

JOINT EVENT

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## Ultrasound image analysis using deep learning algorithm for the diagnosis of thyroid nodules

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**Background:** Fine needle aspiration (FNA) is the procedure of choice for evaluating thyroid nodules and FNA may be required even for nodules with very low suspicion of malignancy if they are larger than 2 cm. However, avoiding unnecessary FNA is important to reduce complications related to FNA and to reduce medical expenses. In this study, we developed an image analysis model using deep learning algorithm and evaluated if the algorithm could predict which nodules would have benign FNA results.

**Methodology:** Ultrasonographic images of thyroid nodules with FNA cytology or surgical pathologic results were retrospectively collected at Boramae Medical Center, Seoul, Republic of South Korea. The images of the nodules were put into the Inception-V3 network model, pre-trained with ImageNet database for fine-tuning. A total of 1,358 images of the nodules (670 benign, 688 malignant) were used for the algorithm development, and the algorithm was trained to predict a nodule as benign or malignant.

**Results:** Total 55 nodules (34 benign, 21 malignant) from SMG-SNU Boramae Medical Center, and 100 nodules (50 benign, 50 malignant) from Kuma Hospital, Kobe, Japan were used for internal and external test sets. For internal test set, of the 21 FNA malignant nodules, 20 were predicted as malignant by the algorithm (sensitivity, 95.2%). Of the 22 nodules algorithm called benign, 21 were FNA benign (negative predictive value, 95.5%). For external test set, of the 50 FNA malignant nodules, 47 were predicted as malignant by the algorithm (sensitivity, 94.0%). Of the 31 nodules algorithm called benign, 28 were FNA benign (negative predictive value, 90.3%).

**Conclusions:** The deep learning algorithm had a high sensitivity and negative predictive value despite an unrealistically high percentage of FNA suspicious for malignancy nodules tested. Using deep learning algorithm may assist clinicians in selecting those nodules that are most likely to be benign and avoid unnecessary FNA.

### Recent Publications

1. Chai Y J et al. (2017) Comparative analysis of 2 robotic thyroidectomy procedures: transoral versus bilateral axillo-breast approach. *Head Neck*. 40(5):886-892.
2. Chai Y J et al. (2017) Lateral transperitoneal adrenalectomy versus posterior retroperitoneoscopic adrenalectomy for benign adrenal gland disease: randomized controlled trial at a single tertiary medical center. *Ann Surg*. Doi:10.1097/SLA.0000000000002603
3. Kim HY et al. (2017) Transoral robotic thyroidectomy: lessons learned from an initial consecutive series of 24 patients. *Surg Endosc*. 32(2):688-694. Doi:10.1007/s00464-017-5724-5.
4. Chai Y J et al. (2017) Transoral endoscopic thyroidectomy for papillary thyroid microcarcinoma: initial experience of a single surgeon. *Ann Surg Treat Res*. 93(2):70-75. Doi:10.4174/astr.2017.93.2.70.
5. Chai Y J et al. (2017) Upregulation of SLC2 (GLUT) family genes is related to poor survival outcomes in papillary thyroid carcinoma: analysis of data from The Cancer Genome Atlas. *Surgery*. 161(1):188-194.

### Biography

Young Jun Chai is an Assistant Professor of Surgery at Seoul Metropolitan Government-Seoul National University Boramae Medical Center since 2013. He was educated and trained at Seoul National University. He is a Managing Editor of *Journal of Endocrinology* (JES), Secretary of Korea Intraoperative Neural Monitoring Society (KINMoS), and Korean Society of Head and Neck Oncology (KSHNS). He is also an Editorial Board of *Clinics in Oncology Journal - Head and Neck Oncology*; an active Member of International Society of Oncoplastic Endocrine Surgeons (ISOPES), and Intraoperative Neural Monitoring Study Group (IONMSG). His major interest is endocrine surgery of thyroid, parathyroid, and adrenal glands. He is also interested in molecular biology of thyroid cancer and gave oral presentation at the annual meeting of American Association of Endocrine Surgeons (AAES) in 2014 and 2016 respectively. He has published more than 40 SCI(E) papers and 3 textbooks.

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