

Differentiation of benign and malignant neck lymph nodes on dual energy CT

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Author(s)

Jeanne Kochkodan

Medical Student

University of Michigan Medical School

Remy Lobo, MD

Lecturer

University of Michigan

Ashok Srinivasan, MD

Director of Neuroradiology

University of Michigan

Abstract Details

Purpose

Differentiation of benign versus malignant metastatic lymph nodes in the head and neck currently relies on size, morphology and functional status, such as abnormal FDG metabolism. Dual energy CT (DECT) has shown potential in differentiating benign and malignant head and neck lesions in prior studies. Our aim was to evaluate the utility of DECT derived parameters in the differentiation of benign and metastatic lymph nodes in patients with head and neck squamous cell carcinoma (HNSCC).

Materials & Methods

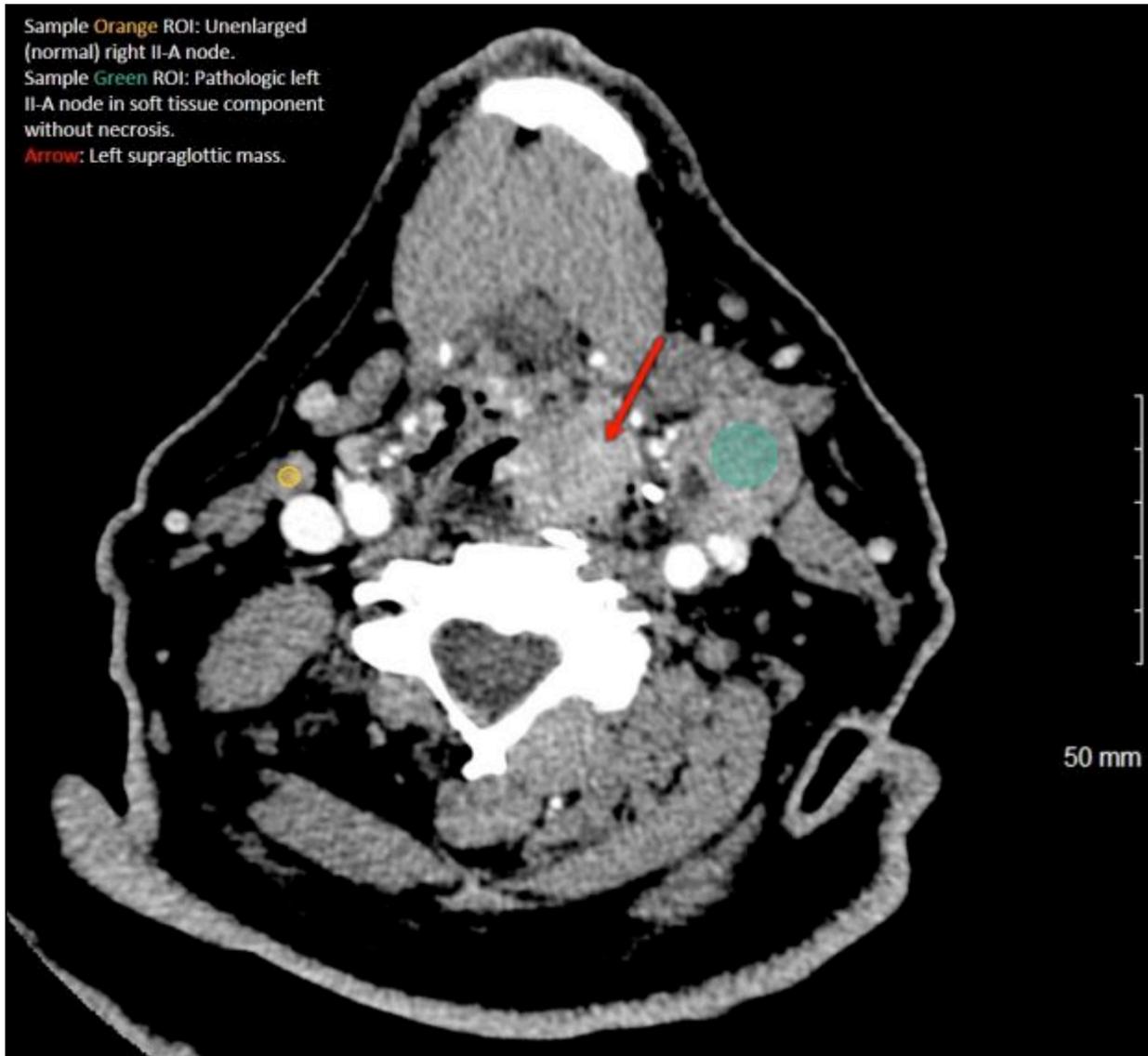
This retrospective IRB approved study included 14 patients with HNSCC who underwent head/neck DECT imaging and PET/CT within 60 days of each other. One reader placed regions of interest within multiple lymph nodes deemed metastatic (on PET/CT or histopathology or both), normal lymph nodes and skeletal muscle in the same patients (32 metastatic nodes and 49 normal nodes in total). Independent samples t-test used to compare the differences in DECT parameters between the two groups including node HU at 40keV, 50keV, 70keV, 140keV, HU40keV-HU140 keV, effective Z and iodine concentration after normalizing the values by creating node to muscle ratios. When gross necrosis was present in the nodes, ROIs that included the entire node as well as that excluded the necrotic portion were separately studied.

Results

Significant differences in node HU40keV and RATIO-HU40keV were seen between normal and metastatic nodes (207 vs 177 HU, $p=0.048$; 2.29 vs 1.91, $p=0.027$) when necrosis was excluded. Similarly, significant differences were also seen in node HU140keV and RATIO-HU140keV were seen between normal and metastatic nodes (30.4 vs 38.2 HU, $p=0.003$; 0.75 vs 0.62, $p=0.012$) as well as RATIO-HU40-140keV ($p=0.047$). The other DECT parameters studied did not reveal any differences between the two groups.

Conclusion

DECT derived lymph node HU at monochromatic 40keV and 140 keV, and ratio of node to muscle HU at monochromatic 40keV and 140 keV are significantly different between normal and metastatic nodes in patients with HNSCC, implying that DECT could have utility in addition to size and morphology of nodes in distinguishing these groups. We plan to further study the thresholds that can be used for employing this in clinical practice.



Iodine concentration measurement using dual-layer spectral detector CT: feasibility and utility in characterization of thyroid nodules

Start Time: 9/28/2018, 11:37 AM

Author(s)

Koji Takumi, MD

Research Fellow, Assistant Professor

Boston University School of Medicine, Kagoshima University Graduate School of Medical and Dental Sciences

Hiroto Hakamada

Clinical Fellow

Kagoshima University Graduate School of Medical and Dental Sciences

Nagano Hiroaki

Clinical Fellow

Kagoshima University Graduate School of Medical and Dental Sciences

Yoshihiko Fukukura

Associate Professor

Kagoshima University Graduate School of Medical and Dental Sciences

Takashi Yoshiura

Professor

Kagoshima University Graduate School of Medical and Dental Sciences

Edward Sung

Assistant Professor

Boston University School of Medicine, Kagoshima University Graduate School of Medical and Dental Sciences

Osamu Sakai, MD, PhD

Professor

Boston Medical Center, Boston University School of Medicine

Abstract Details

Purpose:

Thyroid nodules are among the most common incidental CT findings in daily practice. Additional imaging tests are sometimes performed to exclude malignancy. Dual-layer detector CT (DLCT) inherently acquires spectral

information thereby allowing dual-energy analysis for every examined case. Thus, detailed retrospective characterization of lesions may be possible without additional examinations. The purpose of this study was to examine the feasibility of iodine concentration (IC) measurement using DLCT and its utility in differentiation between benign and malignant thyroid nodules.

Materials and methods:

The population of this retrospective study consisted of 36 patients with 50 thyroid nodules (23 benign and 27 malignant). All patients underwent unenhanced DLCT examination. The CT features (tumor size, round ratio, nodule delineation, peritumoral infiltration, calcification, attenuation values, and ICs) were compared between benign and malignant nodules. Receiver operating characteristic (ROC) curve analysis was performed to assess the ability of IC values to differentiate malignant nodules from benign nodules, and the optimal cutoff value was chosen by using a threshold criterion determined by the largest Youden index. The sensitivity, specificity, positive predictive value, negative predictive value, and accuracy of CT features for diagnosing malignant nodules were calculated.

Result:

Irregular shape and calcification were significantly more common in malignant (70.4% and 48.1%, respectively) than in benign lesions (34.8% and 13.0%, respectively). ICs were significantly lower in malignant than benign lesions (0.36 ± 0.13 vs 0.71 ± 0.37 mg/mL, $p < 0.001$). Irregular shape and calcification for diagnosing malignant thyroid nodules had sensitivity of 70.3 and 40.1%, specificity of 65.2 and 82.6%, and accuracy of 68.0% and 68.0%, respectively. The optimal threshold IC for differentiating malignant nodules was 0.6 mg/mL with a sensitivity of 96.2%, specificity of 56.5%, and accuracy of 78.0%.

Conclusion:

IC value measurement using DLCT can help differentiate between malignant and benign thyroid nodules.

Thyroid nodules on magnetic resonance: correlation with ultrasound TI-RADS classification and histopathology

Start Time: 9/28/2018, 11:44 AM

Author(s)

Jorge S. Palmeira Neto

Radiologist

Hospital Israelita Albert Einstein

Flavio H M. Lessa

Radiologist

Hospital Israelita Albert Einstein

Antonio Rahal Jr

Radiologist

Hospital Israelita Albert Einstein

Daniel V. Sumi

Radiologist

Hospital Israelita Albert Einstein

Regina L E. Gomes

Radiologist

Hospital Israelita Albert Einstein

Rafael M. Loureiro

Radiologist

Hospital Israelita Albert Einstein

Rodrigo W. Murakoshi

Radiologist

Hospital Israelita Albert Einstein

Carolina R. Soares

Radiologist

Hospital Israelita Albert Einstein

Fabio A R. Dalpra
Radiologist
Hospital Israelita Albert Einstein

Miguel Jose Francisco Neto
Radiologist
Hospital Israelita Albert Einstein

Mauro M. Daniel
Radiologist
Hospital Israelita Albert Einstein

Marcelo B G. Funari
Radiologist
Hospital Israelita Albert Einstein

Abstract Details

PURPOSE

To evaluate the possible role of magnetic resonance (MR) imaging in the diagnosis of benign and malignant thyroid nodules and correlate the imaging findings with ultrasound TI-RADS classification and data from histopathological studies.

MATERIALS & METHODS

We retrospectively evaluated exams of patients who underwent thyroid ultrasonography with Thyroid Imaging Reporting and Data System (TI-RADS) classification, as well as MRI of the neck (1.5 and 3.0 T), ultrasound-guided fine-needle aspiration (FNA) and histopathological study, from 2011 to 2017. The MRI scans were analyzed by two radiologists specialized in head and neck imaging, who were blinded as to the result of FNA and histopathological study. The agreement between the observers was evaluated globally and also separately according to histopathological results.

RESULTS

Thirty patients were included in this study, aged between 16 and 81 years (mean: 49.5 years). Most patients were female (63.3%). Thirty-five nodules were evaluated, 45.7% (16) of which were malignant. According to TI-RADS, nodules were classified as category 3 in 29.4% (10) of the cases and as category 4 in 70.6% (24). One nodule (2,8%) was not classified according to TI-RADS. Among the nodules in category 3, 9 were benign and 1 malignant. Among the nodules in category 4, 9 were benign and 15 malignant ($p=0.005$). On ultrasound, 57.9% of the benign nodules (versus 12.5% of the malignant) had an anteroposterior diameter greater than 1 cm ($p<0.001$). The longest diameter (parallel to the skin) was greater than 1 cm in 73.7% of the benign nodules and in 25% of the malignant ones ($p=0.003$). High T2 signal was observed in 78.9% of benign nodules and 46.7% of malignant nodules ($p=0.05$). Thyroid nodules were more conspicuous on T2 (72,4%) and T1 post-Gd (62,1%) MRI sequences. Strong interobserver agreement was observed in the interpretation of diffusion restriction, T2 signal, and enhancement on T1 post-Gd ($p<0.001$). There was also good agreement in determining which sequence the

lesions were more conspicuous ($p < 0.001$), and there was even more agreement when only malignant nodules were considered.

No statistically significant correlation was found between histopathology of thyroid nodules and their signal on T1, margins or contrast enhancement, nor between T2 signal and TI-RADS classification.

CONCLUSIONS

No statistically significant correlation was found between the histopathology of thyroid nodules and their signal on T1, margins or contrast enhancement, nor between T2 signal and TI-RADS classification. Malignant nodules had more frequently low signal on T2 when compared with benign nodules. Nodules larger than 1.0 cm and with a high T2 signal were more frequently related to benign lesions, while nodules smaller than 1.0 cm and with iso / low signal were more frequently related to malignant lesions. Thyroid nodules were more conspicuous on T2 and T1 post-Gd MRI sequences.

Human Papillomavirus Status of Oropharyngeal Squamous Cell Carcinoma: A Meta-Analysis of Primary Tumor Lesion Apparent Diffusion Coefficient (ADC)

Start Time: 9/28/2018, 11:51 AM

Author(s)

Sam Payabvash, MD

Assistant professor

Yale

Abstract Details

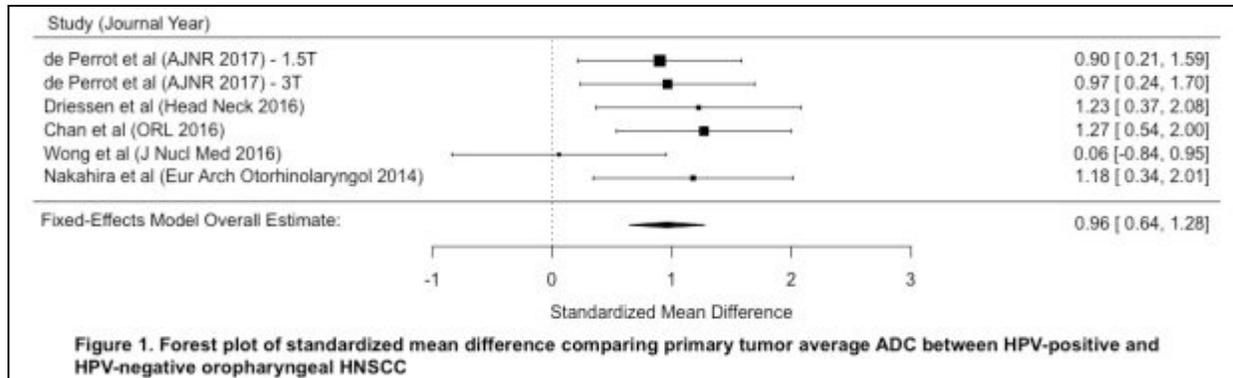
Purpose: Human Papillomavirus (HPV) infection is a well-established risk factor for head and neck squamous cell carcinomas (HNSCC), particularly those in the oropharynx. Patients with HPV-positive HNSCC usually present with distinct clinical and prognostic pattern compared to those with HPV-negative or smoking-related HNSCC. MRI is increasingly used for pretreatment and post-treatment assessment of HNSCC; and on DWI sequence, most HNSCC demonstrate reduced diffusivity due to high cellularity. Recent studies reported promising results for distinction of oropharyngeal HPV status based on quantitative assessment of the primary tumor lesion ADC values. This meta-analysis aimed to compare the average ADC value of oropharyngeal HNSCC primary tumor lesion between HPV-positive and HPV-negative molecular subtypes.

Methods: A systematic search of PubMed, and Embase databases were performed for relevant articles published from January 1, 2000, to May 1, 2018. The search strategy was based on the present of the squamous AND diffusion keywords. Studies reporting quantitative DWI assessment of HNSCC including intravoxel incoherent motion MRI were identified. Only studies comparing the average ADC value of primary HNSCC between patients with and without HPV were included. Studies without mean and standard deviation measurement values were excluded. The NIH Quality Assessment Tool for Observational Cohort and Cross-Sectional Studies was used for quality assessment. The standardized mean difference was calculated for the continuous variable outcome. Both random- and fixed-effects models were calculated using the metafor r package. For random-effects model, the restricted maximum likelihood (REML) was applied, and tau² estimates of total heterogeneity were determined.

Results: The search term returned 479 records in PubMed, and 916 records in Embase, of which 136 articles passed initial screening of titles and abstracts. After full text review of these studies, 5 eligible studies were ultimately included for meta-analysis. These studies represent pooled data of 264 patients with HNSCC, including 185 HPV-negative and 79 HPV-positive tumors. The HNSCC were localized to oral-cavity/oropharynx in 262/264 (99.2%) patients; whereas, the remaining 2 patients had hypopharyngeal/laryngeal HNSCC. The meta-analysis showed that HPV-positive HNSCC are associated with lower average ADC value compared to HPV-negative type ($p < 0.001$). Since, there was no significant heterogeneity in analysis (tau² estimated total heterogeneity of 0, $p = 0.3852$), both random- and fixed-effects models resulted in same estimates of the overall effect = 0.9614 (95% confidence interval: 0.6437-1.2790, Figure 1). Also, the funnel plot showed no significant publication bias in this meta-analysis.

Conclusion: In patients with suspected oropharyngeal HNSCC, quantitative assessment of the primary lesion ADC value on pre-treatment MRI can provide an easy-to-apply objective imaging biomarker for distinction of molecular pathogenesis. Current meta-analysis of 264 patients from 5 studies confirms a significantly lower

average ADC value of primary tumor lesion in patients with HPV-positive oropharyngeal HNSCC compared to those with HPV-negative type. Nevertheless, a standardized and uniform method for calculation of ADC diffusion values is a requisite for development of a universal distinctive value that can be applied across different institutes.



Random Forest Machine Learning Survival Analysis of Head and Neck Squamous Cell Carcinoma Combining PET/CT-based TNM Staging and HPV Status

Start Time: 9/28/2018, 11:58 AM

Author(s)

Sam Payabvash, MD

Assistant professor

Yale

Abstract Details

Purpose: We aimed to use a combination of PET/CT-based TNM staging information, clinical characteristics, and HPV status for prognostication of Head and Neck Squamous Cell Carcinoma (HNSCC) applying the multivariate random forest machine learning survival analysis.

Methods: The clinical and imaging data of patients with HNSCC were extracted from the publically available datasets of The Cancer Imaging Archive (TCIA). Only patients with known HPV status were included in the analysis. For all patients, the age, gender, and initial tumor localization were included in the analysis. The AJCC 7th edition TNM staging components were determined based on the initial PET/CT scan, supplemented with clinicopathological information. The AJCC 7th edition was used since the HNSCC nodal staging was regardless of HPV status. For univariate analysis, G-rho family tests were used to compare survival curves per each variable. The multivariate random forest algorithm with minimal depth variable selection and bootstrapping was performed for survival analysis, as well as identifying clinical and imaging variables with the greatest impact on survival models for time-to-locregional-recurrence, time-to-distant-metastasis, and overall survival. The concordance indices (CI) of 10-fold cross validation for each model are reported as a measure of survival model accuracy.

Results: A total of 150 patients were included: median age of 62 years (interquartile: 56-68) at diagnosis, and 116 (77.3%) patients were male. The HPV status was positive in 85 (56.7%) patients. None of the patients had distant metastasis at the time of diagnosis. The median duration of follow-up was 1123 days (interquartile: 861-1461). During the follow-up period, locoregional recurrence occurred in 17 (11.3%) patients, distant metastasis in 15 (10%), and 15 (10%) patients died. In univariate analyses, the patients age ($p < 0.001$), and HPV status ($p < 0.001$) had significant effect on time-to-recurrence; presence of any nodal disease at diagnosis (N stage greater than 0) had significant effect ($p = 0.04$) on time-to-metastasis; and tumor localization ($p < 0.001$) had significant effect on overall survival. For survival model for time-to-recurrence, the CI was 0.72; and HPV status, tumor localization, and nodal stage had the greatest importance for model accuracy. For time-to-metastasis, the CI was 0.63; and nodal stage of N2/N3, tumor extent of T2/T3, and tumor localization had the greatest importance for model accuracy. For overall survival, the CI was 0.54; and tumor localization, patients age, HPV status, and gender had the greatest importance for model accuracy.

Conclusions: Machine-learning analysis of multicenter megadata pave the road for devising novel imaging prognostic biomarkers with potentials to improve precision treatment planning in patients with HNSCC. In current study, applying random forest machine learning survival analysis with minimal depth variable selection, multivariate models were constructed combining PET/CT staging components, tumor genomics, and patients clinical characteristics. While the HPV status, tumor localization, and nodal stage were the most

important factors affecting time to local recurrence; any T or N stage greater than one, and tumor localization were the most important factors affecting time to distant metastasis. Inclusion of PET/CT radiomics features is the next step for this purpose.

Comparison of Radiologic to Pathologic Measurement of Depth of Invasion in Oral Tongue Squamous Cell Carcinoma

Start Time: 9/28/2018, 12:05 PM

Author(s)

Sarah c. Cantrell, MD

Assistant Professor, Department of Radiology

Emory University

Mihir Patel, MD

Assistant Professor, Department of Otolaryngology.

Emory University

Ashley Aiken

Neuroradiology Fellowship Program Director

Emory University School of Medicine

Kelley Magliocca, DDS, MPH

Assistant Professor, Department of Pathology and Laboratory Medicine

Emory University

Jacqueline Angel, MD

Fellow, Neuroradiology

Emory University

Abstract Details

Purpose/Intro: Depth of invasion (DOI) is newly incorporated into the AJCC 8th edition radiologic staging of oral tongue squamous cell carcinoma (SCC). The purpose of this project was to assess accuracy of radiologic measurement of DOI on pretreatment imaging.

Methods: An IRB approved retrospective review of pretreatment imaging of consecutive oral tongue SCC presenting to a tertiary academic center who subsequently underwent glossectomy/partial glossectomy was performed and DOI, measured by the radiologist using electronic calipers, was compared to depth of DOI determined by histologic analysis. Patients without pretreatment imaging and those whose tumors could not be identified on imaging were excluded. Patients with positive tumor margins (in whom DOI could not be evaluated accurately) were excluded. Demographic (age, sex, tobacco and alcohol exposures) and clinical (radiologic, pathologic and clinical stage and surgical treatment) information was recorded. A CAQ neuroradiologist reviewed pretreatment imaging and measured DOI on axial and coronal (when available) series. On imaging, DOI was measured from line drawn perpendicular from the surface of the tongue to the deepest margin of enhancing tumor. On histology, DOI was measured per AJCC8 from the level of the basement membrane of the closest adjacent normal mucosa using a plumb line dropped from the basement

membrane to the deepest point of tumor invasion.

Results: Preliminary review of 53 cases tumors, 30 female and 23 male. Fifty-two patients reported no prior smokeless tobacco use and one patient reported current (within 1 year) smokeless tobacco exposure. Tobacco exposures were: 8 never smokers, 8 former smokers (quit >1 year prior to diagnosis) and 33/53 current smokers. At time of initial tumor staging, radiologic tumor stage (AJCC 7) was: T1 = 13, T2 = 22, T3 = 7 and T4 = 11.

When comparing radiologic measurement of DOI to histologic DOI, there was no discrepancy in 19/53. Radiologic measurement exceeded histologic measurement in 24/53 cases, with radiologic discrepancy 1-9mm, mean 4mm. Of those tumors in which radiologic measurement exceeded histologic measurement, radiologic measurement resulted in tumor upstage by AJCC 8 in 7 cases, with 4 cases upstaged to T3 (T2 by histologic measurement), and 3 cases upstaged to T2 (T1 by histologic measurement). Radiologic measurement was less than histologic measurement in 10 cases, with radiologic discrepancy of 0.2-3mm (mean 1.2mm). Of those tumors in which the radiologic measurement was less than the histologic measurement, no T stage change resulted from radiologic discrepancy.

Discussion: Both radiologic and histologic measurement of DOI have limitations in accuracy. Histologic DOI may be limited by prior biopsy, and in cases of difficult resection with multiple specimens. In our series, radiologic measurement of DOI matched the histologic measurement in only 19/53 (39%) of patients. Radiologic DOI was more frequently overestimated than underestimated. We propose that the trend toward overestimation was inadvertent measurement of tumor thickness (as opposed to DOI), including exophytic portions of the tumor, and measurement of enhancing inflammatory reaction surrounding the tumor. Radiologic measurement resulted in upstaging of 7 tumors.

Role of cryotherapy for head and neck cancer treatment in the era of immunotherapy

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Author(s)

Abdul Rahman Tarabishy, MD

Associate Professor

West Virginia University

Luke James Higgins

Assistant Professor

West Virginia University

Abstract Details

A case report of a recurrent and refractory base of tongue squamous cell cancer, that recurred in the setting of post-surgical resection, radiation and chemotherapy. The patient had demonstrated worsening local disease burden with development of oro-cutaneous fistula. The aim of the locoregional therapy is to augment the immunotherapeutic treatment regimen. Cryotherapy has been shown to preserve tumor antigens following tumoricidal ablation. This case is supported by a comprehensive literature review demonstrating the added benefit of a combinatorial locoregional and systemic immunotherapeutic approach. Specifically, anecdotal evidence supports the improved immune response to metastatic and other untreated local lesions, a phenomenon known as the abscopal effect.

The Prevalence of Asymptomatic Superior Semicircular Canal Dehiscence using 64-Detector Helical CT.

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Author(s)

Aric W. Berning

Medical Student

University of Pittsburgh School of Medicine

Barton F. Branstetter, IV, MD

Professor of Radiology, Otolaryngology, and Biomedical Informatics

University of Pittsburgh Medical Center

Keerthi Arani, MD

Assistant Professor of Radiology

University of Pittsburgh Medical Center

Abstract Details

Prior studies of superior semicircular canal dehiscence (SSCD) detected CT evidence of SSCD in 11% of the study population. The authors concluded that radiologic SSCD was an insensitive sign and needed to be confirmed with clinical findings. However, those studies were performed before the advent of multi-slice helical CT. Furthermore, there is limited evidence investigating the prevalence of radiologic SSCD in asymptomatic individuals. The purpose of this study is to determine the rate of radiologic SSCD in an asymptomatic population using 64-detector helical CT imaging.

We enrolled consecutive patients who had undergone CT of the temporal bones in the emergency department. To prevent observer bias, we interpreted scans of patients with and without symptoms of SSCD, but only patients without symptoms of SSCD were included in the data analysis. Based on power analyses, patients were enrolled until we reached 500 asymptomatic patients. Two dedicated head and neck radiologists separately reviewed each scan and inter-reader agreement was assessed using the kappa statistic. The rate of asymptomatic radiologic SSCD was calculated, along with 95% confidence intervals using Newcombes method for extreme percentages.

Ten of the 500 asymptomatic patients (2.0%, 95%CI = 1.1% 3.6%) had CT evidence of SSCD. There was excellent inter-observer agreement ($\kappa = 0.98$).

Only 2% of asymptomatic patients have radiologic evidence of SSCD on 64-detector helical CT. This is markedly lower than the previous reports of 11% and approaches the autopsy rate of asymptomatic SSCD. We therefore recommend that asymptomatic patients with CT evidence of SSCD undergo audiologic evaluation, as the rate of false positive scans is extremely low.