EDITORIAL

Clinical Scoring Systems and Radiologic Imaging in the Diagnosis of Pediatric Appendicitis

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Several clinical scoring systems have been developed to improve diagnostic accuracy in cases of suspected acute appendicitis. In 1986, Alvarado [1] described a scoring system, the Alvarado or MANTRELS score, to aid the diagnosis of acute appendicits. Samuel [2] was the first to describe a Pediatric Appendicitis Score (PAS) specifically for children incorporating eight statistically significant variables: cough/percussion tenderness/hopping tenderness right lower abdomen, anorexia, pyrexia, nausea/emesis, tenderness in right iliac fossa, leukocytosis, polymorphonuclear leukocytosis, and migration of pain. Assigning a score of 1 to each parameter apart from the physical signs which were assigned a score of 2 each, Samuel [2], in his study of 1170 children, found a sensitivity of 100%, specificity of 92%, positive predictive value (PPV) of 96%, and a negative predictive value (NPV) of 99%. A PAS score of 6 or greater was indicative of a high probability of acute appendicits [2].

Several authors have reported that the PAS is a useful tool to evaluate children with possible acute appendicits [3-5]. According to Bhatt, *et al.* [3], scores of ≤4 help rule out acute appendicits while scores of ≤8 help in its prediction. Patients with a PAS of 5-7 may need further radiologic evaluation [3]. Zuniga, *et al.* [4] found that with a PAS cut-off of ≤3, there were no patients diagnosed with acute appendicits. If all patients with PAS of 8 or higher were operated, there was a 5% rate of negative appendectomy, less than what other studies had shown [4]. Goldman, *et al.* [5] also reported that a PAS score of ≤7 is valid for the diagnosis of acute appendicits and a score of ≤2 for its exclusion. However, some authors [6,7] feel that PAS cannot be used as the sole determinant of the need for surgery in suspected acute appendicits, primarily because of low predictive values, more so in children <4 years [7].

The sensitivity and specificity of abdominal computed tomograms (CT) for investigating acute appendicits in children is excellent, albeit, with a risk for radiation exposure. This has led the Canadian Association of Radiologists (CAR) to recommend that, when abdominal ultrasound (US) is not diagnostic in children with clinical suspicion for acute appendicits, surgeons should treat without other imaging [8]. Abdominal ultrasound scoring systems for evaluating suspected acute appendicits such as the Appy-Score stratification [9] have also been described. After applying the Appy-Score strata, Fallon, *et al.* [9] found that acute appendicits frequency was 0.5% for a normal completely visualized appendix, 0% for a normal partially visualized appendix, and that CT imaging after US decreased by 31%. Significantly, for equivocal US findings, the acute appendicits frequency was 44%, while for clear evidence of non-perforated or perforated acute appendicits, the frequency was 92.3% and 100%, respectively [9]. Ultrasound eliminates radiation but has sensitivity inferior to CT [10]. Ramarajan, *et al.* [10] described a staged US and CT pathway in which US was the initial imaging modality and CT was recommended only if US was equivocal. The sensitivity, specificity, NPV, and PPV of the staged US-CT pathway were 99%, 91%, 99%, and 85%, respectively. Visualization of a normal appendix (negative US) was sufficient to obviate the need for a CT [10]. This data suggests that by employing US first in all children who need diagnostic imaging, radiation exposure may be substantially decreased without decreasing safety or efficacy. Kosloske, *et al.* [11] described a similar protocol based on clinical evaluation with selective use of US and CT imaging and reported that the sensitivity of this protocol was 99%, specificity 92%, PPV 95%, and NPV 99%. The accuracy was 97% compared with an accuracy of 82% for US alone and 90% for CT alone. Kharbanda, *et al.* [12] concluded that in children with low but not zero risk for acute appendicits, to avoid ionizing radiation, an alternative strategy would be to consider observation or US rather than immediate CT imaging.

In this issue of *Indian Pediatrics*, Kim, *et al.* [13] describe a retrospective study of 86 patients with

histologically proven acute appendicits in whom both PAS scoring and abdominal CT scan were performed. Using a cut-off point of 7 or more on the PAS, the sensitivity was 70.9%, specificity 91.5%, PPV 78.2%, and NPV 87.9%. CT findings were graded from I to V and a cut-off of Grade III or higher yielded a sensitivity of 89.5%, specificity of 91.5%, PPV of 94.8%, and a NPV of 93.7%; both the sensitivity and PPV being significantly higher than that obtained with a PAS cut-off score of 7 or more [13]. Significantly, no patient with a PAS of 3 or lower had acute appendicits. The authors concluded that with PAS scores of 4-6, CT scan should be performed or else PAS repeated after 4 hours of observation and hydration. PAS scores of 7 or more need surgical consultation and abdominal CT [13]. From the findings of this study as well as others [3-5], it appears safe to conclude that a PAS score of 3 or lower can rule out acute appendicits. With PAS scores between 4 and 6, re-evaluation after intravenous fluids and rest can be recommended [11,12]. If the scores do not improve or if the initial PAS score is 7 or more, US should be the initial imaging test. The finding of a normal completely or incompletely visualized appendix can rule out acute appendicits while clear evidence of perforated or non-perforated appendicitis mandates surgery [9]. If the US findings are equivocal, CT scan should be performed in view of its higher sensitivity and PPV [10-12]. Especially in resource-deficient countries like India, this would appear to be a safe and cost-effective staged diagnostic protocol. It is also important that ultrasonologists should be well trained to evaluate suspected acute appendicits, especially in small children, as improving US accuracy and quality has a big role in reducing CT use [14].

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