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Image-guided prediction of pseudocyst formation in pediatric pancreatic trauma

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ABSTRACT

Background: To determine if there is an effective alternative to the current standard of computed tomography (CT) grading of pediatric pancreatic injuries. We hypothesized that the Wong grading scale, which is based on the depth and location of the pancreatic laceration, is more predictive of pseudocyst formation than the American Association for the Surgery of Trauma (AAST) scale after nonoperative management of traumatic pancreatic injury in children.

Materials and methods: A retrospective review of children admitted for pancreatic trauma to two level 1 pediatric trauma centers between 2000 and 2012 was conducted. Patients who underwent primary operation were excluded. Initial CT scans were reviewed by two radiologists blinded to clinical outcomes, and injury grades from both scales were assigned. The primary outcome was pseudocyst formation.

Results: Fifty-three patients (ages 7 mo–17 y) were included. As per the Wong scale, pseudocysts occurred in 0/20 patients with grade A injuries, 2/17 (12%) with BI/CI injuries, and 9/15 (60%) with BII/CII injuries. Using the AAST scale, pseudocysts developed in 2/27 (7%) patients with grade I/II injuries, 7/20 (35%) patients with III/IV/V injuries, and 1/6 (17%) patients with a scan that was indeterminate between grades II and III. Positive Predictive value, negative predictive value, sensitivity, and specificity for pseudocyst formation were all higher using the Wong scale (AAST/Wong: Positive Predictive value 42%/50%, negative predictive value 91%/94%, sensitivity 80%/82%, and specificity 65%/77%).

Conclusions: The Wong CT grading scale may be superior to the AAST scale for early risk stratification for pseudocyst development after nonoperative management of pediatric pancreatic trauma; however, a larger study is needed for verification of these findings.

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1. Introduction

The management of pediatric pancreatic injuries remains controversial regarding indications for operative or nonoperative management. Ductal integrity is an important predictor of adverse outcome, and therefore is important to identify early in the decision-making process. Several studies have demonstrated long-term complications, notably pseudocyst formation, and even mortalities after missed pancreatic duct disruption [1–5]. The American Association for the Surgery of Trauma (AAST) scale, which is widely used for grading pancreatic trauma in adults and children, requires determination of a ductal disruption on computed tomography (CT) scan for classification of 3 of the 5 grades (Table 1) [6]. However, it has been shown that the accuracy of diagnosing a ductal injury by CT is low (only 42.9% in one report), which questions the validity of this grading scale and its utility for clinical decision-making [1]. Conversely, the Wong scale also uses CT imaging to grade pancreatic injuries, but the grading is based on the depth of the laceration rather than the visual appearance of a suspected ductal injury. This scale was created based on the premise that deep lacerations or transections may be more predictive of ductal injuries (Table 1) [7]. To date, the Wong scale has been not been validated for grading pancreatic trauma in children. We hypothesized that the Wong scale is a superior method of grading pancreatic injuries compared with the AAST scale in blunt pediatric abdominal trauma as it is more predictive of adverse outcomes after nonoperative management.

2. Materials and methods

Institutional review board approval was obtained from both institutions involved in this study. All patients aged under 18 y who were admitted to two level 1 pediatric trauma centers at large tertiary free-standing children's hospitals between 2000 and 2012 were included. The initial CT scans were reviewed in randomized fashion by a senior pediatric radiologist (G.B.) who was blinded to the original report and the clinical outcome of the patient. Two injury grades were then assigned to each patient one grade based on the Wong scale and one based on the AAST scale. To determine inter-rater reliability, a second pediatric radiologist (R.O.) was asked to grade the scans as well. Scans that received different grades were then reevaluated by both radiologists to achieve a consensus grade, which was then the basis for data analysis. Scans that could not be differentiated between grades II and III by the AAST scale were deemed indeterminate.

At institution A, trauma CT scans of the abdomen and pelvis were acquired in a helical fashion from the lung bases through the symphysis pubis on one of two CT scanners: a 64-detector row (Lightspeed VCT; GE Healthcare, Waukesha, WI) or a 320 detector-row (Aquilion ONE; Toshiba Medical Systems, Otawara, Japan) scanner. Enteric contrast was administered routinely unless the child was unable to tolerate oral intake, and nonionic-iodinated contrast was administered via peripheral IV for all studies. Examinations were acquired using automatic tube current modulation with minimum and maximum tube current (mA) determined by patient weight. At institution B, trauma CT scans of the abdomen and pelvis were acquired in a similar fashion to those at institution A, with the addition of some studies performed on a 16 detector-row scanner (Lightspeed; GE Healthcare). No enteric contrast was administered for studies performed at the second center. Examinations on the 16 detector-row scanner were acquired with a weight-based fixed tube current. Iterative reconstruction was used on the 320 detector-row scanners after 2011. Coronal and sagittal reconstructions were routinely performed at both centers. After the initial diagnostic CT scan, subsequent imaging was only obtained if clinically indicated during the hospital course (for instance, increasing pain, fever, or rising amylase and/or lipase values).

Patient records were then reviewed for admitting diagnosis, injury severity score (ISS), complications, elapsed time to oral diet, length of stay, and complications, including development of pseudocyst, stricture, fistula formation, or recurrent pancreatitis. Because the most common complication identified was that of an early traumatic pseudocyst (defined as an organized fluid collection visualized on subsequent CT imaging within 30 d of admission), this was determined to be the primary outcome and was evaluated further. Patients were subsequently grouped according to their grade of pancreatic injury as follows: AAST scale—grades I/II, III/IV/V, and injuries that could not be accurately classified (ductal injury indeterminate on CT scan) as II or III, and Wong scale—minor injuries grade A, deep lacerations grades BI/CI, and complete transections grades BII/CII. Data were then

Table 1 – AAST and Wong grading scale comparison.

AAST scale*		Wong scale†	
Grade	Injury	Grade	Injury
I	Minor contusion/superficial laceration without duct injury	A	Pancreatitis or superficial laceration
II	Major contusion/laceration without duct injury or tissue loss	BI	Deep laceration involving tail of pancreas
III	Distal transection or parenchymal injury with duct injury	CI	Deep laceration involving head of pancreas
IV	Proximal transection or parenchymal injury involving ampulla	BII	Complete transection involving tail of pancreas
V	Massive disruption of pancreatic head	CII	Complete transection of head of pancreas

*Data from Moore *et al.* Organ injury scaling II: pancreas, duodenum, small bowel, colon, and rectum. J Trauma 1990; 30:1427–9.
†Data from Wong YC, Wang LJ, Lin BC, Chen CJ, Lim KE, Chen RJ. CT grading of blunt pancreatic injuries: prediction of ductal disruption and surgical correlation. Journal of computer assisted tomography 1997; 21:246-50.