The provision of enteral nutritional support during definitive chemoradiotherapy in head and neck cancer patients

Sarah Bishop, MBBS, MHS, 1,2 & Warren Michael Reed, BSc (Hons), Post Grad Cert (T&L), PhD 3

1 Illawarra Cancer Care Centre, Department of Radiation Oncology, Wollongong Hospital, Wollongong, New South Wales, Australia
2 Radiation Oncology Department, Nelune Comprehensive Cancer Centre, Prince of Wales Hospital, Randwick, New South Wales, Australia
3 Medical Image Optimisation and Perception Group, Discipline of Medical Radiation Sciences, Faculty of Health Sciences, The University of Sydney, Lidcombe, New South Wales, Australia

Keywords
Carcinoma, chemoradiotherapy, enteral nutrition, gastrointestinal, gastrostomy, intubation, squamous cell

Abstract
Combination chemoradiation is the gold standard of management for locally advanced squamous cell carcinomas of the head and neck. One of the most significant advantages of this approach to treatment is organ preservation which may not be possible with radical surgery. Unfortunately, few treatments are without side-effects and the toxicity associated with combined modality treatment causes meaningful morbidity. Patients with head and neck cancer (HNC) may have difficulties meeting their nutritional requirements as a consequence of tumour location or size or because of the acute toxicity associated with treatment. In particular, severe mucositis, xerostomia, dysgeusia and nausea and vomiting limit intake. In addition to this, dysphagia is often present at diagnosis, with many patients experiencing silent aspiration. As such, many patients will require enteral nutrition in order to complete chemoradiotherapy (CRT). Feeding occurs via catheters placed transnasally (nasogastric tubes) or directly into the stomach through the anterior abdominal wall (percutaneous gastrostomy tubes). In the absence of clear evidence concerning the superiority of one method over another, the choice of feeding tube tends to be dependent on clinician and patient preference. This review examines key issues associated with the provision of enteral nutritional support during definitive CRT in HNC patients, including feeding methods, patient outcomes and timing of tube insertion and use.

Introduction
Head and neck cancer (HNC) is an umbrella term encompassing 18 distinct cancer subites as defined by the International Classification of Diseases. 1,2 These cancers are staged according to the Tumour Node Metastases system developed by the International Union Against Cancer (IUCC) together with the American Joint Committee for Cancer (AJCC).3 The gold standard of treatment for locoregionally advanced cancers of the nasopharynx and oropharynx is combined modality treatment with concurrent chemotherapy and radiotherapy. 4 This approach is associated with preservation of organ function and decreased rates of distant failure when compared with definitive local treatment with surgery or radiotherapy alone. 5

The anatomic location of these tumours is often in close proximity to structures vital for breathing, eating and communicating. 6 Patients’ inability to meet their nutritional requirements is often exacerbated by treatment-related toxicity. 7 It is therefore preferable that patients be managed in a dedicated HNC unit with multidisciplinary support from speech pathologists, dieticians, nursing and other medical staff. 8
Patients unable to maintain adequate oral intake have greater rates of weight loss, hospitalisation and forced treatment breaks. Loss of >10% body weight has also been associated with decreased quality of life (QOL). Some 40–57% of HNC patients may be malnourished at presentation, with figures increasing to 88% during treatment. Causes are multifactorial, with contributions from patient, treatment and tumour factors. Enteral nutrition (EN), delivered via nasogastric (NG) or percutaneous gastrostomy (PEG) tube, may enable select patients to maintain their weight and minimise toxicity.

The purpose of this review is to explore the key issues surrounding the use of enteral nutritional support (NS) during definitive chemoradiotherapy (CRT) in HNC patients. In the absence of quality randomised data, anecdotal evidence drives individual clinical practice.

Methods

A review of relevant literature was conducted. Articles of interest were identified using Medline, the Cochrane Library, Embase and PubMed databases. Key search terms included ‘CRT’, ‘chemoradiation’, ‘head and neck neoplasms’, ‘EN’, ‘NG tube’, ‘PEG tube’, ‘nutrition’, ‘cachexia’, ‘dysphagia’ and ‘QOL’. Reference lists from identified articles were also reviewed.

Articles were eligible for inclusion if they were published prior to November 2014 in English-language journals. Randomised control trials, systematic reviews, retrospective trials, case series and evidence-based guidelines concerning nutritional intervention in the setting of radiation treatment for head and neck squamous cell carcinoma (HNSCC) were included. Trials employing definitive radiation, radiotherapy in combination with chemotherapy or radiotherapy as an adjunct to surgery were reviewed. Sources were evaluated by the author for relevance to the objective of this narrative review.

Studies exclusively concerned with outcomes of surgical management of HNSCC were excluded.

Results and Discussion

In total, 106 articles were identified with 30 excluded by preliminary screening of titles and abstracts. A total of 76 articles were examined in detail with 59 being included in the final review.

Enteral feeding

Enteral feeding refers to delivery of nutrition to the stomach or small intestine (post-pyloric) via flexible tubing passed either through the nasal aperture and into the stomach (NG) or percutaneously through the anterior abdominal wall directly into the stomach (gastrostomy). These may be placed prophylactically in anticipation of patient needs prior to treatment, or reactively during treatment at a time when the patient is no longer able to meet their nutritional requirements. Evidence-based practice guidelines endorsed by the Dieticians Association of Australia dictate that the goals of nutritional intervention in HNC patients undergoing CRT should be to ‘minimise a decline in nutritional status/weight and to maintain QOL and symptom management’.

A study of 533 HNC patients undergoing RT by Langius et al. found that individuals who lose 10% of their baseline weight during treatment had lower global QOL scores with negative impact on functioning, social eating and social contact (P < 0.001). Improved QOL scores have been reported in patients who have undergone nutritional counselling, which leads to less weight loss. Regular contact with a dietician or other health professional providing individualised support during treatment improves outcomes and limits weight loss. Interventions such as nurse-led outpatient clinics designed to educate patients and their families about EN have been trialled with promising results.

RTOG 90-03 was a randomised prospective study conducted to compare the efficacy of four radiotherapy fractionation schedules employed in the definitive treatment of head and neck SCC. A secondary analysis of the RTOG 90-03 data was published in 2006, which examined the influence of NS and timing of its initiation on treatment-related toxicity and disease outcomes. Patients were divided into three groups for analysis – NS commenced before treatment, during treatment and no NS. Those patients receiving NS before treatment experienced less weight loss and a lower incidence of severe mucositis, or improved ‘host’ outcomes compared with the remaining cohort. Tumour outcomes, however, were significantly worse in those patients receiving NS at baseline. Five-year overall survival in the pre-treatment support group was 16%, compared with 36% in the during-treatment group and 49% in the no NS group (P < 0.0001). Similarly, rates of locoregional (LR) failure were greater in the pre-treatment NS group. Patient characteristics between the NS groups were unbalanced, with more advanced disease, poorer performance status and greater pre-treatment weight loss associated with early intervention. Despite these negative prognostic indicators, the results remained significant on multivariate analysis.

Re-feeding syndrome (RFS) is a metabolic complication of rapid restitution of nutritional intake first described in severely de-conditioned prisoners at the conclusion of the Second World War. It is characterised...
by marked electrolyte, fluid and glycaemic derangement in the context of re-feeding following a period of starvation. Patients at high risk of RFS include those with limited intake for as little as 5–10 days, oncology patients, chronic alcohol users, significant (>10%) unintentional weight loss within the preceding 3–6 months.22,23 Head and neck cancer patients may possess one or more of these risk factors. Enteral feeding regimens must therefore be prescribed by a qualified dietician, with appropriate monitoring of fluid-balance, cardiac function and electrolytes.

Nasogastric tubes

Insertion of nasogastric tubes (NGTs) may be performed blind or under endoscopic visualisation. Once inserted, the position of the NGT should be confirmed radiologically.9 Incorrect placement within the trachea, lungs or pleura has been reported in up to 15% of cases23 and may cause perforation, pneumothorax or abscess if feeds or medications are introduced into the malpositioned tube. Epistaxis as a consequence of mucosal trauma during NGT insertion is another well-documented complication. Nasal alar necrosis has been reported.24

An NGT may cause increased upper aerodigestive tract irritation in patients already experiencing significant discomfort from treatment-induced mucositis. In addition to this foreign-body response,23 NGTs are known to cause gastro-oesophageal sphincter dysfunction and gastric reflux. This may be significant enough to cause reflux oesophagitis or, in severe cases, aspiration pneumonia.25 Psychological distress owing to the visibility of NGTs should not be underestimated, with NGTs serving as a tangible reminder of illness.19,26

Guidelines suggest that NGTs are suitable for patients anticipated to require EN for short periods of 4–6 weeks.27,28 Dislodgement requiring reinsertion is common. NGTs should be changed after a maximum of 10 weeks. Patients may require conversion from NGT to gastrostomy feeding.29

Percutaneous endoscopic gastrostomy tubes

PEG tubes are passed between the stomach and external abdominal wall.20 Gastrostomy tubes may be inserted surgically, radiologically or, most commonly, endoscopically. PEG tubes are usually inserted under conscious sedation, thus avoiding general anaesthesia and its complications. The three most common methods of endoscopic insertion are the per oral ‘pull’ technique, the per oral ‘push’ technique and the introducer technique, details of which are outlined in Table 1.

Severe coagulopathy, peritonitis or pharyngo-oesophageal obstructions are absolute contraindications to PEG insertion. Relative contraindications such as pregnancy may be circumvented with careful planning. Safe insertion of PEG tubes in patients up to 29 weeks of gestation has been reported.29 In the setting of HNC, patients with alcohol-related liver disease, portal hypertension, oesophageal varices and ascites may be encountered.

Major complications associated with PEG insertion include bowel perforation, injury to liver or spleen, bleeding, buried bumper syndrome, fistula formation, tumour seeding of the stoma site and aspiration pneumonia.30 Major complication rates of 3–8.4% have been reported.25,31 Injury to bowel and other abdominal organs is more likely in patients with a history of prior abdominal surgery. Buried bumper syndrome is generally considered a late complication of PEG tube insertion, however has been reported as early as 3 weeks post-procedure.32 Sequelae include bleeding, local infection, sepsis and death. Once diagnosed, the tube must be removed, usually under endoscopic guidance.

A rare (<1%) but important complication relating to PEG insertion is that of stomal seeding which may result in abdominal wall metastases. Risk factors particularly relevant to HNC include size and location of primary tumour (especially oropharyngeal), use of the ‘pull’ technique, advanced stage of disease and squamous cell histology.23

Minor complications such as tube obstruction, dysfunction and dislodgement, peristomal leakage, superficial wound infection and pneumoperitoneum are not uncommon, with studies reporting a range of incidence rates (6–40%).25,31,33 Administration of

Table 1. Percutaneous endoscopic gastrostomy tube insertion techniques.

| Technique | Procedure |
|-----------|-----------|
| Pull      | Abdominal wall pierced with needle with attached string, string extracted via mouth, gastrostomy tube (GT) fixed to string and guided back through oesophagus, into stomach and through initial abdominal wall puncture site |
| Push      | Similar to pull technique, however, a guidewire is utilised in place of string, with the feeding tube (FT) pushed over the wire and along wire tract |
| Introducer| Relies on Seldinger technique (commonly employed in angiography and central line insertion), thus eliminating need for dangerous trocar use. A guidewire is introduced into the stomach under endoscopic visualisation and a series of dilating catheters are used to increase the size of the tract before the feeding tube is inserted |

© 2015 The Authors. Journal of Medical Radiation Sciences published by Wiley Publishing Asia Pty Ltd on behalf of Australian Institute of Radiography and New Zealand Institute of Medical Radiation Technology
prophylactic antibiotics at the time of insertion has been proven to decrease the incidence of local infection, with guidelines recommending a single dose of cephazolin be administered intravenously 30 min prior to the procedure.34,35

NGT versus PEG

Randomised evidence directly comparing NGT to PEG in HNC patients is scarce, which some authors attribute to patient reluctance to undergo randomisation between feeding tubes (FTs). A Cochrane Collaboration review updated in 2013 identified a single randomised control trial comparing NGT and PEG feeding in the setting of CRT for locoregionally advanced HNC.36 This study by Corry et al.37 saw 33 patients randomised to NGT or PEG feeding – 18 to NGT and 15 to PEG. Tubes were inserted once intake declined below 50% of calculated caloric requirement or ≥5 kg of weight loss from baseline. Cost of insertion of a NGT was reported as $50 AUD compared with $626 AUD for PEG tube placement. This differential reflects the need for endoscopic insertion of PEG tubes, whereas most NGTs are placed by nursing staff.

The findings of key studies comparing outcomes in patients with NGT and PEG tube feeding during treatment of HNC are summarised in Table 2.

With poor accrual for the randomised study detailed in Table 2, Corry elected to continue their study as a prospective non-randomised series from 2003. The results of their analysis of this larger cohort were subsequently published in Head and Neck in 2009.42 Interestingly, after the FT options were explained to prospective participants, the majority elected to have a NGT inserted (73 vs. 32 patients). Again, PEG feeding was associated with modest weight gain at 6 weeks post-treatment (0.8 kg compared with 3.7 kg loss with NGT feeding; P < 0.001). Duration of tube dependence was longer in the PEG group, with patients requiring EN for a median of 146 days (range 55–617). This is in contrast to a median of 57 days (range 5–396) in the NGT cohort.

Neuromuscular fibrosis is a recognised late effect of radiotherapy and may contribute to the development pharyngo-oesophageal strictures and chronic dysphagia in HNC patients.43–45 Swallowing is a highly co-ordinated and sophisticated mechanism46 and despite combined CRT being advantageous in terms of organ preservation, this does not necessarily equate to preservation of function.12 The limited studies directly comparing EN methods in HNC patients undergoing CRT have generally failed to follow patients beyond 6 months. There is evidence to suggest that patients may still develop complications many years following treatment.5,12,44 In addition to this, the manner in which dysphagia is assessed appears inconsistent, with patient weight and FT dependence often serving as a surrogate in place of a formal swallowing assessment with a qualified speech pathologist. Evidence from Wang et al.47 suggests that there is a lower incidence of dysphagia associated with NGT feeding (P = 0.0005). These findings are supported by the results of a retrospective analysis by Oozeer et al.48 examining patient-reported swallowing outcomes more than 24 months post-CRT for HNC. Using the MD Anderson Dysphagia Inventory as a measure of day-to-day swallowing function, patients who received NGT feeding during treatment consistently scored higher across all domains (P < 0.001).

Muscle atrophy associated with disuse has been implicated in the aetiology of dysphagia. It follows that with decreased duration of tube dependence with NGT feeding, patients return to oral intake faster, decreasing the period of disuse. That being said, 14–18% of patients are reported to be silently aspirating48 at the time of diagnosis which suggests a significant component of tumour-related causation.12 Speech pathologist intervention during treatment is likely to involve prescription of swallowing exercises aimed to limit the impact of EN and maintain function.

A brief summary of the advantages and disadvantages of PEG and NGT is outlined in Table 3.

Timing of PEG insertion

In HNC patients undergoing definitive CRT there are two approaches to PEG feeding – first to insert the tubes prior to treatment in anticipation of inadequate intake or second to insert a tube when patients are no longer able to meet their nutritional requirements. Each of these methods is associated with unique advantages and disadvantages, during treatment and beyond.

Prophylactic PEG insertion minimises weight loss, limits hospitalisations relating to malnutrition and dehydration49 and necessitates fewer interruptions to treatment.41,50 Timely completion of treatment in SCC confers benefit in terms of tumour control probability.51 While prophylactic placement suggests that tubes are inserted before treatment and in the absence of swallowing problems, as reported previously, many HNC patients have significant dysphagia at baseline. This is rarely accounted for in literature.

Criticisms of a prophylactic approach to PEG insertion include that a proportion of tubes go unused and are therefore unnecessary. As outlined, insertion is not without risk. A study by Madhoun52 examining rates of prophylactic PEG utilisation demonstrated that 47% of patients treated with CRT never used their PEG or used it for less than 2 weeks. In contrast, Silander et al.53
| Study            | Year | Patient number | Study design                                                                 | Measures                                                                 | Findings                                                                                                                                 |
|------------------|------|---------------|-------------------------------------------------------------------------------|---------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------|
| Corry et al.     | 2008 | 33, PEG       | Randomised trial to compare PEG and NGT in terms of nutritional outcomes, complications, patient satisfaction and cost | Baseline weight, weight loss, upper arm circumference and triceps skin fold thickness at time of tube insertion and 6 weeks post completion of treatment, duration of feeding tube use, dysphagia, quality of life (QOL) assessment | Six weeks post treatment no difference between NGT and PEG groups in terms of absolute weight or upper arm circumference, median weight loss 3 kg NGT versus 1.25 kg PEG ($P = 0.001$), NGT lower triceps skin fold thickness 9.5 versus 13.5 mm PEG ($P = 0.03$) suggesting loss of fat rather than muscle in NGT group; nil significant difference in weight loss at 6 months post insertion 2.1 kg NGT versus 0.9 kg PEG ($P = 0.43$); duration of tube feeding significantly longer in PEG group 139 days compared with 66 days NGT ($P = 0.0006$), nil significant difference in grade 3 dysphagia at 6 months; patient satisfaction with PEG greater than NGT in terms of convenience ($P = 0.03$), body image ($P = 0.05$), but nil difference in overall QOL ($P = 0.89$) |
| Sadasivan et al. | 2012 | 100, PEG      | Prospective, randomised control study to compare the efficacy of PEG and NGT administration of EN in HNC patients undergoing curative treatment | Nutritional assessment including haemoglobin, weight, albumin, mid-arm circumference at baseline and 6 weeks post insertion; complication rates (infection and tube dislodgement); patient satisfaction at 6 weeks post-insertion of tube | Lower mean weight in PEG group 56.5 kg versus NGT 61 kg ($P < 0.01$); PEG group fared better in all nutritional parameters except serum albumin at 6 week ($P < 0.001$ all values); tube dislodgement 36% NGT and 0% PEG ($P < 0.001$), local site infection 64% NGT and 4% PEG ($P < 0.001$); modified QOL assessment at 6 weeks post tube insertion PEG showed statistically significant advantage in all aspects ($P < 0.01$ all variables) Significant dysphagia more persistent among PEG versus NGT at 3 months (59% vs. 30%, $P = 0.015$), 6 months (30% vs. 8%, $P = 0.029$), but difference resolved by 12 months; median feeding tube duration 28 weeks PEG versus 8 weeks NGT ($P < 0.001$); pharyngo-oesophageal dilation required in 23% PEG patients versus 4% NGT ($P = 0.022$), 20% patients treated with chemoradiotherapy versus 0% patients treated with radiotherapy alone ($P = 0.05$) Mean weight loss PEG 1.6 kg, control 4.4 kg ($P = 0.10$); mean percentage weight loss PEG 4.0%, control 7.1% ($P = 0.069$); linear regression adjusting for risk factors $P = 0.016$) |
| Mekhail et al.   | 2001 | 158, PEG      | Retrospective review examining patterns of feeding tube use, incidence of mucositis and dysphagia, duration of tube dependence and need for pharyngo-oesophageal dilatation between patients with PEG versus NGT during treatment of head and neck cancer with radiotherapy +/- chemotherapy | Degree of mucositis and dysphagia at baseline, 1, 3, 6 and 12 months after start of treatment; need for pharyngo-oesophageal dilatation; duration of tube use | Significant dysphagia more persistent among PEG versus NGT at 3 months (59% vs. 30%, $P = 0.015$), 6 months (30% vs. 8%, $P = 0.029$), but difference resolved by 12 months; median feeding tube duration 28 weeks PEG versus 8 weeks NGT ($P < 0.001$); pharyngo-oesophageal dilation required in 23% PEG patients versus 4% NGT ($P = 0.022$), 20% patients treated with chemoradiotherapy versus 0% patients treated with radiotherapy alone ($P = 0.05$) Mean weight loss PEG 1.6 kg, control 4.4 kg ($P = 0.10$); mean percentage weight loss PEG 4.0%, control 7.1% ($P = 0.069$); linear regression adjusting for risk factors $P = 0.016$) |
| Chang et al.     | 2009 | 71, PEG       | Retrospective review examining outcomes in patients undergoing radical radiotherapy for head and neck cancer with prophylactic PEG versus those managed reactively | Absolute weight loss; percentage weight loss; admission for nutrition related factors; treatment interruption | (Continued) |
### Table 2. Continued.

| Study          | Year | Patient number | Study design                                                                 | Measures                                                                 | Findings                                                                                                                                 |
|----------------|------|----------------|------------------------------------------------------------------------------|---------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------|
| Assenat et al. | 2011 | 139, PEG       | Retrospective review to compare nutritional status and treatment interruption because of acute toxicity in patients with advanced head and neck tumours treated with combined chemoradiotherapy with or without prophylactic PEG tube | Weight loss and Nutritional Risk Index at beginning and end of treatment, interruption of treatment for toxicity and duration of interruption | Poorer nutritional status in PEG group at baseline \( (P < 0.0001) \); poorer nutritional status in control group post-treatment with median weight loss 5 kg versus 1 kg PEG \( (P < 0.001) \); 57% control group required parenteral nutrition via central venous catheter with 7/45 patients developing CVC infection; incidence of treatment interruption, duration of interruption significantly lower in PEG group \( (P = 0.01 \text{ and } P = 0.003, \text{ respectively}) \) |
| Clavel et al.  | 2011 | 253, NGT       | Retrospective review of safety and efficacy of reactive use of NGT feeding only when required in patients undergoing combined chemoradiotherapy | Weight loss, hospitalisations, complications, duration of tube use, disease-free survival and overall survival at 3 years | Median duration of NGT feeding 40 days; nil serious complications reported; nil significant difference in DFS or OS between NGT and control (83.7% vs. 82.0%, \( P = 0.948) \); median 33 month follow-up with 3.6% patients requiring gastrostomy and 0.8% requiring pharyngo-oesophageal dilatation |

PEG, percutaneous endoscopic gastrostomy; NGT, nasogastric tube; CVC, central venous catheter; DFS, disease-free survival; OS, overall survival.
reported that only one of 69 prophylactic tubes was not required.

A historical cohort study by Kramer et al.,49 compared outcomes in patients treated with definitive CRT or adjuvant CRT according to the timing of PEG insertion. Fifty-six patients underwent insertion of prophylactic PEG versus 30 patients who were managed expectantly. The groups were comparable across all variables except for a higher incidence of human papilloma virus (HPV) positivity in the prophylactic PEG group (P = 0.10). Their results demonstrate that patients treated reactively had a shorter duration of tube dependence (mean 139 vs. 227 days; P < 0.01). These figures correlate with the findings of a randomised trial by Salas et al.,54 who also demonstrated an improvement in QOL measures at 6 months post-treatment in patients with prophylactic PEG (P = 0.001). It is important to recognise that many of these randomised studies, such as the one by Salas et al., see patients separated into intervention (prophylactic PEG) and no intervention (no placement of prophylactic PEG). As such, the comparison is not being performed directly between outcomes associated with prophylactic and reactive PEGs because a proportion of the control group will not require PEG insertion.

Analysis of the financial impact of prophylactic and reactive PEG insertion suggests significantly higher costs and longer hospitalisations associated with a reactive approach ($6233 AUD vs. $14,461 AUD).55 This retrospective review by Baschnagel also reported higher incidence of treatment interruption (23% vs. 1%; P < 0.01) and long-term toxicities such as stricture and aspiration at 1 and 2 years in the reactive PEG cohort.

**Implications for practice**

The factors contributing to an individual’s NS requirements are complex and varied. In keeping with findings from the 2013 Cochrane review66 and the 2014 Canadian Agency for Drugs and Technologies in Health report,56 this narrative examination of the literature has failed to demonstrate the superiority of one enteral feeding method over another.

Patients with locoregionally advanced HNC are at increased risk of malnutrition at presentation,57,58 a circumstance compounded by the toxicities associated with definitive treatment. In clinical practice, patients frequently require NS during treatment. Obstructing tumours and severe mucositis causing odynophagia and dehydration limit the role for oral supplementation in isolation and necessitate the delivery of feeds via tube.

The timing of FT insertion is another source of controversy, with various models proposed to identify high-risk patients who are most likely to benefit from early and aggressive intervention and placement of prophylactic tubes.27,41 Conversely it may be possible to distinguish a low-risk cohort of patients who are able to avoid the complications associated with EN without compromising outcome and optimising QOL.57

In the absence of randomised prospective data it seems unlikely that a consensus will be reached in the form of evidence-based guidelines to guide this aspect of care. In lieu of such guidelines, an individualised approach, encompassing patient, tumour and treatment factors, as well as the availability of specialised clinical support, must be employed. Functional outcomes QOL should be considered in tandem with oncologic outcome.46 Strategies to reduce long-term treatment-related toxicities need to be explored, including investigation of de-escalation of treatment in the setting of HPV-related HNC and preferential sparing of vital structures such as the pharyngeal constrictor muscles using intensity modulated radiation therapy.59

**Limitations**

This overview of the literature is not a systematic review of evidence. It includes data and outcomes detailed in studies in patients who have had radiotherapy in both

| Variable          | PEG                          | NGT             |
|-------------------|------------------------------|-----------------|
| Insertion         | Requires sedation, theatre time or endoscopy suite | Outpatient procedure |
| Cost (AUD)        | $626                         | $50             |
| Duration          | Indefinite, tube replaced annually as outpatient | <4 weeks, max. 10 weeks |
| Complications – acute | Less common                 | Dislodgement common, pain in setting of mucositis |
| Complications – late | Longer term tube dependence, dysphagia, increased risk of pharyngo-oesophageal strictures | Less common, shorter tube dependence |
| QOL               | Patient satisfaction generally high | Generally considered less convenient, negative impact on social functioning and body image |

PEG, percutaneous endoscopic gastrostomy; NGT, nasogastric tube; AUD, Australian Dollars.
definite and adjuvant settings, with and without chemotherapy.

**Conclusion**

The arguments for EN during combined modality treatment for HNC are certainly compelling. The best method of delivery remains unclear with unique challenges associated with both NGT and PEG feeding. The evidence in favour of a reactive approach to PEG feeding appears less conclusive and the reports of increased late toxicity are certainly of concern. The difficulties associated with recruitment for a randomised trial in a setting where patients do not recognise the need for intervention at all or express a strong preference for a particular intervention are certainly acknowledged. A multidisciplinary approach to management, particularly with support from dieticians and speech pathologists, is perhaps the most important means of maintaining function and maximising QOL.

**Conflict of Interest**

The authors declare no conflict of interest.

**References**

1. Australian Institute of Health and Welfare. Head and neck cancers in Australia. Cancer series no 83. Cat no. CAN 80. Report No.: no. 83. AIHW, Canberra, 2014.
2. World Health Organisation. ICD-10: International statistical classification of diseases and related health problems, 10th edn. World Health Organization, Geneva, 2010.
3. Hansen E, Roach M. Handbook of Evidence-Based Radiation Oncology, 2nd edn. Springer, New York, 2010.
4. Brockstein B, Vokes E, Eisbruch A. Locally advanced squamous cell carcinoma of the head and neck: Approaches combining chemotherapy and radiotherapy. In: Posner M, Brzel D, Fried M (eds). UpToDate. UpToDate, Waltham, MA, 2014.
5. National Comprehensive Cancer Network. NCCN Guidelines Version 2.2014 Head and Neck Cancers. National Comprehensive Cancer Network, 2014.
6. Galloway T, Amdurr R. Management and prevention of complications during initial treatment of head and neck cancer. In: Posner M, Brockstein B, Brzel D, Deschler D (eds). UpToDate. UpToDate, Waltham, MA, 2014.
7. Garg S, Yoo J, Winquist E. Nutritional support for head and neck cancer patients receiving radiotherapy: A systematic review. Support Care Cancer 2010; 18: 667–77.
8. National Institute for Clinical Excellence (Great Britain). Improving outcomes in head and neck cancers: The manual. National Institute for Clinical Excellence, London, 2004.
9. Jatoi A, Loprinzi C. The role of parenteral and enteral/oral nutritional support in patients with cancer. In: Hesketh P, O’Lipman T (eds). UpToDate. UpToDate, Waltham, MA, 2014.
10. Ehrsson YT, Langius-Eklöf A, Laurell G. Nutritional surveillance and weight loss in head and neck cancer patients. Support Care Cancer 2012; 20: 757–65.
11. Langius J, van Dijk A, Doornaert P, et al. More than 10% weight loss in head and neck cancer patients during radiotherapy is independently associated with deterioration in quality of life. Nutr Cancer 2013; 65: 76–83.
12. Tulunay-Ugur OE, McClinton C, Young Z, Penagaricano JA, Maddox A-M, Vural E. Functional outcomes of chemoradiation in patients with head and neck cancer. Otolaryngol Head Neck Surg 2013; 148: 64–8.
13. Isenring E, Zabel R, Bannister M, et al. Updated evidence-based practice guidelines for the nutritional management of patients receiving radiation therapy and/or chemotherapy: 2012 Radiation therapy and/or chemotheraphy nutrition guidelines. Nutr Diet. 2013; 70: 312–24.
14. Langius JA, Zandbergen MC, Van Tuider MW, Eerenstein SEJ, Leemans CR, Wejs PIM. Effect of nutritional interventions on nutritional status of patients with head and neck cancer receiving (chemo)radiotherapy: A systematic review. Clin Nutr 2013; 32: 671–8.
15. Husaini H, Lazarus C, Hu K, et al. EORTC QOL rating, performance status, and oral outcomes in head-and-neck cancer patients treated with chemoradiation therapy. Int J Radiat Oncol Biol Phys 2013; 87: S441–2.
16. Sheth CH, Sharp S, Baughan C, Walters E. A 1 year two phase prospective project looking at nutritional risk in reactive vs elective nasogastric enteral feeding in head and neck cancer patients undergoing radical (chemo) radiotherapy. Gut 2012; 61: A102.
17. Findlay M, Bauer J, Brown T; Head and Neck Guideline Steering Committee. Evidence-based practice guidelines for the nutritional management of adult patients with head and neck cancer [Internet]. Cancer Guidelines [cited 2014 October 24]. Available from: http://wiki.cancer.org.au/australia/COSA:
Head_and_neck_cancer_nutrition_guidelines.
18. Hansen M, Primdahl H. Change of practice: Does an outpatient tube clinic affect patient weight and duration of tube feeding? Eur J Cancer 2013; 49: S760.
19. Goransson H, Rolin E, Wedmark C. Enteral feeding increases the well-being for patients with head and neck cancer undergoing radiation therapy and lowers the cost in out-patient care. Conference on Innovative Approaches in Head and Neck Oncology. Barcelona, Spain; 2013.
20. Fu KK, Pajak TF, Trotti A, et al. A Radiation Therapy Oncology Group (RTOG) phase III randomized study to compare hyperfractionation and two variants of
accelerated fractionation to standard fractionation radiotherapy for head and neck squamous cell carcinomas: First report of RTOG 9003. *Int J Radiat Oncol Biol Phys* 2000; **48:**7–16.

21. Rabinovitch R, Grant B, Berkey B. Impact of nutrition support on treatment outcome in patients with locally advanced head and neck squamous cell cancer treated with definitive radiotherapy: A secondary analysis of RTOG Trial 90-03. *Head Neck* 2006; **28:**287–93.

22. Ahmed S, Travis J, Mehanna H. Re-feeding syndrome in head and neck — Prevention and management. *Oral Oncol* 2011; **47:**792–6.

23. Blumenstein I. Gastroenteric tube feeding: Techniques, problems and solutions. *World J Gastroenterol* 2014; **20:**8505.

24. Hodin RA, Bordeianou L. *Nasogastric and nasoenteric tubes.* 2nd edn. *UpToDate.* UpToDate, Waltham, MA, 2013.

25. Koyfman SA, Adelstein DJ. Enteral feeding tubes in patients undergoing definitive chemoradiation therapy for head-and-neck cancer: A critical review. *Int J Radiat Oncol Biol Phys* 2012; **84:**581–9.

26. Kumari AC, Shanmughakumar S, Balasubramaniam P. Assessment of quality of life in head and neck cancer patients with enteral tube feeding. *J Cancer Res Therapeutic* 2012; **8:**S176.

27. Howard A, Shah R. Enteral feeding for head and neck cancer (HNC) patients treated in Oxford with radiotherapy (RT) or chemoradiotherapy (CRT): Development of clinical guidelines. *European Archives of Oto-Rhino-Laryngology* 2012; **269:**1343–4.

28. Clavel S, Fortin B, Després P, et al. Enteral feeding during chemoradiotherapy for advanced head-and-neck cancer: A single-institution experience using a reactive approach. *Int J Radiat Oncol Biol* 2011; **79:**763–9.

29. Rahemai-Azar AA. Percutaneous endoscopic gastrostomy: Indications, technique, complications and management. *World J Gastroenterol* 2014; **20:**7739.

30. McAllister P, MacIver C, Wales C, et al. Gastrostomy insertion in head and neck cancer patients: A 3 year review of insertion method and complication rates. *Br J Oral Maxillofac Surg* 2013; **51:**714–18.

31. DeLegge M. Gastrostomy tubes: Complications and their management. In: Saltzman J, O Lipman T (eds). *UpToDate.* UpToDate, Waltham, MA, 2013.

32. Geer W, Jeannomond R. Early presentation of buried bumper syndrome. *West J Emerg Med* 2013; **14:**421–3.

33. Vanis N, Saray A, Gornjakovic S, Mesihovic R. Percutaneous endoscopic gastrostomy PEG: Retrospective analysis of a 7-year clinical experience. *Acta Inform Medica* 2012; **20:**235.

34. Lipp A, Lusardi G. Systemic antimicrobial prophylaxis for percutaneous endoscopic gastrostomy. In: *The Cochrane Collaboration,* (ed). Cochrane Database of Systematic Reviews [Internet]. Chichester, UK: John Wiley & Sons, Ltd; 2013 [cited 2014 Nov 4]. Available from: http://doi.wiley.com/10.1002/14651858.CD005571.pub3.

35. Banerjee S, Shen B, Baron TH, et al. Antibiotic prophylaxis for GI endoscopy. *Gastrointest Endosc* 2008; **67:**791–8.

36. Nugent B, Lewis S, O’Sullivan JM. Enteral feeding methods for nutritional management in patients with head and neck cancers being treated with radiotherapy and/or chemotherapy. *Cochrane Database Syst Rev* 2013, CD007904.

37. Corry J, Poon W, McPhee N, et al. Randomized study of percutaneous endoscopic gastroscopy versus nasogastric tubes for enteral feeding in head and neck cancer patients treated with (chemo)radiation. *J Med Imaging Radiat Oncol* 2008; **52:**503–10.

38. Sadasivan A, Faizal B, Kumar M. Nasogastric and percutaneous endoscopic gastrostomy tube use in advanced head and neck cancer patients: A comparative study. *J Pain Palliat Care Pharmacother* 2012; **26:**226–32.

39. Mehkail T, Adelstein D, Rybicki L, Larto M, Saxton J, Lavertu P. Enteral nutrition during the treatment of head and neck carcinoma: Is a percutaneous endoscopic gastrostomy tube preferable to a nasogastric tube? *Cancer* 2001; **91:**1785.

40. Chang JH, Gosling T, Larsen J, Powell S, Scanlon R, Chander S. Prophylactic gastrostomy tubes for patients receiving radical radiotherapy for head and neck cancers: A retrospective review. *J Med Imaging Radiat Oncol* 2009; **53:**494–9.

41. Assenat E, Thezenas S, Flori N, et al. Prophylactic percutaneous endoscopic gastrostomy in patients with advanced head and neck tumors treated by combined chemoradiotherapy. *J Pain Symptom Manage* 2011; **42:**548–56.

42. Corry J, Poon W, McPhee N, et al. Prospective study of percutaneous endoscopic gastrostomy tubes versus nasogastric tubes for enteral feeding in patients with head and neck cancer undergoing (chemo)radiation. *Head Neck* 2009; **31:**867–76.

43. Payakachat N, Ounpraseuth S, Suen JY. Late complications and long-term quality of life for survivors (>5 years) with history of head and neck cancer. *Head Neck* 2013; **35:**819–25.

44. Mourad WF, Hu KS, Puckett L, et al. Five-year outcomes of squamous cell carcinoma of the tonsil treated with radiotherapy. *Am J Clin Oncol* 2014; **37:**57–62.

45. Brady O, Donnelly M, Horgan A, Maher M. Post-radiotherapy side effects for head and neck cancer - the patient’s perspective. Proceedings of the Nutrition Society. Harrogate; p. E283.

46. Russi EG, Corvò R, Merlotti A, et al. Swallowing dysfunction in head and neck cancer patients treated by radiotherapy: Review and recommendations of the
supportive task group of the Italian Association of Radiation Oncology. *Cancer Treat Rev* 2012; 38: 1033–49.

47. Wang J, Liu M, Liu C, Ye Y, Huang G. Percutaneous endoscopic gastrostomy versus nasogastric tube feeding for patients with head and neck cancer: A systematic review. *J Radiat Res (Tokyo)* 2014; 55: 559–67.

48. Oozeer NB, Corsar K, Glore RJ, Penney S, Patterson J, Paleri V. The impact of enteral feeding route on patient-reported long term swallowing outcome after chemoradiation for head and neck cancer. *Oral Oncol* 2011; 47: 980–3.

49. Kramer S, Newcomb M, Hessler J, Siddiqui F. Prophylactic versus reactive PEG tube placement in head and neck cancer. *Otolaryngol Head Neck Surg* 2014; 150: 407–12.

50. Chen AM, Li B-Q, Lau DH, et al. Evaluating the role of prophylactic gastrostomy tube placement prior to definitive chemoradiotherapy for head and neck cancer. *Int J Radiat Oncol* 2010; 78: 1026–32.

51. Ames JA, Karmell LH, Gupta AK, et al. Outcomes after the use of gastrostomy tubes in patients whose head and neck cancer was managed with radiation therapy. *Head Neck* 2011; 33: 638–44.

52. Madhoun MF. Prophylactic PEG placement in head and neck cancer: How many feeding tubes are unused (and unnecessary)? *World J Gastroenterol* 2011; 17: 1004.

53. Silander E, Nyman J, Bove M, Johansson L, Larsson S, Hammerlid E. Impact of prophylactic percutaneous endoscopic gastrostomy on malnutrition and quality of life in patients with head and neck cancer - a randomized study. *Head Neck* 2012; 34: 1–9.

54. Salas S, Baumstarck-Barrau K, Alfonsi M, et al. Impact of the prophylactic gastrostomy for unresectable squamous cell head and neck carcinomas treated with radio-chemotherapy on quality of life: Prospective randomized trial. *Radiother Oncol* 2009; 93: 503–9.

55. Baschnagel AM, Yadav S, Marina O, et al. Toxicities and costs of placing prophylactic and reactive percutaneous gastrostomy tubes in patients with locally advanced head and neck cancers treated with chemoradiotherapy. *Head Neck* 2014; 36: 1155–61.

56. Canadian Agency for Drugs and Technologies in Health. Nasogastric Feeding Tubes versus Percutaneous Endoscopic Gastrostomy for Patients with Head or Neck Cancer: A Review of Clinical Effectiveness and Guidelines [Internet]. PubMed Health. 2014 [cited 2015 Feb 19]. Available from: http://www.ncbi.nlm.nih.gov/pubmedhealth/PMH0070223/pdf/TOC.pdf.

57. Prevost V, Joubert C, Heutte N, Babin E. Assessment of nutritional status and quality of life in patients treated for head and neck cancer. *Eur Ann Otorhinolaryngol Head Neck Dis* 2014; 131: 112–20.

58. Kubrak C, Olson K, Jha N, et al. Nutrition impact symptoms: Key determinants of reduced dietary intake, weight loss, and reduced functional capacity of patients with head and neck cancer before treatment. *Head Neck* 2009; 32: 290–300.

59. Paleri V, Roe JWG, Strojan P, et al. Strategies to reduce long-term postchemoradiation dysphagia in patients with head and neck cancer: An evidence-based review: Strategies to reduce dysphagia after chemoradiation. *Head Neck*. 2014; 36: 431–43.