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論文審査の結果の要旨及び担当者

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論文審査の結果の要旨

当研究は、透視装置で液体の嚥下を連続撮影し、得られた画像の濃淡と液体量の関係から、嚥下中の食塊量（液体量）を、世界で初めて、可能な限り正確に定量評価する方法を確立した。さらに舌骨が急峻に動き出す直前を嚥下開始、食塊（液体）が画面上から消えるまでを嚥下と定義し、その方法を用いて、世界で初めて、健常人の液体の嚥下を評価した。その結果、健常人が、液体20ccを飲み込む際には、様々なバリエーションがあることが客観的に示し、また、舌骨下縁付近、輪状軟骨下縁付近の2か所で食塊が一時的に貯留され、その2か所への貯留時刻が同時であるものと、ズレがあるものの少なくとも2種類があることを示した。このように、嚥下中の液体量を客観的に計測し、嚥下機能評価を行った研究はなく、今後、この方法を用いて嚥下機能を評価していくとこは、以前から行われている嚥下機能検査では、明らかにできない嚥下機能の側面を明らかにする可能性がある研究であり、博士（医学）の学位授与に値する。

論　文　内　容　の　要　旨

Synopsis of Thesis

氏　名 Name	新井　伸征
論文題名 Title	A novel fluoroscopic method for multidimensional evaluation of swallowing function （透視撮影を用いた、新たな多次元的嚥下機能評価方法）

論文内容の要旨

Objectives: Dynamic videofluoroscopic swallow study (VFSS) is used to investigate swallowing movements. However, it requires prolonged radiation exposure and mainly provides qualitative information. Herein, we present a multi-dimensional method for analyzing swallowing based on a pulsed, low-dose fluoroscopy technique that uses serial-shot images and evaluates the size, position, and temporal profile of the bolus to obtain a more comprehensive and realistic analysis of swallowing movements.

Methods: Fifteen healthy adults drank two liquids: 20 mL of pure water followed by 20 mL of contrast medium mixture in a fluoroscopic study. Data were recorded in serial-shot images (7.5 frames/second, 1024 × 1024-pixel resolution, DICOM format). The images from the water and contrast swallows were inverted, synchronized, and subtracted to visualize the bolus in each frame. The pathway of the bolus was divided into 15 parts traversing the oropharynx, hypopharynx, and upper esophagus, and the total gray value was measured in each section. The results were presented as contour graphs.

Results: The contour graphs allowed for information on the size, anatomical location, and temporal location of the bolus during swallowing to be displayed simultaneously. Two distinct swallowing patterns were observed in the subjects. The bolus showed two peaks—one in the hypopharynx and one in the upper esophagus—in all subjects. However, in nine of the 15 subjects, the two peaks were in different frames, whereas in six of the subjects, the two peaks were in the same frame.

Conclusions: We developed a new method for quantitatively evaluating swallowing. The technique allows for multidimensional assessment of the size, position, and temporal profile of the movement of the bolus across the pharynx. This method evaluates the swallowing movements using sharp, high-resolution images obtained by serial-shot, pulsed fluoroscopy with low radiation exposure. Additional studies are required to further clarify the variability of swallowing patterns and their clinical relevance in the evaluation of swallowing movements in healthy subjects and in patients with swallowing disorders.