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Quality assurance peer review of head and neck contours in a large cancer centre via a weekly meeting approach

Abstract

Aims: To assess the impact of weekly scheduled peer review of head and neck contours for definitive and adjuvant radiotherapy cases based on rates of recommended changes.

Methods: Retrospective analysis of a prospective database. Recommended changes were prospectively classified as 'major' (change in GTV and/or high dose CTV, dose/fractionation) or 'minor' (change in intermediate or elective dose CTVs or organs at risk). Univariate analysis to explore associations between recommended changes and tumour site/stage and radical/adjuvant indication.

Results: 307/375 (82%) of all head and neck cases treated with VMAT were prospectively peer reviewed over a 12 month period. 195 (64%) cases received definitive and 112 (36%) received adjuvant radiotherapy. Overall a total of 43/307 (14.0%) of changes were recommended within the peer review meetings. This comprised 27/307 (8.8%) major changes and 16/307 (5.2%) minor changes. 33/43 (77%) of changes were in the CTV. Rates of recommended changes were significantly higher for adjuvant versus definitive radiotherapy (odds ratio 2.26, p=0.014), and for larynx compared with oropharynx (odds ratio 3.02, p=0.02). There was no overall correlation between clinician experience and rates of change (p=0.62).

Conclusion: Routine weekly meeting contour-based peer review resulted in a number of major and minor changes to treatment. Compliance was high. Peer review was potentially beneficial for all tumour sites/stages/indications and any degree of clinician experience.

Keywords

Head and neck cancer; radiotherapy; peer review; quality assurance

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Introduction

There is accumulating evidence that contouring quality impacts upon clinical outcomes. In clinical trials, radiotherapy protocol deviations are associated with increased risks of treatment failure and overall mortality [1, 2] and in co-operative group trials, protocol violations have been associated with increase rates of treatment failure, detrimental impact upon survival and increased toxicity [3]. Peters et al. [2] showed a correlation between centre experience and plan quality in a head and neck radiotherapy trial. The Radiation Therapy Oncology Group found inferior overall survival amongst head and neck cancer patients treated at low volume accruing centres [4]. These studies come from the pre-IMRT era, and the impact of clinician experience on patient outcomes could be more pronounced in the current era.

Delineation of target volumes and OARs can have a significant impact upon doses delivered to targets and normal structures [5]. However, variation in clinician contouring is well documented and has been described as one of the 'weakest links' in the series of processes in treatment delivery [6, 7] .

Peer review can be defined as re-evaluation of treatment planning decisions by at least one radiation oncologist who is not the prescribing physician. The Canadian Partnership for Quality Radiotherapy [8], American Society for Radiation Oncology (ASTRO) [9], Royal Australian and New Zealand College of Radiologists [10] and the Royal College of Radiologists in the UK [11] have developed peer review guidance. There has been significant uptake of peer review into clinical practice [12]. For example, in Canada, a survey found at least half of centres peer review at least 80% of curative-intent plans [13], whilst in the USA 70-80% of radiation courses undergo peer review [7].

Peer review is potentially resource and time intensive. Variations in the format includes prospective and retrospective review [11, 12] with recent analysis showing pre-treatment peer review taking place in <40% of cases [12]. Intention can be to review of all [14] or only a proportion of cases [12, 15]. Single institution reports have illustrated the varied approaches, which can include peer review of indication for treatment, dose-fractionation, target contours, OAR contours and plan dosimetry [12]. The optimal method of peer review remains uncertain, and may be influenced by tumour site, complexity and size of institution.

With inevitable time/resource constraints it is necessary to define the most effective method of peer review and which parts of the planning process it is most beneficial/effective to peer review. As a useful insight into these issues, a large UK centre (Birmingham) recently reported their experience of

an ‘on-demand’ model of peer review of clinician selected patients with head and neck cancer (HNC), designed to provide timely peer review of cases without delaying the treatment pathway [15]. This raises interesting possibilities for peer review of HNC as to whether it is possible to select subgroups of patients for whom peer review is useful. Other data suggests peer review may be less valuable for contours delineated by more experienced clinicians [8] or that changes recommended by peer review may become less common with experience of peer review within a team [16-19].

In this report we detail our experience in a large UK centre of peer review of HNC cases in a scheduled weekly meeting, evaluating rates of recommended major and minor changes, whether any tumour sites can be identified which do not require peer review, influence of clinician seniority on rates of change.

Methods

In Leeds Cancer Centre a one hour weekly scheduled quality assurance meeting has taken place for peer review of head and neck cancer contours since June 2015. Data has been prospectively collected during the meeting since February 2017. The initial 12 months of data collection were retrospectively analysed for this report.

Case review

Six Clinical Oncologists are involved in treating head and neck cancer with radiotherapy and all have time allocated in job plans to attend the meeting (minimum two required for meeting to take place). The meeting is routinely attended by a member of the dosimetry team; their role is to ensure good communication from clinicians to the planning team with regard to priorities/expectations for the plan. Case review takes place in a meeting room with access to two computers with large screen displays. One computer is used to display radiology images or radiotherapy contours and the other to access electronic patient records and to document outcomes of the meeting in MOSAIQ patient records and in a prospective database. It is not currently possible to display radiology images side-by-side with contours on the planning scan. For patients with co-registered MRI and CT the quality of the registration is reviewed by the treating clinician and physics team outwith the remit of this meeting; co-registered MRI and CT are routinely reviewed in the meeting for GTV assessment when a co-registration has been performed. The intention of the meeting is to peer review contours for all radical/adjuvant head and neck radiotherapy plans contoured during the preceding week (lymphoma and sarcomas treated by other site specialist teams are not included). Contours for early glottic tumours and palliative cases are not reviewed within the meeting. Patients are identified via an electronic planning list. Review is intended to take place regardless of attendance of the treating oncologist. A radiotherapy planning note (example shown in Appendix A) by the treating clinician including tumour site, TNM stage, dose/fractionation and approach to delineation of CTVs, including which lymph node levels are included, the use or otherwise of bolus, is routinely documented prior to the meeting at the contouring stage and is available for the meeting. For each case, a clinical synopsis is presented by treating clinician, trainee or other member of the group in the absence of treating oncologist. Relevant radiology images are displayed. GTV and CTV contours are presented for each case. OARs are not routinely reviewed. Radiotherapy plans are not routinely reviewed but could be accessed if already completed (often contours are reviewed prior to planning). The meeting aims to reach a consensus on recommendations.

Contouring and treatment approach

Contouring is done according to institutional protocols. In general contouring for definitive radiotherapy uses a volumetric approach with a high dose CTV for primary tumour of GTV+1cm and for lymph nodes, GTV +5 to 10mm; remaining whole nodal levels are included in low dose CTV. Elective lymph node level contouring (low dose CTV) is according to international guidelines for node negative and positive disease [20, 21], with sparing of high contralateral level II and contralateral retropharyngeal lymph nodes in the contralateral node negative neck [22]. Intermediate dose CTVs are only used for equivocal lymph nodes (equivocal lymph node + 5mm margin with remainder of nodal level included in low dose CTV). Elective primary subsite treatment (low dose CTV) is only used for treatment of larynx/hypopharynx cancers. Post-operative radiotherapy is according to previously published principles [23]. Standard definitive concurrent chemoradiotherapy dose/fractionation schedules are 70Gy in 35 fractions over 7 weeks (intermediate and low dose volumes to 63Gy and 57Gy respectively). For definitive radiotherapy without chemotherapy either the above schedule or 65Gy in 30 fractions over 6 weeks (intermediate and low dose volumes to 60Gy and 54Gy respectively) are employed. For adjuvant radiotherapy standard doses are 66Gy in 33 fractions over 6.5 weeks (low dose volumes of 54-60Gy) for high risk disease or 60Gy in 30 fractions over 6 weeks (low dose volumes 54Gy). Treatment is delivered using volumetric modulated arc therapy (VMAT).

Outcomes

Outcomes of peer review at the quality assurance meeting are prospectively documented using a proforma (shown in Appendix B). Multiple changes on one case are recorded as free text. Changes recommended by are classified as ‘major’ and/or ‘minor’ using a similar classification to that employed by the Peter MacCallum Cancer Centre [14]. A ‘major’ change is defined as an alteration to the GTV for primary tumour/lymph node GTV and/or high dose CTV, and/or prescribed dose or fractionation. A ‘minor’ change is defined as alteration to intermediate or elective dose CTV.

Statistical analysis

The main endpoint of analysis was to determine proportion of cases for which major and minor changes were recommended. Comparison of rate of change was made between the initial and subsequent six month experience. Univariate logistic regression was performed to identify potential predictors of changes (major or minor considered together). Tumour site, overall stage, T stage, N stage, definitive versus adjuvant and consultant experience were included in the analysis). For tumour site, the most common site (oropharynx) was used as the baseline comparator. Spearman’s

rho was used to assess for a potential correlation between years of consultant experience and rates of change. Statistical significance was declared at $p<0.05$.

Results

A total of 307 cases were discussed within the weekly peer review quality assurance programme over a 12 month period, from February 2017. A total of 51 meetings took place. The median number of cases discussed per meeting was 6 (range 1-16). From electronic radiotherapy databases, the total number of head and neck cancer patients receiving VMAT at Leeds Cancer Centre during that period was 374, giving a compliance rate of 82%. Table 1 provides a breakdown of cases discussed by tumour site and stage. 128/307 (42%) of patients had oropharyngeal carcinoma and 222/309 (72%) had stage IV disease. 195/307 (64%) were treated definitively and 112/307 (36%) adjuvantly.

Recommended changes

Overall a total of 43/307 (14.0%) changes were recommended within the peer review meetings. This comprised 27/307 (8.8%) major changes and 16/307 (5.2%) minor changes. The overall rate of change in the first six months versus the second six months of this period was 11% versus 16%. 5 patients who had already had plans generated required replanning prior to treatment start as a result of contour peer review. No delays in treatment start were identified as a result of peer review process. Table 2 details changes per tumour site and per treatment intent (definitive or adjuvant radiotherapy). 20/195 (10.3%) changes were recommended for definitive treatments, and 23/112 (20.5%) for adjuvant treatments. Table 3 provides details of the types of changes which were recommended. The majority of changes involved the CTV. For definitive cases, CTV changes were recommended in 20/195 (10.3%) cases with 14/20 changes being in the high dose CTV. GTV was altered in only 4/195 (2.1%) definitive cases. For adjuvant cases 13/112 (11.6%) changes were recommended in the high dose CTV. Univariate analysis to identify potential predictors of changes revealed that rates of recommended changes were significantly higher for larynx compared with oropharynx (odds ratio 3.02, p=0.02), and for adjuvant versus definitive radiotherapy (odds ratio 2.26, p=0.014). Stage did not predict rates of change (Table 4).

Changes by radiation oncologist

The six radiation oncologists involved in the peer review had 1,2,4,6,12 and >20 years experience at consultant level in the treatment of head and neck cancer. Rates of change per consultant are shown in Figure 1. There was no significant correlation between rates of change and experience (p=0.62), although there were significant differences according to individual consultant eg. significantly lower overall rate of change for B versus A (p=0.03) and C versus A (p=0.03).

Discussion

Our approach to head and neck quality assurance has been to focus on peer review of contouring. A recent review across multiple tumour sites suggests that the majority of peer review occurs prior to dosimetry (2 of 13 studies included in the review reviewed dosimetry), and that review of dosimetry led to fewer changes compared to pre-planning contour review [12]. Based upon inter-observer variability on target volume contouring [24-26], this step represents a key part of the planning process likely to benefit from peer review.

In our series spanning one year of peer review for 307 patients we have identified an overall rate of change of 14.0%, with a rate of 'major' change of 8.8% and 'minor' change of 5.2%. Our data reflects our third year of weekly meetings: the structure of the meeting has developed over time but these data suggest that a significant number of changes continue to be made, highlighted by the higher rate of change (16% versus 11%) in the second half of the time period studied. Compliance with peer review was 82%. To the best of our knowledge this is the largest reported UK experience of head and neck radiotherapy peer review. Table 5 provides a comparision with other key series reporting head and neck cancer peer review. Rates of change vary considerably from 1.5% to 55%. It has been suggested that rates of change >10% implies the value of peer review [14]. Comparisons of the impact of peer review are limited by differences in the peer review process, mixed tumour site reports and differing methods of classification of changes [12, 27]. A systematic review in 2017 [27] identified 11 studies with a mean modification rate of 10.8% of radiation treatment plans, with rates of 'any change' or 'minor changes' highest for head and neck cancer, whilst 'major' changes were most common for patients with lung cancer. Ballo et al. [18] found that tumour sites utilizing IMRT had higher rates of change from peer review, whilst rates of change appear to be dependent upon complexity of the tumour site [12, 16, 28, 29].

Our overall rate of change of 14% is lower that that reported in the largest series from Peter MacCullum Cancer Centre of 548 patients with a rate of 35.8% [14]. There are several possibilities to account for this difference and these series provide a useful comparision between the approach of a weekly team meeting in our series and dedicated review by a single radiation oncologist [14]. The time taken may be an important factor in the rigorousness of review and consequently the likelihood of a change being recommended. An average time spent per single oncologist review was in the 10-20 minute bracket in the Amarasena et al. series [14]; this is comparable with a median of 17 minutes per case in the subset of single oncologist peer review reported by Fong et al [15]. We have not captured time per case discussion but discuss a median of six cases in the one hour meeting. However, one limitation of the weekly meeting is the variability of the number of cases requiring review; at an extreme in one week there were 16 cases to review with considerably less time

available per case review. Although at times our meetings can overrun there is a time limitation which may limit the extent of the review process when larger number of cases require review. Interestingly, by contrast with Amarasena et al. [14], in the recent series from Birmingham of single oncologist-based peer review the rates of 'significant change' were lower falling to only 2% with an unselected case mix [17]. The team-based meeting approach has the potential advantage of providing 'multiple eyes' on each case. We have not collected data on meeting attendance but it is unusual for <4 oncologists to be present. In our experience it is not uncommon for only one oncologist to suggest a change not picked up by others; a consensus is then reached upon whether this change is required. We do not have data on how many of recommended changes were implemented; however, our view of the consensus approach is that we would intend to implement each of these changes.

There are no standardised methods for classification of changes. We have used a similar method of defining 'major' and 'minor' changes to Amarasena et al. [14]. This method regards changes of any size to the high dose volume or dose fractionation as 'major' and to elective target volumes or OAR as 'minor'. There are limitations to this method. For example a small reduction in high dose volumes may not intuitively be considered of great important but would be classified as 'major'. By contrast, decisions to include omitted nodal levels or even whether to treat the contralateral neck may be critical to outcome but are classified as 'minor'. In our experience, the clinicians will have a view as to whether changes recommended are important or can be regarded more as 'fine-tuning' but not of critical importance. One alternative approach to classification is to regard recommended changes as 'mandatory' or 'discretionary' [15] – this has the advantage of taking account of the clinicians' views of the importance of recommended changes, although loses detail of whether high dose or elective dose volumes are involved. A hybrid of these two models may be useful and in view of these limitations it is valuable to record details of changes as in Table 3. In the future we would suggest prospectively documenting what was reviewed (eg. contours/plan), details of recommendations as well as a classification as described above into major/minor and whether these are considered discretionary.

This highest rates of change has been reported by a centre in California [30]. In this series peer review of target delineation took place in weekly meetings in which a specialist radiologist was present with GTV alterations made in 26/80 patients. By contrast, GTV changes were uncommon in our series. In addition to the absence of radiology expertise, this may relate to inability to display diagnostic imaging and contours side-by-side (both are viewed on the same large screen) and also difficulties in assessing GTV accuracy when the peer reviewer has not performed clinical examination

(photographs of examination/nasoendoscopy findings are only occasionally available in practice). In the future we aim to develop facilities for side-by-side review of contours and diagnostic imaging as well as increasing the detail available of clinical examination/photography.

Clinician experience, ability, personality and single centre nature of the review process may all impact upon the review process. There is potential that particular clinicians may dominate discussions, although anectodally this has not been our experience. It has been suggested that senior clinicians are less likely to be have changes proposed due to a 'hierarchical bias' [12, 16]. This is likely to depend upon developing a respectful open culture to allow peer review to flourish. One study [8] reported an inverse correlation between a clinician's contouring experience and the proportion of cases for which changes were recommended at peer review. It is notable from our outcomes and those of Amarasena et al. [14] that clinician seniority did not correlate to rate of change from peer review. We use detailed institutional outlining protocols based as much as possible upon published guidelines as reference point for the peer review process; we anticipate that this will mitigate against confirmation bias of single centre peer review and the potential for excessive influence by individual clinicians. An additional valuable step for the future would be to obtain input from an external clinician observing the process.

It would be appealing from a time/resource perspective to focus peer review on complex/rare cases as reported by Fong et al. [15]. However it was not possible to identify subgroups in whom peer review was not required in our experience and that of Amarasena et al [14]. We are continuing to aim to review all radical/adjuvant cases.

In order to avoid delays in starting treatment our approach has not been to await peer review before commencing planning. 10 working days are routinely allocated between planning scan to treatment start; this means that peer review usually but not always takes place prior to planning. The downside of this approach is that a small number of patients have required replanning when changes have been made after peer review. We have not identified any patients in whom start date has been delayed as a consequence of the peer review process.

In summary, a scheduled weekly meeting for head and neck contour peer review has led to a number of treatment changes of potential clinical importance. The value of peer review has not diminished with time. It has not been possible to identify tumour sites/indications for which peer review is not required and peer review is valuable for all levels of clinician experience.

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Appendices

Appendix A: Example of free text radiotherapy planning note routinely made by treating clinician made at time of contouring and available at weekly peer review meeting: for a patient due to receive concurrent chemoradiotherapy for a right tonsil cancer.

'T2 right tonsil squamous cell carcinoma, poorly differentiated, p16+ve.
For concurrent cisplatin-radiotherapy.
Clinically non-lateralised with infiltration adjacent soft palate.
Equivocal right II LN on MRI. PET is suspicious for involvement of 2 level II LNs on right. US/S: abnormal heterogeneity of LN right level II. FNA non-diagnostic - blood only. In view of PET/US/S appearances and prominence of LN to treat as LN positive. Ie. T2N1M0 (TNM8), T2N2bMO (TNM7). In addition, prominent but non-avid R III LN - equivocal. To treat in CTV63.

CTV70=primary 1cm margin +likely involved R II LN +8mm margin
CTV63= equivocal R III +4mm margin
CTV57=R neck Ib-Va/b, VIIa (RSS not included as small II LN only), L II-IVa'

(*Abbreviations used*: LN=Lymph node, FNA=fine needle aspirate, US/S=ultrasound scan, CTV=clinical target volume, RSS=retrostyloid space)

Appendix B: Proforma used for prospective recording of peer review for each case

Contours reviewed and agreed:	Yes / No
Major Change	Yes / No
Minor Change	Yes / No

Any other comments:

Figure Legends

Figure 1: Rates of major and minor changes for each treating Clinical Oncology consultants. Clinicians are A to F, with A having the greatest experience and F the least.