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Tissue Contrast Differentiation between Head and Neck Squamous Cell Carcinoma Tumors and Adjacent Tissues in Early and Late Phases by Multi-Slice CT Scan

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Abstract

Background: Malignancies of head and neck are common cancers responsible for 6 percent of all malignancies. Use of multi-slice CT scan has led to shorter time of scan with optimal capacity in constant time. This study aimed to evaluate the tissue contrast differentiation between head and neck Squamous Cell Carcinoma tumors and adjacent muscle tissue in early and late phases by multi-slice CT scan.

Methods and materials: In this cross-sectional study, 76 patients with head and neck Squamous Cell Carcinoma referred to us in imaging center of Tehran Amir A'lam hospital in 2014-2015. Multi-slice CT scan were conducted at early time (20 seconds) and 180 and 300 seconds after contrast media injection. Then, Hounsfield score of affected tissue and nearest muscle was measured. Δ density was defined as the contrast between tumor density and nearest muscle density.

Results: The mean of tumor density at early phase, late phase (180s) and (300s) was $75/76 \pm 21/08$, $75/26 \pm 12/96$ and $74/14 \pm 12/57$, respectively ($P>0.05$). Conversely, the muscle density significantly was lower in early phase compare to late phase ($65/31 \pm 11/65$ vs. $69/06 \pm 12/23$ and $69/82 \pm 10/69$, $P<0.001$). Our results also showed that Δ density was decreased in late phases, however, this reduction was not statistically significant ($P=0.08$).

Conclusion: Results indicated that multi-slice CT scan may have good tissue contrast differentiation ability between head and neck Squamous Cell Carcinoma tumors and adjacent muscle tissues in early phases after contrast media injection.

Keywords: Squamous cell carcinoma; Head and neck; Multi-slice CT scan; Tumor; Muscle

Introduction

Malignancies of head and neck are common cancers responsible for 6 percent of all malignancies with 600000 new cancers and 350000 deaths due to cancers annually [1]. These include oral, nasopharyngeal, oropharyngeal, laryngeal, and sinonasal cancers and are as Squamous Cell Carcinoma (SCC) in 95% of cases [2,3]. Clinical symptoms, treatment, and prognosis are related to pathological type and grade [4] and 5-year survival is nearly 60% [5]. An epidemiologic study in 2016 in Iran showed that the incidence of head and neck cancers was 7.4 per 100,000 in 2009 [6].

Since early diagnosis can result in better prognosis, use of optimal imaging modalities would result in better outcomes. Use of multi-slice CT scan has led to shorter time of scan with optimal capacity in constant time [7,8]. Higher contrast in cervical vessels would result in higher resolution of images and higher quality [7,9,10]. Contrast-enhanced diagnostic CT is useful for approximation of head and neck cancer volumes [11]. It should be considered that Contrast enhancement at CT is affected by numerous interacting factors including patient, contrast medium, and CT scanning factors [11,12].

There are few studies about contrast increase in soft tissue, it has been reported various resolutions in early times [13,14] and the importance of late phase is not yet clear. The more constant and homogeneous tissue in any part of the neck is muscular tissue and so it is logical we compare various tumors by the most nearby muscle, instead of other tissues in the neck. In paranasal sinuses native contrast of the air and soft tissues make differentiation of tissues easier and so we did not enter any paranasal sinus SCC in our study. In this study, we

evaluated the tissue contrast differentiation between head and neck SCC tumors and adjacent muscle tissue in early and late phases by multi-slice CT scan.

Material and Methods

Study population

In this cross-sectional study, 76 patients with head and neck SCC referred to us in imaging center of Tehran Amir A'lam hospital in 2014-2015. The patients were diagnosed with pathological findings. The exclusion criteria were pregnancy and also contraindication for contrast use. Four cases with benign pathology or other malignancies were excluded. Also two cases had more than one mass which were considered as two separate cases to increase the number of them. The study protocol was approved by the ethics committee of Tehran University of Medical Sciences and all participants were informed before taking part in the study.

Multi-slice CT scan

Early and late indices in multi-slice CT scan were conducted by Siemens Co. (Emotion 16 Slice model) with dual phase model. Hounsfield score of affected tissue and nearest muscle was measured at early time (20 seconds) and 180 and 300 seconds after injection. For each 1.5 centimeter one region of interest (ROI) was considered and the mean ROI was calculated. The contrast differentiation potency was determined and compared between SCC tumors and surrounding muscle tissue. The early phase of scan was performed 20 seconds from initiation of contrast injection. Delta (Δ) density was defined as the contrast between tumor density and nearest muscle density.

Statistical analysis

In this study, we used the software SPSS 25 package (SPSS Inc, Chicago, IL) for data analysis and statistical calculation. The normal distribution of the numerical variables of patients was assessed using Kolmogorov-Smirnov Z-test. Friedman and Wilcoxon signed-rank tests were used to compare delta Δ density between three and two phases, respectively. P-value was considered as statistical significant when P was below 0.05.

Results

The mean age of patients was 58.89 ± 16.48 years and 81.5% of them were male. 61.8% of patients were smoker. Clinical and demographic characteristics of the patients are summarized in **Table 1**. The mean of tumor density at early phase, late phase (180s) and late phase (300s) was $75/76 \pm 21/08$, $75/26 \pm 12/96$ and $74/14 \pm 12/57$, respectively. Our analysis showed lack of significant difference between three time interval regard to tumor density (**Table 2, Figure 1A**). Conversely, the muscle density significantly was lower in early phase compare to late phase ($65/31 \pm 11/65$ vs. $69/06 \pm 12/23$ and $69/82 \pm 10/69$, $P < 0.001$, **Table 2, Figure 1B**). Our results

also showed that delta (Δ) density was decreased in late phases, however, this reduction was not statistically significant ($P = 0.08$, **Table 2, Figure 1C**).

Table 1 Clinical and demographic features of SCC patients.

Characteristics	SSC patients
Number of subjects	76
Gender	62/14
Age (Mean \pm SD)(years)	58.89 ± 16.48
Smoker (Yes/No)	47/29

Table 2 Tumor density, nearest muscle density and Δ density at different phases.

Factor	Early phase	Late phase (180s)	Late phase (300s)	P-value
Tumor density	$75/76 \pm 21/08$	$75/26 \pm 12/96$	$74/14 \pm 12/57$	0.57
Muscle density	$65/31 \pm 11/65$	$69/06 \pm 12/23$	$69/82 \pm 10/69$	< 0.001
Δ density	$17/15 \pm 18/18$	$14/4 \pm 10/97$	$12/65 \pm 10/38$	0/08

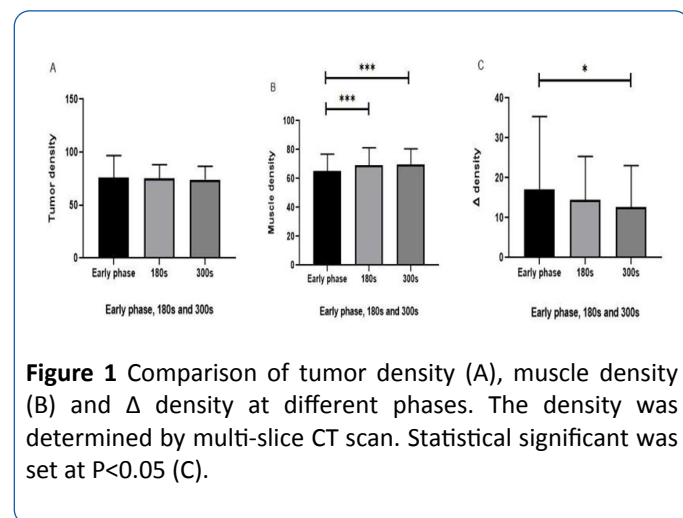


Figure 1 Comparison of tumor density (A), muscle density (B) and Δ density at different phases. The density was determined by multi-slice CT scan. Statistical significant was set at $P < 0.05$ (C).

Discussion

In this study, the tissue contrast differentiation between head and neck SCC tumors and adjacent muscle tissues was determined in early and late phases by multi-slice CT scan. It was seen that tumor adjacent muscle had better resolution in late phases that early phases and tumor density and tissue differentiation contrast (Δ density) had no significant changes. In this era some similar studies are compared in next paragraphs, but in the past we have not comparison of tissue contrast in relation to muscles as a potential tool for better visualization of tumor extension which it is our goal in this study.

Groell et al. [15] reported that early scans are better for helical CT studies of the head and neck, but delayed scans may

improve lesion detection in patients with SCC of head and neck. Similar to Groell et al.'s study, we observed that tumor adjacent muscle conspicuity significantly was better in late phases, whereas, tumor density and were not significantly difference between early and late phases.

Conrad et al. [13] demonstrated that in 58% of patients with pharyngeal or laryngeal carcinoma, early scans are better for detection of squamous cell carcinomas in the pharynx and larynx. A Study by Keberle and his colleagues [16] assessed the time of best contrast of neck malignancies in contrast-enhanced CT in 20 patients with SCC of head and neck and showed an optimal tumor contrast and a good contrast between lymph nodes and neck vessels or muscle between 50 and 75 s after starting the injection. The discrepancy between us and similar studies may be in part due to different study protocol. Joshi et al. reported that among different imaging modalities for head and neck SCC tumors, the multi-slice CT scan had good tissue contrast ability and are useful for treatment decision-making. This matter was also seen in our study for early phase [17].

Hadjiiski et al. [18] reported that multi-slice CT scan may be used at early phase for differentiation of tumor parts with therapeutic response as well difference seen in our study. Schmitz and colleagues [19] reported that multi-slice CT scan may be used at early phase for treatment response monitoring. Also Hwang et al. [12] reported that it may be used for determination of recurrence which is in congruence with our results in current study.

Conclusion

Taken to gather, it may be concluded that multi-slice CT scan may have good tissue contrast differentiation ability between head and neck SCC tumors and adjacent muscle tissues in early and late phases after contrast media injection with higher ability at early phase which is lowered at late phase and there is no difference between two late phases. However, further studies with larger sample size and assessment of other modalities for head and neck SCC tumors are recommended to be performed.

Conflict of Interest

The authors declare that there is no conflict of interests.

Acknowledgement

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Limitations

There was no limitation of the study.

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