Korean Journal of Radiology

RE: Efficacy and Safety of Radiofrequency Ablation for Benign Thyroid Nodules: A Prospective Multicenter Study

Qi Di, MD

Children's Hospital Affiliated to Zhengzhou University & Henan Children's Hospital & Zhengzhou Children's Hospital, Zhengzhou 450000, China

Dear Editor,

With great interest, we read the article "Efficacy and safety of radiofrequency ablation for benign thyroid nodules: a prospective multicenter study" (1). In the present article, the authors (1) developed a multiple linear regression prediction model to identify factors that were independently predictive of the reviewed volume reduction. The model predictors included (1): age, sex, number of treatment sessions, initial solidity, delivered energy, initial volume, and initial vascularity. In this instance, the multivariate analysis showed that the initial solidity ($p <$ 0.001) and delivered energy ($p =$ 0.01) were predictors of the volume reduction. We noted the results as interesting. We would like to thank the authors for this highly useful work.

It is noted that regression is widely used for reading and publishing in the medical literature, and consequently there is a question as to the reliability and validity of the data. A multiple regression model is based on a large number of samples, and its predictive performance is restricted by the size and characteristic of the samples (2). The initial validation is noted as quite promising with statistically significant and meaningful differences across time and study populations (3). Therefore, it is important that we recommend that the multiple linear regression prediction model as developed by Jung et al. (1) should be internal validated (4). The internal validation essentially means reusing parts or all of the dataset on which a model was developed to assess the likely overfit and correct for the resulting 'optimism' in the performance of the prediction model (5). The entire data (N) is randomly partitioned into the development data-set (A) and test data-set (N-A), which in this case are used for the prediction model for development and validation (6), respectively. And the R square of the prediction model were in this case, derived on the basis of the multivariate regression analysis.

REFERENCE

1. Jung SL, Baek JH, Lee JH, Shong YK, Sung JY, Kim KS, et al. Efficacy and safety of radiofrequency ablation for benign thyroid nodules: a prospective multicenter study. *Korean J Radiol* 2018;19:167-174
2. Chen J, Tang H, Huang H, Lv L, Wang Y, Liu X, et al. Development and validation of new glomerular filtration rate predicting models for Chinese patients with type 2 diabetes. *J Transl Med* 2015;13:317
3. Enders F. Do clinical and translational science graduate students understand linear regression? Development and early validation of the REGRESS quiz. *Clin Transl Sci* 2013;6:444-451
4. Bright JA, Richards R, Kruijver M, Kelly H, McGovern C, Magee A, et al. Internal validation of STRmix™ - A multi laboratory response to PCAST. *Forensic Sci Int Genet* 2018;34:11-24
5. AlBadawy EA, Saha A, Mazurowski MA. Deep learning for segmentation of brain tumors: impact of cross-institutional training and testing. *Med Phys* 2018;45:1150-1158
6. Haniffa R, Beane A, Baker T, Riviello ED, Schell CO, Dondorp AM. Development and internal validation of the Simplified Mortality Score for the Intensive Care Unit (SMS-ICU). *Acta Anaesthesiol Scand* 2018;62:407-408

Response

So Lyung Jung, MD[1], Jung Hwan Baek, MD, PhD[2]

[1]Department of Radiology, Seoul St. Mary's Hospital, College of Medicine, The Catholic University of Korea, Seoul 06591, Korea; [2]Department of Radiology and Research Institute of Radiology, University of Ulsan College of Medicine, Asan Medical Center, Seoul 05505, Korea

To the Editor,

First of all, we appreciate your thoughtful comment on our article published in the Korean Journal of Radiology (1). As you suggest, multivariable prediction models have been widely used for diagnosis, screening, and as tools for decision-making procedures that assist doctors. To address model prediction, randomly splitting a single data set into model development and validation techniques needs from the Transparent Reporting of a multivariable prediction model for Individual Prognosis or Diagnosis (TRIPOD) guidelines (2). We agree with your opinion regarding the/ our prediction model procedure; however the aim of our study is somewhat different from the opinion you have expressed.

The primary outcome of our prospective multicenter study was to prove the generalizability of thyroid radiofrequency ablation (RFA) for nonfunctioning thyroid nodules by trained radiologists who followed a unified protocol and used similar devices. Our secondary outcome was to discover independent factors related to the volume reduction of treated nodules at 12 months (1). To prove the generalizability of thyroid RFA, we enrolled trained radiologists and used similar techniques and devices (3, 4). Then we evaluated the efficacy and safety of thyroid RFA. The mean volume reduction in the present study was 80.3% at 12 months, which is comparable to that reported in a large population study performed by Jeong et al. (5) (84.1% at 12-month follow-up). Additionally, our multicenter study achieved a 95.3% volume reduction at a 5-year follow-up. The major complication rate was only 1.1%, which is comparable to that of a previous large-population multicenter study (1.4%, n = 1459) (6). Moreover, to find independent factors, we performed univariate and multivariate linear regression analysis. Unfortunately, we missed linear regression analysis in each of our selected variables (age, sex, number of treatment sessions, initial solidity, delivered energy, initial volume, and initial vascularity) in Table 4. Even though some variables are questionable with regard to the beneficial factor of volume reduction in RFA (7), we assume the eight variables are influential for volume reduction and were performed by multiple linear regression analysis.

We believe that your comments have enriched our study and deeply appreciate your attention.

REFERENCE

1. Jung SL, Baek JH, Lee JH, Shong YK, Sung JY, Kim KS, et al. Efficacy and safety of radiofrequency ablation for benign thyroid nodules: a prospective multicenter study. *Korean J Radiol* 2018;19:167-174
2. Moons KG, Altman DG, Reitsma JB, Ioannidis JP, Macaskill P, Steyerberg EW, et al. Transparent Reporting of a multivariable prediction model for Individual Prognosis or Diagnosis (TRIPOD): explanation and elaboration. *Ann Intern Med* 2015;162:W1-W73
3. Park HS, Baek JH, Park AW, Chung SR, Choi YJ, Lee JH. Thyroid radiofrequency ablation: updates on innovative devices and techniques. *Korean J Radiol* 2017;18:615-623
4. Park HS, Baek JH, Choi YJ, Lee JH. Innovative techniques for image-guided ablation of benign thyroid nodules: combined ethanol and radiofrequency ablation. *Korean J Radiol* 2017;18:461-469
5. Jeong WK, Baek JH, Rhim H, Kim YS, Kwak MS, Jeong HJ, et al. Radiofrequency ablation of benign thyroid nodules: safety and imaging follow-up in 236 patients. *Eur Radiol* 2008;18:1244-1250
6. Baek JH, Lee JH, Sung JY, Bae JI, Kim KT, Sim J, et al. Complications encountered in the treatment of benign thyroid nodules with US-guided radiofrequency ablation: a multicenter study. *Radiology* 2012;262:335-342
7. Baek JH. Factors related to the efficacy of radiofrequency ablation for benign thyroid nodules. *Ultrasonography* 2017;36:385-386

Corresponding author: Jung Hwan Baek, MD, PhD, Department of Radiology and Research Institute of Radiology, University of Ulsan College of Medicine, Asan Medical Center, 88 Olympic-ro 43-gil, Songpa-gu, Seoul 05505, Korea.
• Tel: (822) 3010-4348 • Fax: (822) 476-0090
• E-mail: radbaek@naver.com