DEVELOPMENT AND VALIDATION OF A SOFTWARE ENGINE TO JUSTIFY AN EXPERT SYSTEM'S CONCLUSIONS FOR DETECTING RENAL OBSTRUCTION FROM Tc-99m MAG3 SCANS

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Objectives: We have previously developed a renal expert system (RENEX) as a decision support tool to assist in the interpretation of Tc-99m MAG3 scans to detect renal obstruction in patients referred for diuresis renography. A decision support system may give the right answer for the wrong reasons. This project is to develop and validate a software engine to justify the conclusions reached by RENEX for evaluating suspected renal obstruction.

Methods: RENEX consists of sixty heuristic rules (IF A THEN B) extracted from the domain expert to generate the knowledge base and a forward chaining inference engine in order to determine obstruction. The justification engine keeps track of the sequence of each rule that is instantiated to reach a conclusion. Once the final conclusions are reached, they are reported in a concatenated set of sentences stringing the conclusions together; the key conclusions are underlined. The interpreter can then request justification for a specific conclusion by clicking on the underlined word. The justification process then reports the English translation of all concatenated rules instantiated to reach that conclusion. The justification engine was validated using a prospective group of 60 patients (32 females, mean age = 53.8 ± 17.6, 117 kidneys). After reviewing the standard renal pre and post furosemide MAG3 scans together with associated quantitative results determined by QuantEM 2.0 (I have used 2.0 in the submitted lasix and variability papers) II. a blinded expert determined if each kidney was obstructed, equivocal or not obstructed and identified and ranked the main variables associated with each interpretation. Two parameters were then tabulated: 1) the frequency the main variables associated with obstruction by the expert were also justified by RENEX and 2) the frequency that the justification rules provided by RENEX were deemed to be correct by the domain expert. Only when RENEX and the domain expert agreed on the diagnosis (87 kidneys), were the results used to test the justification; kidneys interpreted as equivocal (22) were not used for this evaluation.

Results: In these 87 kidneys where there was agreement, RENEX agreed with 91% (184/203) of the rules supplied by the expert for justifying the diagnosis. RENEX provided 103 additional rules justifying the diagnosis: the expert agreed that 102 (99%) were correct although the rules were considered of secondary importance.

Conclusions: We have developed and validated a software engine to justify a renal expert system’s conclusions for detecting renal obstruction using pre and post furosemide Tc-99m MAG3 renal scans. This tool is expected to increase the confidence for RENEX’s interpretation; assist physicians gain a higher level of expertise and importantly aid the developers improve the diagnostic performance of the decision support system.