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Nutrition Intervention Improves Nutritional Status and Quality of Life Outcomes in Patients Undergoing Radiotherapy

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1. Introduction

As radiation therapies continue to evolve it is important that supportive care, including effective nutrition support, also improves for best patient care and outcomes. Several sets of evidence-based nutritional management guidelines have been developed for patients with cancer. There is strong evidence to suggest that nutritional counselling by a dietician and/or supplementation is beneficial in improving nutritional status and quality of life in patients with gastrointestinal and head and neck cancer receiving radiotherapy. There is also some evidence to suggest that specialised supplements including omega 3 fatty acids and/or immunonutrition may be beneficial in particular patient groups. In order to provide timely and appropriate nutrition intervention and improve patient outcomes, early and ongoing nutrition screening and assessment needs to be implemented. As new cancer care centres and treatments become available it is important that evidence-based nutritional care is provided as part of multidisciplinary care for best patient outcomes.

2. Malnutrition is common in patients with cancer

Patients with cancer are one of the diagnostic groups at greatest nutritional risk (Watterson et al 2009). A recent observational study in 191 oncology patients receiving cancer services at a public Australian hospital found that almost one half of patients were malnourished, and common symptoms impacting on dietary intake included taste changes, poor appetite and nausea (Isenring et al 2010). Consequences of malnutrition include increased risk of infections, poor wound healing, decreased quality of life and transfer to higher level care (Watterson et al 2009). Malnutrition is particularly of concern as it has been shown to independently lead to increased hospital readmissions and in-hospital mortality, even after

adjusting for disease type and severity (Agarwal et al 2012). Strong evidence exists to support the prevention and early detection of malnutrition, with nutrition intervention significantly improving patient and clinical outcomes (Watterson et al 2009).

3. Why can radiotherapy lead to nutritional problems?

While radiotherapy techniques are continually improving they may result in significant side effects to the patient. Radiotherapy has a localised anti-tumour effect, damaging rapidly dividing cells, but can also affect healthy tissue within the treatment field. Radiotherapy acts by directing X-rays to cause damage to cell DNA so cells cannot replicate. Rapidly dividing cells (e.g. blood cells and gut mucosa) are the most susceptible to radiation change. Therefore tumours that require radiotherapy to an area of the head and neck or gastrointestinal tract are likely to lead to nutritional problems. Potential side effects of radiation therapy to the head and neck area may include mucositis, odynophagia, thick saliva, xerostomia, trismus, pharyngeal fibrosis and decreased appetite due to changes in sense of smell and taste (Rademaker et al., 2003). Radiotherapy can also exacerbate tooth decay due to induction of xerostomia and removal of dental fluoride. Patients with head and neck cancer should see a dentist prior to commencing treatment and decayed teeth should be removed at least 7 days prior to commencement of radiation therapy. Radiotherapy to the thyroid gland in the neck area may lead to hypothyroidism so patients should have their neck area checked regularly (People Living with Cancer 2012). Consuming enough calories to prevent additional weight loss is therefore vital for survivors at risk of unintentional weight loss, such as those who are already malnourished or those who receive anticancer treatments affecting the gastrointestinal tract (Rock et al., 2012). Patients receiving radiotherapy to the gastrointestinal area may experience diarrhoea, constipation, gastric pain, indigestion and/or flatulence which can impact on nutritional status and quality of life.

An aspect of treatment not usually considered is that during radiotherapy patients are required to spend large amounts of time receiving medical treatment and waiting for appointments which can disrupt routines and lead to missed meals. In our experience, rural patients may be at increased nutritional risk as they often need to travel large distances to receive treatment. Their alternate accommodation may not have suitable cooking facilities or equipment such as a blender for softer, pureed foods that may be required if experiencing swallowing difficulties. The patient may not have the energy or skills to prepare suitable foods and fluids during this time. Therefore having an occupational therapist, social worker and/or nurse who can liaise with the patient, care givers, if available, and/or organise home help may be particularly important for the patient at nutritional risk without sufficient support to help with shopping and cooking.

Patients may not be aware that side effects of radiotherapy are often experienced a few weeks after commencement, continue during treatment but may also continue to build and be experienced for 4-6 weeks after completing radiotherapy treatment. This period is an important time for review e.g. a telephone review by a nurse to see how the patient is progressing. Often the patient thinks that the side effects will stop and they will feel better

after finishing radiotherapy treatment. However, as the side effects can continue and even become worse for 2 weeks after treatment completion, if the patient does not have adequate support, they can become dehydrated and/or malnourished. These nutritional issues may not be picked up unless the patient is admitted to hospital or when they next come in for a medical review which may be 4-6 weeks later. Therefore a follow up telephone review in the first few weeks following radiotherapy treatment can be useful to identify any problems that may require additional medication and/or support.

Patients receiving radiotherapy to the head and neck area may also experience long term swallowing difficulties. These swallowing difficulties may increase the risk of malnutrition. Therefore ongoing liaison and review by the multidisciplinary team, including a dietician and speech pathologist, may be required.

4. Importance of good nutrition during radiotherapy

The continuum of cancer survivorship raises different nutritional needs and challenges and includes cancer treatment, recovery, living after recovery and for some, living with advanced cancer (Rock et al., 2012). Maintaining nutritional status during anti-cancer treatments including radiotherapy is important for a number of reasons. Significant loss of body weight is not only an indicator of poor prognosis and associated with decreased physical function and quality of life, but weight loss can also affect treatment schedules. Weight loss during radiation therapy to the head and neck can place the safety and effectiveness of the treatment at risk, requiring repeat CT scans in order to keep critical structures to within accepted tolerance doses (Davidson et al., 2006)).

5. Overview of nutrition intervention in patients receiving radiotherapy

There is strong evidence that nutrition intervention improves patient outcomes in patients receiving radiotherapy to the gastrointestinal or head and neck region. Dietary counselling by a dietician and/or oral nutritional supplements are effective methods of nutrition intervention and have been found to improve dietary intake, nutritional status and quality of life in patients receiving radiotherapy (NHMRC grade of recommendation A) (Isenring et al 2012).

6. Head and neck cancer patients

As previously discussed, because of the field of radiotherapy treatment, patients with cancer of the head and neck area are often those at greatest nutritional risk. In 2011, Evidence Based Practice Guidelines for the Nutritional Management of Adult Patients with Head and Neck Cancer (HNC) were released. These HNC guidelines, which cover all treatment modalities (radiotherapy, chemotherapy and surgery), reviewed 288 studies including 45 randomised controlled trials. There is evidence (Grade A) in patients with HNC that supports weekly dietician contact during radiotherapy and at least fortnightly for 6 weeks post treatment, with contact as required for up to 6 months (Grade C).

7. Early identification of nutritionally at risk patients

Medical Nutrition Therapy involves the assessment of nutritional status, nutritional diagnosis and using professional judgement to individually tailor an appropriate nutritional plan. Obviously, the goals and outcomes of nutrition intervention will be dependent on the diagnosis and prognosis of the patient.

Firstly, in order for patients with cancer who are at nutritional risk to be appropriately identified and referred to the dietician, nutrition screening should be routinely used in oncology settings (Isenring 2008). Several valid nutrition screening tools for oncology patients exist, including the Malnutrition Universal Screening Tool (MUST), Malnutrition Screening Tool (MST) and Nutrition Risk Screening 2002 (NRS-2002) (Skipper et al., 2012). Some nutrition screening tools are more detailed than others and designed for different settings and users. Therefore it is recommended to use a valid and reliable tool appropriate to the setting. The simplest tool, the Malnutrition Screening Tool (MST) consists of two questions enquiring about unintentional weight loss and poor dietary intake and can be administered by nursing or administration staff or by the patient themselves (Ferguson et al 1999). In absence of a formal screening system, malnourished patients can be overlooked, especially if they appear normal or overweight (Watterson et al., 2009). Patients identified as at nutritional risk by the MST can then be referred to the dietician or a trained health professional for a comprehensive nutrition assessment.

A valid and reliable nutritional assessment tool for patients with cancer is the scored Patient Generated – Subjective Global Assessment (PG-SGA). The PG-SGA is specific for cancer patients and was developed from the commonly used nutritional assessment tool, Subjective Global Assessment (SGA). Using the PG-SGA tool, patients are categorised as well-nourished (SGA A), moderately or suspected of being malnourished (SGA B), or severely malnourished (SGA C). The PG-SGA also has a scoring system which includes: a patient-completed medical component (weight loss, nutrition impact symptoms, dietary intake and functioning), and a clinician-completed component (diagnosis, age, and metabolic stress). An increase in PG-SGA score reflects greater risk for malnutrition. This system enables clinicians to rank the nutrition risks of individuals within the same SGA category.

Patients deemed to be at very high nutritional risk e.g. head and neck cancer receiving chemo-radiation may bypass screening and proceed directly to nutritional assessment. If a patient is identified as at nutritional risk and there is no dietician available, then it may be appropriate to proceed directly to a nutrition intervention such as high energy and protein diet, oral nutrition supplements or seek further nutritional advice from someone with nutritional expertise e.g. oncologist or physician trained in nutrition. These health care professionals can individualise nutritional recommendations to the patient, but some general tips are described below:

- Small frequent meals
- Make every mouthful count i.e. nutritious foods eaten first, including high energy and protein sources

- Use sauces to moisten meals
- Add fats and sugars to increase energy density and milk/protein powders to increase protein density
- Milkshakes made at home, sauces, commercially available dairy convenience foods
- Commercial high energy and protein supplements, can be dairy, soy or cordial based
- Fortify foods and fluids with protein and carbohydrate powders

If these strategies are not helping to prevent/slow weight loss then more intensive nutritional intervention may be required e.g. enteral (tube) feeding. If the gastrointestinal tract is not functioning appropriately then parenteral nutrition may be warranted. Nutrition support decisions should be made by the multidisciplinary treatment team in conjunction with the patient and carer.

8. Nutritional monitoring of cancer patients receiving radiotherapy

It is important that body weight is regularly monitored and recorded. Even small amounts of unintentional weight loss each week can result in significant unintentional weight loss over a few months. It is easier to slow unintentional weight loss than to try and lead to weight gain after a patient has already lost a significant amount of weight (eg. 5% of body weight in one month or 10% of body weight in 6 months).

Tips for effective body weight monitoring include:

- Measure at the same time of day each week
- Be consistent i.e. before meals, no shoes, in light clothing
- Be aware that different conditions can affect hydration levels influencing body weight e.g. chemotherapy, renal disorders, end stage of disease

It is important that clinicians remember that body weight gives no indication to body composition and fat can mask significant loss of muscle mass. It is this lean tissue that contributes to physical function impacting on patient quality of life. There are many simple bioelectrical impedance devices that give an indication of body composition as well as body weight. Although these devices can be affected by hydration levels, as long as their limitations are understood they can still provide more useful information than body weight alone.

If a health professional trained in nutrition is available then regular assessment of nutritional status by a validated tool e.g. PG-SGA is recommended. Regular nutrition screening, early and timely referral and assessment and intervention by the dietician, as part of the multidisciplinary team and regular monitoring of outcomes offers best nutritional care for patients.

9. Mouth care

Sugar-free chewing gums and sweets, and alcohol-free mouth rinses can help with a dry mouth. Artificial saliva sprays and oral lubricants may be useful, but once again appear to be based on personal preference. Mouth care is important and many centers recommend

patients use a made-at-home salt water and/or bicarbonate of soda mouth rinse. For a dry mouth, carrying around a water bottle and sipping frequently as well as keeping a glass of water by the bedside can be beneficial.

<ul style="list-style-type: none">• Implement routine nutrition screening e.g. Malnutrition Screening Tool• Refer high risk patients for nutrition and swallowing assessment e.g. Scored Patient Generated Subjective Global Assessment• Consider whether patient may require a feeding tube (discuss with the multidisciplinary team, patient, and caregiver)• Monitor weight regularly (ideally weekly during radiation therapy, every outpatient appointment)• Aim for weight maintenance (or at the very least minimize weight loss) during treatment• Manage nutrition-related symptoms as a multidisciplinary team

Table 1. Summary of nutritional management of patients receiving radiotherapy

10. Nutrition and physical activity recommendations for cancer survivors

Cancer survivors are often highly motivated to seek information about food choices, physical activity, and dietary supplements to improve their treatment outcomes, quality of life, and overall survival (Rock et al., 2012). Many patients are interested in nutrition and seek nutritional advice external to the cancer centre. It has been reported that 40% of cancer patients are seeking extra nutrition resources and would like further information regarding dietary tips for managing side effects and supplements (Isenring et al 2010). Therefore it is important that health professionals feel comfortable answering common nutritional queries using an evidence-based approach, have access to appropriate resources e.g. Cancer Council handouts, or can refer to a dietician. The World Cancer Research Report recommends that all cancer survivors receive nutritional care from an appropriately trained professional (physician and/or qualified nutrition professional e.g. dietician) if able to do so. Unless otherwise advised, patients should aim to follow the recommendations for diet, healthy weight and physical activity (WCRF 2010). Patients receiving anticancer treatment can exercise if they wish during treatment but should restrict activity if they are anaemic and should avoid chlorine exposure to irradiated skin (eg, from swimming pools) (Rock et al., 2012).

11. Cancer cachexia

The complex clinical syndrome known as cancer cachexia (from Greek **kakos** (bad) and **-hexia** (condition)) differs from malnutrition in that it is characterised by a negative protein and energy balance, progressive loss of skeletal body mass (sarcopenia), anorexia and metabolic derangements (Dewey et al 2010; Fearon et al 2011). The weight loss seen in patients with cachexia is from both muscle and fat, which is distinct to that seen in patients with malnutrition or anorexia where weight loss is predominantly from fat (Evans et al 2008). This variation is due to the metabolic alterations and inflammatory state that occurs in

cachexia (Arends et al., 2006). Cancer cachexia is a multi-factorial syndrome that cannot be fully reversed by conventional nutritional support and leads to progressive functional impairment (Fearon et al., 2011). Cancer cachexia is most commonly exhibited in patients with advanced disease particularly in solid tumours such as pancreatic, lung, gastric and colorectal cancer (Bauer et al., 2005; Dewey et al., 2010). Symptoms may include severe weight loss, anorexia, early satiety, together with associated fatigue and weakness (Bauer et al., 2005; Dewey et al., 2010). Cachexia has a significant impact upon patient morbidity, reduced quality of life and is implicated in 30-50% of all cancer deaths (Palomares et al., 2006).

The nutritional goals and outcomes of patients, particularly those with advanced cancer, need to be realistic, individualised and synonymous with the overall goals for the patient (Bauer et al., 2005). The patient's prognosis and own wishes must be considered with the nutrition intervention adjusted accordingly for those requiring palliative supportive care. The *Evidence Based Practice Guidelines for Nutritional Management of Cancer Cachexia* provides a clear and evidence-based framework to effectively guide nutritional intervention in patients with cachexia (Bauer et al., 2005).

Weight stabilisation is an appropriate nutrition intervention goal for patients with cancer cachexia as it has been shown to improve quality of life and prolong survival compared to patients who lose weight (Andreyev et al 1998, Davidson et al 2004). In order to accomplish weight maintenance in patients with cancer cachexia, it is important to ensure that patients have optimal symptom control and can achieve adequate energy and protein intakes. It has been estimated that an energy intake of at least 120kJ/kg/day and protein intake of approximately 1.4g/kg/day should be prescribed to patients with cancer cachexia in order to maintain weight (Davidson et al., 2004; Bauer et al., 2005). Frequent nutrition counselling (weekly to fortnightly) by a dietitian has shown to improve nutritional and clinical outcomes in cancer patients. The consumption of high protein energy supplements does not appear to negatively impact upon the amount of food consumed (Isenring et al., 2004; Bauer & Capra 2005). In addition, a multidisciplinary approach in order to effectively manage patients with cancer cachexia has shown to be beneficial and further investigation into novel service delivery models is warranted (Glare et al., 2010).

Some studies, though not necessarily nutrition interventions, examined energy expenditure of oncology patients using indirect calorimetry. The Resting Energy Expenditure (REE) ranged from 6300kJ/day (Bosaeus et al 2002) to 8700±1500kJ/day (Cereda et al 2007). In all of these studies, the Harris-Benedict equation significantly underestimated total energy expenditure compared to indirect calorimetry. Therefore there is still a gap in evidence regarding actual total daily energy requirements and at least 120 kJ/kg/day and close monitoring of intake and body weight is recommended. All patients should be considered on an individual basis dependent on clinical factors and discussed amongst the medical team.

Cancer cachexia is challenging to treat. In addition to providing adequate energy and protein intake, other agents have been investigated, including fish oil (eicosapentaenoic acid). Further research regarding the effectiveness of these agents is required.

12. Antioxidants

There are three level I reviews addressing the issue of antioxidant use in radiation therapy and chemotherapy. All reviews (Block et al., 2002; Lawenda et al., 2008; Greenlee et al., 2009) concluded that there was insufficient evidence to provide clear guidelines on use of antioxidant supplements, due to the lack of understanding of the dose-relationship response and the small number of studies on each antioxidant. On the basis of these reviews, it is not recommended that supplemental doses of antioxidants be used, at least until further well-designed studies are published.

As part of the nutritional management of these patients, it is important to not only replenish protein and energy intakes but also vitamin and mineral intakes. Dietary intakes of vitamins and minerals should not be greater than the recommended dietary intakes (RDI) as these may interfere with treatment (Rock et al., 2012). It is important that patients always notify their medical team of any medications and vitamin, mineral and/or herbal supplements they may be taking. Alcohol is an irritant, even in the small amounts found in mouth washes, therefore it is reasonable to recommend that alcohol intake should be avoided or limited in patients with or at risk of mucositis and those receiving radiation therapy to the head and neck area (Rock et al., 2012).

13. Recommendations post radiotherapy

13.1. Long term: Healthy eating strategies for cancer survivors

If there are no long term side effects or nutritional concerns such as swallowing difficulties, reliance on feeding tube or at risk of malnutrition, then general healthy eating and lifestyle recommendations are the same as those for the general population. Key themes include eating plenty of plant-based and whole grain foods, and limiting weight gain (Rock et al., 2012). This may decrease the risk of cancer recurrence (for those with dietary link – over 25% of all cancers including breast, HNC) and other lifestyle diseases such as Type II diabetes mellitus and cardiovascular disease. It is recommended to achieve and maintain a healthy weight, engage in regular physical activity with at least 150 minutes per week and strength training on two days a week and achieve a dietary pattern that is high in vegetables, fruits, and whole grains and reducing energy dense but nutrient poor products such as sugary drinks (Rock et al., 2012).

13.2. Palliative care

Clinicians must always have treatment goals in mind. Therefore whether the patient is receiving radical radiotherapy or non-curative treatment but still may have months or even years to live. In these situations nutrition can still play an important role in terms of preserving lean tissue and body weight and help with activities of daily living and quality of life. If the patient is receiving palliative radiotherapy and is end stage, then the nutritional issues become more about patient preference, eating for enjoyment and quality of life. The use of enteral nutrition and parenteral nutrition support should be individualized with

recognition of overall treatment goals (control or palliation) and the associated risks of medical complications and/or ethical dilemmas (Rock et al., 2012). For patients with end-stage disease, focus should be on patient comfort and quality of life (Isenring et al., 2008). Patients with minimal dietary intake may require tube feeding (depending on prognosis and in consultation with patient and medical team) (Isenring et al., 2008).

14. Summary

In conclusion, there is strong evidence to support the benefits of nutrition intervention in improving nutritional status and quality of life in patients receiving radiotherapy. A nutrition screening process should be in place to identify those patients at nutritional risk and put appropriate nutritional assessment and interventions in place. A multi-disciplinary approach is the preferred treatment option as it leads to better patient satisfaction and outcomes. All new cancer treatment centres should include access to an Accredited Practising Dietitian or equivalent (e.g. Registered Dietician) for best patient care. This highlights the importance of early identification and management of nutrition-impact symptoms with adequate follow-up in order to provide optimal care for people with cancer undergoing radiotherapy.

Example meal plans for oncology patients undergoing radiotherapy

Based on a male weighing 70kg. Provides approximately 8500-9000kJ/d (2000-2150Kcal/d) and 110-120 g protein/d.

	Standard High Energy-High Protein (no mouth pain or swallowing difficulties)	Soft High Energy-High Protein e.g. sore mouth	Minced and Moist High Energy-High Protein e.g. dysphagia, mucositis
Breakfast	1 bowl of cereal with 1 tbsp nuts/seeds and 2 tbsp yogurt, milk* to cover Or 2 eggs (any style) with 2 sl toast, medium spread margarine/butter	1 bowl cereal (without dried fruit or nuts) e.g. porridge, weet bix, rice bubbles) with milk*, Or 2 scrambled or poached eggs on buttered toast (no crusts)	1 bowl cereal well moistened with milk* e.g. weetbix, or porridge or semolina, 2 tbsp yogurt Or 2 scrambled or poached eggs with mashed baked beans
Morning Tea	Cheese and 3 crackers and 1 piece of fruit	Nourishing drink Or dairy dessert	Nourishing drink Or dairy dessert
Lunch	Egg, cheese or meat and salad sandwich (2 sl any bread, includes crusts) 1 piece of fruit	1 sl. Quiche Or Soft sandwich (e.g. egg and mayonnaise on 2	150g Minced meat and soft cooked vegies (e.g. Bolognese) or mashed baked beans

		sl. white bread with crusts removed) Soft fruit e.g. ripe banana or tinned fruit	and vegies with extra gravy/white sauce Soft fruit e.g. cut up ripe banana or cubed tinned fruit
Afternoon Tea	1 piece of fruit Nourishing drink	Nourishing drink Or dairy dessert	Nourishing drink Or dairy dessert
Dinner	150 g (cooked weight) Meat or vegetarian alternative and 3-4 vegies Any dessert	200g Fish or soft casserole with sauce Well-cooked vegies Pudding or moist cake with custard/yogurt	200g Nourishing soup or minced/finely chopped stew with extra sauce Mashed banana or stewed fruit (skin removed or finely chopped) with custard/ice cream
Supper	Nourishing drink	Nourishing drink	Nourishing drink

Tips

Milk*Fortified milk=1 heaped tbsp milk powder(FCM or skim) to 1 cup milk

Nourishing drink = 300ml drink made on milk or dairy alternative e.g. soy milk, such as milk shake, hot chocolate or commercial oral nutrition supplement e.g. Sustagen, Ensure. If weight loss is occurring aim for 3 nourishing drinks per day. If weight loss continues refer to nutritional professional e.g. dietician for assessment.

Dairy dessert can include yogurt, pudding, mousse, baked custard, ice-cream etc.

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