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REVIEW ARTICLE

Highlights from the scientific and educational abstracts presented at the ASER 2014 Annual Scientific Meeting and Postgraduate Course

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Abstract The American Society of Emergency Radiology (ASER) 2014 Annual Scientific Meeting and Postgraduate Course offered dedicated learning sessions, oral presentations, and digital exhibits on a broad spectrum of topics in emergency radiology, including traumatic and nontraumatic emergencies, quality, communication, education, and technology. This article highlights the scientific and educational abstracts presented at the meeting (Emerg Radiol 21:431–471, 2014).

Keywords American Society of Emergency Radiology (ASER) · Emergency · Radiology · Imaging · 2014 · Highlights

Introduction

The American Society of Emergency Radiology (ASER) 26th Annual Scientific Meeting and Postgraduate Course returned to the west coast this year, descending on Portland, Oregon, for the first time in its history. This year, over 360 attendees took part, representing 19 countries and varied practice settings. Nearly 1/4 of the participants were registered as "in-training." The program kicked off as usual with the 2-day "Trauma Head-to-Toe" imaging review course, encapsulating both time-honored and novel imaging principles of the acutely traumatized patient. A digital audience response system was introduced this year as a tool to enrich learner experience through audience participation during case-based sessions. Yet, another addition was a series of panels on emergency radiology staffing and imaging protocols for blunt cerebrovascular injury and whole body computed tomography (CT), led by leaders from prominent emergency radiology centers in the USA. The Friday session explored questions and challenges relevant to a rapidly unifying identity of the subspecialty itself, such as optimizing emergency radiologist throughput, defining the scope of emergency radiology for maintenance of certification, and laying the groundwork for establishing an emergency radiology fellowship.

During each of three scientific sessions, emergency radiology faculty and trainees presented data on their original research and fielded questions from the audience; participant emergency radiology acumen was put to the test with several unknown "cases-of-the day" displayed throughout the conference; and over 130 educational and scientific posters were exhibited at this year's meeting. Abstracts from the oral scientific sessions and poster exhibits were published in the October 2013 issue of *Emergency Radiology Emergency Radiology*. A synopsis of select presentations follows.

Traumatic emergencies

Trauma is the leading cause of death in the USA in individuals 1–44 years and the third leading cause of death in adults 45–64 years [1]. At the same time, emergency department (ED) visits continue to escalate unabated in the USA, and as the final provisions of the Patient Protection and Affordable Care Act are rolled out, the rate of ED utilization is projected to steadily increase [2]. Though there has been a decrease in all-site CT utilization in the USA in recent years, perhaps as a consequence of heightened attention to risks associated with

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ionizing radiation, the ED is the only setting that has seen an increase in CT utilization, and overall medical imaging ordered through EDs continues to grow at a significant pace [3]. The common denominator of these factors is an ever-growing volume of medical imaging originating from the ED, and accordingly, the central role that the emergency radiologist can expect to play at the nexus of the treatment and evaluation process of the acutely injured patient.

Neuroradiological trauma

Traumatic orbital injuries are a common presentation in the ED. Accurate interpretation of orbital trauma by the emergency radiologist can decrease the risk of loss of vision or ocular deformity. Arneja et al. focused on common and uncommon traumatic injuries to the orbit, including the imaging features of wooden foreign bodies, gunshot wounds, complex orbital fractures, globe rupture, and retinal hemorrhages [4]. Acknowledging that radiologists often focus on documenting bony trauma of the orbit, Rolen et al. discussed often subtle orbital soft tissue injuries, such as hyphema, corneal laceration, traumatic cataract, and choroidal detachments. For example, the classic feature of choroidal detachment is a biconvex configuration reflecting the accumulation of blood between the choroid and sclera [5].

A significant proportion of patients involved in severe trauma, such as motor vehicle and automobile versus pedestrian collisions, open vehicle accidents and falls, will suffer facial injuries. Whitesell et al. reported on both the incidence and clinical predictors of facial fractures in the setting of whole body CT for trauma, as well as clinical outcomes of facial fractures. In a study of 500 patients, the authors reported that the absence of any facial physical exam findings reliably excluded facial fractures (negative predictive value of 96.4 %), and no patient in this group required operative management. Additional clinical factors that were positively associated with facial fractures included Glasgow coma scale ≤8, Injury Severity Score ≥16, intubated status, and loss of consciousness at the time of injury. Additionally, patients with facial fractures were more likely to be hospitalized and admitted to the intensive care unit with a longer average inpatient stay, and more likely to be transferred to inpatient rehabilitation facilities [6]. A review of facial fracture patterns was also presented this year by Mkpolulu and Patel, detailing the anatomy, epidemiology, mechanism, and classification of facial injuries [7].

CT is the standard of care for the evaluation of cervical spine injuries in the setting of polytrauma. Although cervical spine fractures and facet dislocations are readily apparent, subtle soft tissue injuries may elude even the most experienced radiologist. Myers et al. discussed subtle and more obvious clues to soft tissue injury on trauma cervical spine CT, including ligamentous and muscular injury, disk injury, and epidural hematoma, and included an overview of management [8]. Garg et al. also discussed cervical spine injuries, reviewing unstable cervical spine injury patterns on CT, magnetic resonance imaging (MRI), and plain radiography [9].

Thoracic trauma

Traumatic injuries to the thorax can affect many vital structures, such as the heart, lungs, major vasculature, and osseous structures. Havey et al. reviewed mechanisms of sternal trauma, including direct and indirect patterns of injury, as well as thoracic injuries related to deceleration. A sternal fracture in conjunction with a thoracic vertebral body fracture, for example, represents a flexion-distraction injury that amounts to an unstable thoracic spinal injury until proven otherwise. A notable entity associated with sternal trauma is tracheal injury resulting from compression between the sternum and the thoracic spine, with lacerations of the trachea commonly located 2 cm from the carina. Blunt cardiac injury can also be associated with sternal fractures and may manifest as hemopericardium or extravasation of contrast from a cardiac chamber [10]. Pulmonary contusions are a frequently observed consequence of blunt thoracic trauma, whereas pulmonary arterial extravasation is relatively uncommon. Yokota et al. discussed the significance of pulmonary arterial extravasation in polytrauma patients and proposed management guidelines. Pulmonary arterial extravasation is associated with an elevated mortality rate, which is proposed to be related to uncontrolled bleeding aggravated by trauma-related coagulopathy. Strict imaging surveillance is advocated at 15–30-min intervals after extravasation has been detected. If exacerbation of the bleeding occurs during this monitoring stage, then surgical intervention is proposed [11].

Musculoskeletal trauma

Musculoskeletal system injury is very common in both polytrauma and single organ system trauma. This year's scientific and educational posters highlighted the full range of musculoskeletal injuries detectable on plain radiography, CT and MRI.

Rolen et al. explored the history and imaging findings of eponymous upper extremity injuries commonly cited in radiology reports. These included familiar names like Edward Bennett and Silvio Rolando (fractures of the base of the first metacarpal) and Harold Hill and Maurice Sachs (cortical depression in the superior posterolateral humeral head associated with anterior glenohumeral dislocation) [12]. Stravrakis et al. reviewed the Neer classification of proximal humerus fractures, demonstrating the utility of 3D volume rendered CT imaging in grading these fractures. The Neer classification takes into consideration involvement of four specific anatomical segments of the proximal humerus and on displacement or angulation of any fracture fragment. These segments include the greater tuberosity, lesser tuberosity, humeral head, and humeral shaft. Displacement is determined by either angulation ≥45° or displacement by ≥10 mm [13]. Patterns of anteroposterior (AP) and lateral compression (LC) injuries of the pelvis were reviewed by Cheekatla and West using the Young-Burgess classification. The characteristics of an LC injury include impaction, overriding apposition, and comminution of the fractures, a horizontal or coronal orientation of the anterior ring fractures and internal rotation of the fractured segment of the pelvic ring. This is in contrast to the AP compression type injuries that are characterized by distraction and external rotation of the fractured segments [14, 15]. Cheekatla and West also reviewed different classification schemes of sacral fractures, including the Denis classification, which assigns zones of the fracture based on the location of the fracture relative to the sacral neural foramina. Zone I fractures are lateral to the neural foramina, zone II fractures traverse the neural foramina, and zone III fractures are medial to the neural foramina. Isler and Roy-Camille modified classification systems were also reviewed [16].

As availability of MRI in EDs increases, so does the need for the emergency radiologist to be familiar with patterns of injury of the extremities, such as the knee, as depicted on MRI. Eickenhorst et al. reviewed MRI findings of various traumatic patterns of the knee, including lateral patellar dislocation and pivot-shift, dashboard, clipping, lateral collateral ligament complex, and patellar tendon injuries. The typical contusion pattern of a lateral patellar dislocation includes the inferomedial patella and lateral aspect of the lateral femoral condyle. It is important to interrogate the medial retinaculum in patellar dislocation injuries, as disruption can be surgically addressed to prevent future dislocations [16]. Myers et al. reviewed the Danis-Weber and Lauge-Hansen ankle injury classifications and how they can be used in conjunction to describe ankle injuries [17]. Avulsion fractures of the foot can be missed on the initial exam and misdiagnosed as ankle sprains due to similar clinical presentations. Rotman et al. illustrated common avulsion fractures of the foot, addressing also mechanism of injury, clinical presentation, and treatment. The most common fracture of the foot is a fracture of the proximal fifth metatarsal. Jones fractures are proximal fifth metatarsal fractures that typically enter the intermetatarsal joint. Pseudo-Jones, or avulsion, fractures occur from ankle inversion and plantar flexion involving the lateral plantar aponeurosis and present with mild tenderness and underlying swelling and ecchymosis. Treatment of avulsion fractures of the fifth metatarsal is usually conservative. Surgical intervention is reserved for cases with displaced fracture, substantial cubometatarsal joint involvement, or comminution [18].

Nontraumatic emergencies

Although trauma imaging plays the starring role in the practice of the emergency radiologist, nontraumatic emergencies, which are decidedly less spectacular, are nonetheless more common, accounting for 70 % of emergency department visits in the USA [19]. Nontraumatic emergencies affect the full range of organ systems, and the emergency radiologist's broad expertise in bread-and-butter nontrauma emergency imaging is often a keystone in next-step patient management. As such, a significant proportion of the educational and scientific offerings at this year's conference was dedicated to nontraumatic imaging.

Neuroradiological emergencies

Imaging plays a crucial role in triaging patients with suspected acute stroke. A recent update in the imaging algorithm for acute stroke put forth jointly by the American Society of Neuroradiology (ASNR), the American College of Radiology (ACR), and the Society of Neurointerventional Surgery (SNIS) was explicated by Grechushkin et al. The primary goal of brain imaging of patients with suspected stroke is to exclude intracranial hemorrhage with noncontrast head CT. In the absence of intracranial hemorrhage, select patients with recent onset of symptoms may undergo chemical fibrinolysis with intravenous (IV) tissue plasminogen activator (tPA). For patients who do not meet tPA treatment criteria but who may nonetheless benefit from reperfusion therapy, either MRI or CT perfusion in conjunction with magnetic resonance angiography (MRA) or CT angiography (CTA) may help determine eligibility for endovascular therapy with selective arterial revascularization. Perfusion imaging is no longer recommended for patients who are not candidates for endovascular therapy. While fibrinolysis is contraindicated in patients with intracranial hemorrhage, CTA is recommended to identify a potential alternative etiology for hemorrhage, such as arteriovenous malformation, aneurysm, or vasculitis [20].

Thalamic lesions are not uncommonly encountered on CT or MRI, and clinical presentation is variable. Chaudhry et al. provided a systematic approach to assessing unilateral and bilateral thalamic pathology. The differential diagnosis for thalamic pathology is broad and includes vascular disease, metabolic disorders, infection, and neoplastic and inflammatory processes. Imaging can help narrow this differential based on bilaterality and the presence of reduced diffusion or hemorrhage. Metabolic disorders implicated in thalamic abnormalities on CT or MRI include Wernicke encephalopathy, osmotic demyelination syndrome, Wilson disease, mitochondrial disorders, Krabbe disease, and solvent inhalation and toxic substance ingestion. On MRI, Wernicke encephalopathy demonstrates areas of T2-hyperintensity in the dorsal medial nucleus of the thalamus without enhancement and with variable reduced diffusion. Associated midbrain and mammillary body abnormalities may also be present. Osmotic demylination syndrome commonly affects the thalamus, external capsule, putamen, and caudate nucleus and is typically symmetrical. Although abnormal T2 signal is often noted in Wilson disease, the putamina and caudate nuclei are preferentially involved in this condition. Thalamic hyperdensity on CT is typically seen in Krabbe disease with corresponding T2-hyperintensity on MRI [21].

Cauda equina syndrome presents with low back pain, sciatica, lower extremity motor weakness, saddle paresthesia, and loss of visceral function. Malhotra et al. reviewed MRI findings of suspected acute cauda equina syndrome. According to the ACR Appropriateness Criteria, MRI of the lumbar spine is the modality of first resort for the evaluation for cauda equina syndrome. The decision to use IV contrast depends on clinical history, i.e., if epidural abscess is suspected or the patient has a known history of malignancy, then contrast may have added benefit. Common causes of cauda equina syndrome include disk herniation, trauma, epidural abscess, postoperative complications, and metastatic and primary neoplasms [22].

Thoracic emergencies

Chest pain as a chief complaint is common in patients presenting to the ED (5–20 %), and nongated chest CTA is often performed to exclude pulmonary embolism or acute aortic syndrome as a cause of chest pain; however, cardiac causes of chest pain may be present on nongated CTA that may be overlooked due to motion artifact. Rigas et al. and Morris et al. explored common causes of cardiac pathology visible on CT. Disease states relating to cardiac size, the myocardium and pericardium, coronary arteries, and valves may have CT correlates. The pericardium normally contains 15–50 ml of fluid, but rapid accumulation or large volumes of fluid within the pericardial space can lead to cardiac tamponade. CT signs of cardiac tamponade include anterior flattening of the heart, enlarged superior vena cava and inferior vena cava, and reflux of contrast into the azygos, hepatic, and renal veins. Measuring the pericardial fluid attenuation can help narrow the differential diagnosis for pericardial effusion: effusions secondary to heart or renal failure typically measure <20 Hounsfield units (HU), but if an effusion measures >20 HU, then malignancy, hemorrhage, or infection should be considered [23, 24].

Tuberculosis (TB) is an established global health issue. While it is fairly uncommon in the USA, recognition of the various pulmonary manifestations of TB with radiography and CT is nonetheless extremely important to ensure proper diagnosis and minimize exposure to other individuals. Baker and Moore reviewed the imaging findings of primary, progressive primary, postprimary, and miliary pulmonary TB. Primary TB is nonspecific and often presents as airspace consolidation, with middle and lower lobe and right-sided predominance. There may be associated ipsilateral lymphadenopathy and/or pleural effusion. When lymphadenopathy is present, it is usually low in attenuation as measured on CT. Progressive primary TB demonstrates worsening of airspace consolditations, possible cavitation, and centrilobular or tree-in-bud nodular opacities. The classic imaging feature of post-primary TB is upper lobe consolidation with cavitation. Tubercular cavities are usually thick-walled and may contain an air-fluid level. Miliary TB is secondary to hematogenous dissemination of TB, which manifests as innumerable nodules less than 5 mm in a random distribution. If TB is suspected, immediate communication with the referring clinician will help facilitate isolation [25].

Abdominal emergencies

Vincent et al. illustrated unusual CT appearances of acute cholecystitis and its complications. Acute cholecystitis is the leading consideration for right upper quadrant pain in ED patients. Although ultrasound is the preferred initial imaging examination, CT may be considered in complex or indeterminate cases. Gallstones, gallbladder distension or wall thickening, pericholecystic fluid or fat stranding, mucosal hyperenhancement, and adjacent hepatic hyperemia are CT findings of acute cholecystitis. It is often possible to identify complications of acute cholecystitis on imaging. Gangrenous cholecystitis may be depicted by sloughed intraluminal membranes, irregular mural enhancement, as well as intraluminal or intramural gas (emphysematous cholecystitis). Intraluminal hyperattenuating fluid would suggest hemorrhagic cholecystitis. Perforated cholecystitis can manfiest as extraluminal gallstones, pneumobilia, or pericholecystic fluid collection [26].

The adrenal gland is often considered a minor character in the otherwise sensational playbook of abdominopelvic emergencies, but adrenal gland emergencies do exist and can be life-threatening, as in the case of hypertensive crisis from pheochromocytoma or bilateral adrenal hemorrhage. Hemorrhage can occur within adrenal myelolipomas, from meningococcal septicemia or metastasis or spontaneously, particularly during pregnancy. Myelolipomas are benign lesions that contain hematopoietic and mature adipose tissue. As such, these lesions may demonstrate loss of signal on chemical shift imaging (in-and out-of-phase) due to their fat content. These tumors are at risk for spontaneous hemorrhage in a size-dependent fashion. Another potentially fatal condition is adrenal insufficiency, which can occur acutely from spontaneous bilateral adrenal hemorrhage or secondary to a chronic process, such as Addison disease or adrenal tuberculosis [27].

Small bowel wall thickening is not an uncommon CT finding in patients presenting with abdominal symptoms in the

ED. As detailed by Vakili et al., recognizing patterns of small bowel wall thickening on CT can assist in condensing the list of diagnostic possibilities. The initial approach to interpreting small bowel wall thickening is to differentiate segmental from diffuse involvement. Segmental wall thickening is attributable to intramural hemorrhage, Crohn disease, lymphoma, infectious enteritis, or intestinal ischemia. Diffuse small bowel wall thickening is seen more commonly in the setting of vasculitis, angioedema, and graft-versus-host disease. Considerable overlap exists between segmental and diffuse small bowel wall thickening with respect to infectious and ischemic causation, and clinical history is necessary in making this distinction. Other findings that can be helpful in evaluating the small bowel wall thickening include a reversed jejunoileal fold pattern in Celiac disease and hypoattenuating mesenteric lymph nodes associated with Whipple disease, tuberculosis, lymphoma, necrotic metastases, as well as Celiac disease [28].

Though the use of oral contrast in abdominopelvic CT was standard in the past, its use in the ED has been shown to increase length of stay, time to diagnosis, and cost without adding diagnostic value. Hanna et al. evaluated the gastrointestinal distribution of oral contrast in the ED setting. Of 1349 abdominopelvic CTs performed, 530 involved the use of oral contrast; however, oral contrast reached the terminal ileum in only 271 (51 %) of cases, contravening its intended function in the remaining 49 %. Bowel pathology was present in 31 % (165/530) of cases, 65 % of which revealed small bowel obstruction. Of note, the ACR Appropriateness Criteria advises against the use of oral contrast in cases of suspected high-grade small bowel obstruction. These data support the existing prevailing practice of foregoing oral contrast with abdominopelvic CT [29].

Pelvic ultrasound is recommended as the initial imaging study in the assessment of pelvic pain in female patients. Cystic adnexal lesions in premenopausal patients are commonly seen on pelvic ultrasound, and the emergency radiologist is then confronted with ascribing clinical significance to these, recognizing that while most are benign and require no further management (e.g., dominant follicle), others may be malignant. Chedrawy et al. outlined imaging findings and management of common cystic adnexal lesions. Simple anechoic cysts measuring ≤3 cm are almost always physiologic and require no follow-up. Simple anechoic cysts measuring 5–7 cm should be followed up with yearly ultrasound, but cysts ≥7 cm should be further evaluated with MRI or surgical consultation. It is important to recognize classic appearances of common complicated but benign adnexal lesions, such as hemorrhagic cysts, endometriomas, and corpora lutea, to avoid misdiagnosis and unnecessary patient anxiety or intervention. Acute hemorrhagic cysts demonstrate heterogeneous intracystic material representing clotted blood; however, as these blood products evolve, a “lace-like” or reticular pattern may emerge. Endometriomas represent extrauterine endometrial tissue deposition and have a characteristic “ground-glass” appearance. Corpora lutea are thick-walled cysts with a characteristic circumferential “ring of fire” on Doppler imaging, corresponding to peripheral vascularity. An important common feature of these benign complicated cystic lesions is the absence of internal Doppler signal. Cystadenomas are benign cystic ovarian surface epithelial neoplasms that may be unilocular or multiloculated. The presence of prominent soft components, wall or septal thickening or mural nodularity suggest malignant cystadenocarcinoma [30].

Musculoskeletal emergencies

One of the most potentially devastating emergencies of musculoskeletal system is necrotizing fasciitis (NF), which is a rapidly progressive infection of the soft tissues involving superficial and deep fascial planes. This entity can be fatal if not promptly treated with surgical debridement and antibiotic administration. Baker et al. discussed the clinical and imaging findings of NF and noted common mimickers. Radiography is nonspecific early in the disease and may be normal or may reveal only soft tissue swelling. Not until the later stages of the disease will soft tissue gas be apparent. CT and MR are used to interrogate the superficial and deep fasciae and can reliably detect gas, nonorganized fluid, or fluid collections within the deep fascia. The addition of IV contrast may reveal nonenhancement of the soft tissues, indicating myonecrosis or confirm the presence of an abscess as a rim-enhancing fluid collection. Mimickers of NF include non-necrotizing (eosinophilic, paraneoplastic, nodular, proliferative, ischemic, and granulomatous) fasciitis, cellulitis, myositis, diabetic myonecrosis, compartment syndrome, and dermatomyositis. The most common confounder is cellulitis, an infectious or inflammatory condition of the subcutaneous soft tissues without deep fascial involvement. If enhancing or thickened fascia is present without soft tissue gas, the leading diagnostic consideration is non-necrotizing fasciitis. Despite the utility of imaging in suggesting the diagnosis, NF is diagnosed clinically [31].

A multimodality review of the imaging characteristics of chronic recurrent multifocal osteomyelitis (CRMO) was provided by Gul et al. CRMO is a chronic inflammatory disorder that typically affects adolescents and young adults and presents with recurrent multifocal bone pain. Tubular long bones and the clavicle are common sites of involvement with a predilection for the metasphyseal portion. Early imaging findings include lytic regions in the medullary cavity with reactive sclerosis appearing at 1 to 2 weeks. Sclerosis and hyperostosis become the dominant feature as the disease progresses. The differential diagnosis includes chronic infectious osteomyelitis, metastases, systemic mastocytosis, tuberous sclerosis, and multiple osseous infarcts. Treatment of CRMO is immunosuppressive therapy with glucocorticoids and interferon gamma. CRMO has a good prognosis, and most lesions completely resolve following treatment [32].

Pediatric emergencies

Radtke and Cohen reviewed both classic and newly recognized radiographic and sonographic features of hypertrophic pyloric stenosis (HPS). Infants with HPS present with nonbilious vomiting and dehydration and is best evaluated with ultrasound, which performs with nearly 100 % sensitivity and specificity. Sonographic findings in HPS are the target/donut sign (hypoechoic thickened wall around echogenic mucosa), mucosal heaping/antral nipple (redundant pyloric mucosa protruding into the antrum), and the double track sign (parallel echogenic lines in the lumen of the pyloric channel). The classic radiographic/fluoroscopic signs include the caterpillar (hyperperistaltic gas-dilated stomach), string (small barium streak through narrowed pyloric channel), antral beaking (mass impression upon the barium-filled antrum), and double track (parallel streaks of barium with an interposed radiolucent band) signs. Pylorospasm can be potentially confused with HPS. HPS is favored over pylorospasm when there is persistent wall thickness of 3–4 mm and pyloric length of 14–18 mm [33]. Sur et al. explored the common causes of abdominal pain in the pediatric patient, including intussusception, which is the most common cause of intestinal obstruction in children 3 months to 5 years. The classic ultrasound finding in intussusception is the presence of a tubular structure in the right lower quadrant with alternating concentric hyperechoic and hypoechoic regions. The hallmark appearance on radiography is a right upper quadrant abdominal mass with co-incident small bowel obstruction. These features represent the ileocolic type of intussusception, which is the most common form. Meckel diverticulum is a surprisingly common congenital intestinal anomaly that usually originates from the distal ileum. Sonographic findings of a Meckel diverticulum include a fluid-filled, blind-ending, thick-walled structure connected to normal peristaltic segment of small bowel. Complications include intussusception, gastrointestinal hemorrhage, and Meckel diverticulitis [34]. Parmet et al. discussed the use of 99-m technicium pertechnetate scintigraphy to assist in differentiating a Meckel diverticulum from other causes of gastrointestinal hemorrhage. If ectopic gastric mucosa is present, radiotracer uptake accumulates within the expected location of the diverticulum. Other causes of acute gastrointestinal bleeding were reviewed, including necrotizing enterocolitis, infectious colitis, peptic ulcer disease, and Henloch-Schönlein purpura [35].

Acute appendicitis is the most common clinical indication for cross-sectional imaging in children presenting with acute abdominal pain. Increasing concerns related to the use of ionizing radiation from medical imaging has resulted in a growing preference for ultrasound and MRI for the initial evaluation of acute appendicitis in the ED pediatric patient. Myers et al. reviewed sonographic findings of acute appendicitis. These include a dilated and enlarged appendix measuring >7 mm in diameter, noncompressibility, hyperemia, and periappendiceal inflammation/fluid. Low et al. and Myers et al. also reviewed the MRI finding of acute appendicitis, which include appendiceal diameter >7 mm, wall thickness >3 mm, and T2-hyperintensity within the appendiceal wall and periappendiceal area. Diffusion-weighted imaging also has a high sensitivity and specificity for acute appendicitis [36, 37]. Some of the technical limitations of MRI include image degradation from patient motion and slice selection/thickness. Cognitive errors in interpretation may relate to misattribution of nonspecific inflammatory changes in the right lower quadrant to inflammation secondary to appendicitis.

Pediatric fractures were again prominently featured this year. Goud and Patel reviewed the spectrum of pediatric elbow injuries and referenced the "CRITOE" mnemonic for the temporal order of appearance of ossification centers of the elbow in interpreting elbow injury on plain radiography. Generally, elbow ossification centers appear in a progressive manner according to the following timeline: capitellum (C) at 1 year, radial head (R) at 3 years, medial epicondyle ("I"nternal) at 5 years, trochlea (T) at 7 years, olecranon (O) at 9 years, and lateral epicondyle ("E"xternal) at 11 years of age. The authors reviewed the importance of assessing normal alignment of the elbow on lateral radiography as evaluated by the anterior humeral line and the radiocapitellar line. The anterior humeral line is drawn along the anterior aspect of the humerus on the lateral radiograph and should intersect the middle third of the capitellum. If the line intersects the anterior third of the capitellum, then a supracondylar fracture should be considered. The radiocapitellar line is drawn along the long axis of the radius and should intersect the capitellum on all views. If the line does not intersect with the capitellum, then the radial head is subluxed or dislocated. The most common elbow fracture in the pediatric population is a supracondylar fracture, which can be graded according to the Gartland Classification. A type 1 fracture is nondisplaced, a type 2 fracture is displaced but with intact posterior cortex, and a type 3 fracture is completely displaced. The second most common fracture is a lateral epicondylar fracture. The search pattern for the elbow should include an assessment for joint effusion. The anterior fat pad is revealed as a band-like lucency anterior to the distal humerus on flexed lateral view. The posterior fat pad is normally not visualized. When the elbow joint is distended with fluid or blood from a fracture, the anterior fat pad is displaced superiorly and conforms to a triangular configuration, referred to as the anterior fat pad sign, or "sail sign." An effusion also results in displacement of the posterior fat pad from the olecranon fossa and groove, and its appearance is termed the posterior fat pad sign [38].

Imaging in pregnancy

First trimester ultrasound is a common sonographic procedure performed in the ED for a variety of presentations, such as pelvic pain, suspected ectopic pregnancy, and evaluation of complications of early pregnancy. Advances in ultrasound technology have led to improved visualization of late first trimester fetus and present an early opportunity to detect fetal structural anomalies. DelProposto and Rheinboldt illustrated several of these congenital conditions. Cranial anomalies include open rhombencephalon (7–9 weeks), encephalocele (14 weeks), anencephaly, and acrania (10–14 weeks). Encephalocele is a result of an open neural tube defect in which meninges with or without brain herniation outside the calvarium and is most commonly located at the posterior midline (75 %). Gastroschisis and omphalocele can also now be detected on late first trimester ultrasound. The authors emphasize that umbilical herniation should not be present when the crown-rump length (CRL) exceeds 45 mm [39]. Knowledge of normal and anomalous appearances of the umbilical cord is essential. Umbilical cord anomalies were presented by Huang and Troiano and include a single umbilical artery, umbilical cord cyst, marginal and velamentous cord insertion, and vasa previa. The normal umbilical cord has two arteries and one vein and should insert onto the center of the placenta. Though rare (1 % prevalence), a single umbilical artery is associated with an elevated risk for intrauterine growth restriction (IUGR), renal and cardiac anomalies. On ultrasound, a single umbilical artery is present when the umbilical vein and unpaired umbilical artery are depicted as the "two vessel sign," optimally visualized on transverse view of the umbilical cord. Marginal cord insertion is also associated with IUGR and is characterized by umbilical cord insertion <2 cm from the placental edge. Marginal cord insertion may progress to a velamentous cord insertion (adjacent to placenta, directly onto the uterine wall), which carries a higher risk of serious complications, including placenta previa and vasa previa [40].

As in nonpregnant patients, right lower quadrant pain in pregnant women may be secondary to acute appendicitis. Appendectomy is the most common nonobstetric surgical procedure in pregnancy with a fetal loss rate of 3–5 % in unruptured appendicitis and 20–25 % in ruptured appendicitis, highlighting the magnitude of an accurate diagnosis. In most adult patients with suspected acute appendicitis, abdominopelvic CT is the imaging study of choice; however, CT is generally unsuitable in pregnant patients. Low et al. discussed the use of MRI in this setting. MRI features of appendicitis are the same as previously discussed in the pediatric section; however, the appendix is preferentially displaced superiorly in the second and third trimester due to mass effect from the gravid uterus. Common mimickers of acute appendicitis on MRI include obstructive hydronephrosis, acute cholecystitis, colitis, and neoplastic processes [41].

Vascular imaging

Traumatic and nontraumatic vascular emergencies are potentially life-threatening, and early diagnosis and treatment are essential. Spak and Chinapuvvula discussed various abdominal aortic emergencies, including traumatic aortic injury (TAI), intramural hematoma, ruptured aortic aneurysm, aortic dissection, and graft endoleak. Traumatic aortic injuries are rare but can result from both blunt or penetrating injury. There are four major categories of TAI, including intimal tear (21 %), large intimal flap (39 %), pseudoaneurysm (11 %), and rupture (29 %). Intramural hematoma occur secondary to traumatic injury, penetrating atherosclerotic ulcer or spontaneously. Retroperitoneal hematoma is the most common finding in abdominal aortic aneurysm rupture. A contained rupture is suspected when the posterolateral aortic wall is poorly distinguished from adjacent structures or is closely applied along the contour of the spine. This appearance is termed the "draped aorta" sign [42].

Vascular injuries of the extremities can be evaluated quickly and accurately using CTA. Prompt and accurate identification of vascular injuries is imperative for adequate treatment. Solberg and Brunner discussed CTA findings of pseudoaneurysm, arteriovenous fistula, dissection, transection, occlusion, and active extravasation of contrast. Pseudoaneurysms, which may present as a pulsatile mass clinically, will be depicted as an outpouching involving, or a contrast-filled sac adjacent to, the artery in question on CTA. Arteriovenous fistulas, classically presenting as a palpable "thrill" on clinical exam, can be diagnosed on CTA by early venous enhancement during arterial phase. Vessel disruption or occlusion is readily apparent on CTA and can result in diminished peripheral pulses or, when a large artery is occluded or transected, a pale and cold extremity. It is important to remember that arterial spasm may prevent visualization of active contrast extravasation in the setting of artery transection [43].

Quality

Do telephone call interruptions have an impact on radiology resident diagnostic accuracy? This is the question that Balint et al. explored to evaluate whether reading room disruptions adversely impact accuracy. In this study, discrepancy reports and reading room telephone logs were collected over a 13-month period. Telephone call volume and preliminary report time stamps were compared between “discrepancy shifts” and “no discrepancy shifts.” Though the average number of telephone calls for the “discrepancy shifts” was slightly higher than the “no discrepancy shifts,” the difference did not attain statistical significance; however, there was a statistically significant increase in the average number of phone calls in the hour preceding the generation of a discrepant preliminary report. Specifically, one additional phone call was associated with a 12 % increased risk of a subsequent resident error an hour later, signaling a delayed effect on interpretation accuracy. Consequently, efforts should be made to reduce the number of reading room disruptions in order to improve study interpretation [44].

Aside from interpreting medical imaging, radiologists can play a valuable role in providing certain noninterpretive services, such as intervening when errors occur at the time of radiology study ordering by clinicians. Ordering errors are unfortunately common and may be immediately harmful (e.g., administering intravenous contrast to a patient with known anaphylaxis to contrast) or delayed (e.g., contrast-induced nephropathy and radiation effects). Rolen et al. evaluated ordering errors in 4440 CT examinations performed over a 19-month study period. Twenty-four percent (1059) of these CT orders contained errors. The four most common ordering errors were reported as missing serum creatinine (39 %), missing pregnancy status (18 %), wrong modality (16 %), and inappropriate clinical indication (11 %). IV contrast-enhanced examination ordered on a patient with known history of contrast allergy occurred in 2 %. Radiologists can play an enhanced role in patient safety by identifying and rectifying such foreseeable errors [45].

Emergency radiology workflow and turnaround time

One of the major purported advantages of having a dedicated emergency radiology (ER) division is improved report turnaround times. McMenamy et al. reported on final read turnaround times comparing a single-person ER reader and a group of multiple organ-based subspecialty readers. Report turnaround time was markedly statistically faster in the dedicated ER reader arm (36±26 min versus 115±77 min). Additionally, the authors noted that a dedicated emergency radiologist can provide services to the ED by virtue of his or her proximity to the ED and unique expertise in emergency imaging, such as assisting in study selection, reviewing acquired images near real-time and alerting the clinician of emergent findings, and determining whether excretory phase imaging or CT cystography would be beneficial before the patient leaves the scanner [46].

As clinicians, patients and evolving standards of care more and more demand around-the-clock imaging interpretation, a number of 24/7 radiology practice models are emerging. Brunner et al. delineated six such models of coverage in academic centers, enumerating their various advantages and disadvantages. The traditional academic model is typified by subspecialty attending-level coverage during normal work hours with an overnight resident providing preliminary reports. Other paradigms include an evening “swing” shift for attending staff with subsequent overnight resident coverage at the end of that shift, teleradiology for after-hours service providing preliminary interpretations, subspecialized teleradiology 24/7 coverage, and an in-house ER division [47]. Rolen et al. also discussed different models for after-hours attending-level coverage. These include the “generalist” model (non-ER fellows and radiology subspecialists working in the capacity of a generalist radiologist), the “subspecialist” model (interpretations for exams originating from the ED provided by subspecialists corresponding to area of expertise), the “ER subspecialist” model (faculty who work predominantly in the emergency radiology reading room and/or are ER-fellowship trained), and the “teleradiology” model (faculty and fellows who assist with inpatient and satellite workflow from home). Due to the growing number of imaging studies performed outside of the traditional workday, many radiology departments at academic centers are supplementing resident call coverage with dedicated attending-level coverage. Accordingly, radiology departments may have to adopt a “staggered shift” paradigm to ensure more comprehensive off-hour interpretation services [48].

Conflict of interest The authors declare that they have no conflict of interest.

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ASER 2014 Annual Meeting Awards

Gold Medalist
Shanmuganathan Kathirkamanathann, M.D.
University of Maryland Medical Center
Baltimore, MD

Founders' Lecturer
C. Craig Blackmore, M.D., MPH
Virginia Mason Medical Center, University of Washington
Seattle, WA

2014 ASER Fellows
Sravanthi Reddy, M.D.
LAC+USC Medical Center, Keck School of Medicine
Los Angeles, CA
Douglas R. Katz, M.D., FACR
State University of New York at Stony Brook – Winthrop University Hospital
Mineola, NY

Harris Award
David Tso, M.D., Vancouver General Hospital, Vancouver, BC, Canada, for *Predicting Mortality from Hypovolemic Shock Complex in the Polytrauma Setting.*

Novelline Award
Adam Sipe, M.D., Mallinckrodt Institute of Radiology, Saint Louis, MO, for *Red Connection: A Pictorial Review of Aortic Fistulae.*

Scientific Paper Presentation Winners
Summa Cum Laude
Aaron Sodickson, M.D., Ph.D., Brigham and Women's Hospital, Boston, MA, for *Dual Energy Post-Processing of Incidental Renal Lesions Encountered in the Emergency Department: Reducing the Need for Follow-up Imaging.*

Magna Cum Laude
David Tso, M.D., Vancouver General Hospital, Vancouver, BC, Canada, for *Predicting Mortality from Hypovolemic Shock Complex in the Polytrauma Setting.*

Cum Laude
Chih Hsu, M.D., Chang Gung Memorial Hospital, Taoyuan, Taiwan, for *Unstable Hemodynamics Do Not Always Make Computed Tomography Scans Unfeasible in the Management of Patients with Multiple Torso Injuries.*

Scientific and Educational Exhibit Winners
Summa Cum Laude
Adam Sipe, M.D., Mallinckrodt Institute of Radiology, Saint Louis, MO, for *Red Connection: A Pictorial Review of Aortic Fistulae.*

Magna Cum Laude
Suresh Cheekatala, M.D., University of Texas Medical School at Houston, Houston, TX, for *Patterns of Young-Burgess Lateral Compression (LC) Pelvic Ring Disruption.*

Cum Laude
Stephen Jones, M.D., Baylor Schott and White Hospital, Houston, TX, for *MR Evaluation of Traumatic Injury to the Brachial Plexus: What the Emergency Radiologist Needs to Know.*

Certificates of Merit
Urvi Fulwadhva, M.D., Brigham and Women's Hospital, Shrewsbury, MA, for *Bowel Pathology in Color versus Shades of Gray: Understanding Bowel Diseases with Use of Dual Energy CT and Iodine Maps.*
David Spak, M.D., The University of Texas Medical School at Houston, Houston, TX, for *MDCT Evaluation of Abdominal Aortic Emergencies.*
Diamanto (Amanda) Rigas, M.D., The University of Texas Medical School at Houston, Houston, TX, for *Getting to the Heart of the Matter: Cardiac Findings on Non-Gated Chest CTA in the ED.*

Case of the Day Winner
Daniel Falco, D.O.
John H. Stroger Jr. Hospital of Cook County
Chicago, IL