Use of Classification and Regression Trees in Diuresis Renography

José Nilo G. Binongo, PhD, Andrew Taylor, MD, Andrew N. Hill, PhD, Brian Schmotzer, MS, Raghuveer Halkar, MD, Russell Folks, CNMT, Eva Dubovsky, MD, PhD, Ernest V. Garcia, PhD, Amita K. Manatunga, PhD

Rationale and Objectives. Decision support systems have the capacity to improve diagnostic performance and reduce physician errors. The purpose of this study was to evaluate the use of classification and regression trees (CART) with bootstrap aggregation as a decision support system in the baseline plus furosemide (F ~ 20) diuresis renography protocol to determine when obstruction can be excluded without the furosemide acquisition and to identify the key parameters for making this determination.

Materials and Methods. Patients with suspected ureteral obstruction were randomly assigned to a training set (80 patients, 157 kidneys) and a validation set (64 patients, 124 kidneys). Forty quantitative parameters (curve parameters, MAG3 clearance and voiding indices) were generated from each baseline Tc-99m mercaptoacetyltriglycine (MAG3) scan. Three expert readers independently evaluated each kidney regarding the need for furosemide and resolved differences by majority vote. CART with bootstrap aggregation was applied to the training set to generate prediction algorithms which were tested in the validation set.

Results. The algorithm agreed with the expert decision on the necessity of furosemide in 90% (111 of 124 kidneys), with misclassification rates of 10.0% and 10.9% for the left and right kidneys, respectively. The most important discriminators were the postvoid-to-maximum count ratio, the cortical 20-minute-to-maximum count ratio, and the postvoid-to-1-to-2-minute count ratio.

Conclusion. CART can identify the key parameters for discriminating between nonobstruction and possible obstruction, has the potential to serve as a decision support tool to avoid unnecessary furosemide imaging, and can be applied to more complex imaging problems.