tr>
<td>ENT (n = 23)</td>
<td>12 (52.2)</td>
<td>4 (17.4)</td>
</tr>
<tr>
<td>Other (n = 20)</td>
<td>9 (45.0)</td>
<td>6 (30.0)</td>
</tr>
<tr>
<td>Primary site unknown (n = 7)</td>
<td>3 (42.9)</td>
<td>1 (14.3)</td>
</tr>
<tr>
<td>Vesicle (n = 7)</td>
<td>3 (42.9)</td>
<td>1 (14.3)</td>
</tr>
<tr>
<td>Kidney (n = 5)</td>
<td>2 (40.0)</td>
<td>0 (0.0)</td>
</tr>
<tr>
<td>Colorectal (n = 103)</td>
<td>37 (35.9)</td>
<td>10 (9.7)</td>
</tr>
<tr>
<td>Lung (n = 68)</td>
<td>21 (30.9)</td>
<td>7 (10.3)</td>
</tr>
<tr>
<td>Ovary (n = 20)</td>
<td>5 (25.0)</td>
<td>3 (15.0)</td>
</tr>
<tr>
<td>Uterus (n = 16)</td>
<td>5 (31.3)</td>
<td>2 (12.5)</td>
</tr>
<tr>
<td>Thyroid (n = 4)</td>
<td>1 (25.0)</td>
<td>0 (0.0)</td>
</tr>
<tr>
<td>Prostate (n = 24)</td>
<td>4 (16.9)</td>
<td>1 (4.2)</td>
</tr>
<tr>
<td>Breast (n = 132)</td>
<td>13 (9.8)</td>
<td>7 (5.3)</td>
</tr>
<tr>
<td>Liver (n = 5)</td>
<td>0 (0.0)</td>
<td>0 (0.0)</td>
</tr>
<tr>
<td>Total (n = 476)</td>
<td>144 (30.2)</td>
<td>51 (10.7)</td>
</tr>
</tbody>
</table>

*Body mass index in kg/m².*

The aim of this study was to identify this subgroup of patients at high risk of malnutrition through a better understanding the factors associated with the risk. The long-term objective is to improve early screening and management of patients with cancer at risk of malnutrition with a simple, fast and inexpensive method before substantial weight loss occurs.

**patients and methods**

We undertook an observational, cross-sectional survey for 2 weeks in 11 university hospital services in Saint Etienne (France): radiotherapy ward, day hospital ward, oncology consultation and ward, pneumology, gynaecology, hepatogastroenterology, ENT, urology, and thoracic and digestive surgery wards. The protocol was approved by our local ethics committee.

Patients 18 years old and over, with an evolving cancer at different stages of management were included. Patients with primary skin, eye or central nervous system tumours or with malignant haematopathy, those who had not received treatment for 2 years or more and those who had not been informed about their cancer or were unable to answer the questionnaire were excluded.

Medical students were recruited to collect the data. These medical students were present in each service for 2 weeks and collected the data from the patients’ dossiers, by questioning the patients and a brief clinical examination. All patients gave informed consent.

The patients’ nutritional status was measured using: weight loss since the start of the illness or appearance of the first symptoms; weight loss since 1 week, 1 month and 6 months; body mass index (weight/height²); nutrition risk index [22] and subjective classification using the categories from Worksheet 5 of the Patient-Generated Subjective Global Assessment (PG-SGA) [8,23,24].

Sociodemographic data, and data on the primary tumour and the management of the disease were collected: gender, age, professional status, living conditions, primary tumour site, disease stage at diagnosis, current episode, previous and on-going treatment, functional capacity (evaluated using WHO Performance Status) and other factors affecting the nutritional status. Double data entry was performed using Epi-info (version 6.04). After cross-verification of the data, they were analysed statistically using SPSS® version 12.

The primary outcome was the percentage weight loss since the start of the illness. After a descriptive analysis of the studied population, we performed a univariate analysis for each of the patients’ characteristics. The qualitative variables were compared with a chi² test and the quantitative variables with a Student t-test. The variables associated with a weight loss of more than 20% were used in the multivariate analysis.
The variables that were strongly correlated with weight loss were excluded from the analyses.

A descending, step-by-step logistic regression with an entry and exit threshold of 5% was performed using the likelihood ratio with SPSS® version 12. The variables remaining in the logistic model equation were combined in a single, discrete quantitative variable called “score”.

A second logistic regression with this single explicative variable gave a simplified model for calculating the risk. The risk of weight loss was calculated for each possible value of this new variable “score”. The validity of the model was verified with a ROC curve.

Results

We included 477 patients: 276 women (58.4%) and 197 men (41.6%), with a mean age of 62 years old (± 11.9 years). In this population: 10.6% had a body mass index (BMI) <18.5 (or 21 for those over 75 years old); 21.8% had lost weight over the 2 weeks prior to inclusion; 22.4% had lost more than 5% of their weight in a month or more and 10% in 6 months; 30.2% had lost ≥10% of their weight since becoming ill; and 42.1% had been diagnosed with moderate or severe malnutrition with the subjective classification of the categories on Worksheet 5 of the PG-SGA. The nutrition risk index was not analysed because of the low number of results for albuminaemia available (5.2%).

Univariate analysis

The prevalence of weight loss of ≥10% as a function of the primary tumour site is given in Table 1. We combined the sites with a high prevalence (digestive and ENT) to compare them with the other sites, and found that 45.1% of patients with digestive and ENT primary cancers had a weight loss of ≥10% compared with 21.7% of patients with cancers in other sites. We observed that 144 patients had lost more than 10% of their weight and 51 had a BMI below the normal limit.

Age, professional status, retired status, current episode, depression, diet, current infection, radiotherapy and surgery were not statistically significantly associated with weight loss (Table 2). Gender was associated with weight loss—almost 42% of men compared to 22% of women had lost more than 10% of their weight (P<0.001). The tumour stage at diagnosis (local, locoregional or metastatic) was statistically significantly associated with weight loss (P = 0.010). Almost 40% of patients who had received or were receiving chemotherapy had lost weight compared with 16% of those who had not had chemotherapy (P = 0.001).

Multivariate analysis

The results from the multivariate analysis showed that depression (OR = 3.49; P = 0.002); tumour site (OR = 3.20; P<0.001); chemotherapy (OR = 2.66; P = 0.011); gender (OR = 2.30; P = 0.001); and professional status (OR = 2.08; P = 0.02) were statistically significantly associated with weight loss (Table 3).

Since the odds ratios for these five variables were similar (between 2 and 4) we combined them to create a new variable, “score”, which included the five variables and could take values from 0 to 5. The logistic model including this score enables the risk for weight loss or malnutrition, as a function of its value, to be estimated. The value for OR obtained was 2.320 (95% CI = 1.836–2.932). The model can be expressed as

\[
\text{Weight (weight loss \geq 10%/ Score)} = 1/(1 + \exp (3.009 - 0.842 \text{Score}))
\]

These results have been represented as a graph that can be used in routine practice. The validity of the model was explored by comparing the results with those for the percentage of weight loss since the beginning of the illness using a ROC curve (Figure 2).

Discussion

The patients included in our study had cancer at different stages with 30% having a weight loss of more than 10%, and 10.7% having a BMI lower than normal. Multivariate analysis using the patients’ characteristics showed there was a significant association between weight loss of ≥10% since the beginning of the illness and depression, digestive and ENT tumours, chemotherapy, male gender and professional status. We developed a score, which can be calculated based on the

<table>
<thead>
<tr>
<th>Variable</th>
<th>Log (odds ratio)</th>
<th>SD</th>
<th>Wald</th>
<th>P</th>
<th>OR (95% CI)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Depressed (Yes = 1; no = 0)</td>
<td>1.249</td>
<td>0.398</td>
<td>9.837</td>
<td>0.002</td>
<td>3.487 (1.598–7.611)</td>
</tr>
<tr>
<td>Tumour site (Digestive or ENT = 1; others = 0)</td>
<td>1.162</td>
<td>0.250</td>
<td>21.639</td>
<td>0.000</td>
<td>3.196 (1.959–5.214)</td>
</tr>
<tr>
<td>Chemotherapy (Yes = 1; no = 0)</td>
<td>0.978</td>
<td>0.383</td>
<td>6.508</td>
<td>0.011</td>
<td>2.660 (1.254–5.640)</td>
</tr>
<tr>
<td>Gender (Male = 1; female = 0)</td>
<td>0.831</td>
<td>0.255</td>
<td>10.664</td>
<td>0.001</td>
<td>2.296 (1.394–3.782)</td>
</tr>
<tr>
<td>Profession (Blue collar = 1; white collar = 0)</td>
<td>0.734</td>
<td>0.316</td>
<td>5.378</td>
<td>0.020</td>
<td>2.083 (1.120–3.872)</td>
</tr>
<tr>
<td>Constant</td>
<td>−3.276</td>
<td>0.491</td>
<td>44.601</td>
<td>0.000</td>
<td>0.038</td>
</tr>
</tbody>
</table>
The patients included in this study came from 11 different departments, suggesting that they are representative of patients with cancer. However, it must be remembered that patients in private healthcare structures and those followed as out-patients were not included. In addition, patients with primary neurological, skin or ocular tumours and those with malignant haemopathy were not included.

The originality in our approach lies in the fact that we aimed to prevent nutritional problems at a very early stage of the process, before important weight loss or other clinical or biological signs of malnutrition appeared. We identified variables specific to the patients and their illness which will allow their risk for malnutrition to be identified. We considered variables that could have an impact on the deterioration of the nutritional status other than those commonly used (weight variation, modification of eating habits, digestive problems, functional capacity, clinical examination, albuminemia, etc).

We decided to use several criteria for the evaluation of the nutritional status and we have reported those that we thought were the most sensitive. Percentage weight loss since the beginning of the illness is relatively objective, although the patient’s usual weight is not always known exactly. One disadvantage of this criterion is that it does not take into account the rate of weight loss. We were not able to use the Detsky index, the SGA [12,25] or the PG-SGA completely because of the difficulty in assessing the clinical items; anthropometric measurements are rarely taken routinely and there is wide inter- and intraevaluator variability [21].

The body mass index is often used in the decision to install nutritional management, but in our study only 10% of the patients had a body mass index lower than normal, suggesting that this index alone is not a sufficiently sensitive indicator in our population. The five predictive factors that we identified have already, more or less, been identified in previous studies. The high prevalence of malnutrition in patients with digestive or ENT cancers was report in 1980 in a study that evaluated 3000 patients [3]. In another study published in 1998, a significant difference was observed at diagnosis for gender, with men at a higher risk (men 51% vs. women 44%) of weight loss [12]. The nutritional consequences associated with different symptoms or side-effects due to chemotherapy have also been reported [26,27]. Depression is a known factor in the physiopathology of anorexia and other nutritional troubles [28]. A study in 2003 showed that one or two criteria used to assess the depression status could identify patients at risk of malnutrition who could then benefit from a nutritional intervention [17]. Other studies suggest that a psychological treatment to prevent malnutrition could have some advantages, while recognizing the harmful effects of a poorly adapted nutritional intervention [29]. However, only very few studies have shown an association between the patient’s professional status and the risk of malnutrition during a cancer.

The instrument that we have developed is not intended to replace the different existing nutritional evaluation scores but to select patients likely to benefit most from a more specific evaluation (rate of weight loss, food intake, physical examination, albuminemia, etc.), an intervention or a specific follow-up [21,30]. A decision algorithm could be developed based on the assessed risk of malnutrition. This algorithm could be linked with recommendations for the type of evaluation to perform and the therapeutic strategy to consider (simple or more intense follow-up, training session on nutrition for patients, oral supplements, etc.) [31,32].

The implementation of a nutritional surveillance could enable rapid treatment of symptoms (anorexia, dysphagia, nausea, vomiting, constipation, tiredness, etc.) which could have a role in the malnutrition process [33]. The initial identification would be performed by physicians, and the treatment would be the responsibility of a multidisciplinary team (nurses, dietician, psychologist, etc.) [34]. This score will now be validated in prospective studies.
acknowledgements

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references