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REVIEW ARTICLE

Highlights from the scientific and educational abstracts presented at the ASER 2016 annual scientific meeting and postgraduate course

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Abstract The annual meeting of the American Society of Radiology (ASER) took place in San Francisco, California on September 14 through September 17, 2016. Attendees represented the USA as well as international emergency radiology communities, including those from academic, private practice, and teleradiology settings. There were several "members in training" in attendance as well. The meeting again featured the "Trauma Head to Toe" 2-day didactic course, highlighting various important topics on imaging of traumatic injuries. Scattered throughout the 4 days were several poster and case of the day presentations, scientific sessions, and self-assessment modules. The following is a summary of the educational posters and scientific papers.

Keywords American Society of Emergency Radiology (ASER) · Emergency radiology · Imaging, 2016 · Highlights

Introduction

The annual meeting of the American Society of Radiology (ASER) took place in San Francisco, California on September 14 through September 17, 2016. Attendees represented the USA as well as international emergency radiology communities, including those from academic, private practice and teleradiology settings. There were several "members in training" in attendance as well. The meeting again featured the "Trauma Head to Toe" 2-day didactic course, highlighting various important topics on imaging of traumatic injuries. Scattered throughout the 4 days were several poster and case of the day presentations, scientific sessions, and self-assessment modules. The following is a summary of the educational posters and scientific papers.

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Educational posters

Traumatic emergencies

A handful of posters focused on neuroradiological trauma. Two posters specifically focused on cervical spine MR. Israr et al. gave an extensive educational review of cervical spine trauma. Noteworthy points include the presence of cord hemorrhage signifying a poor clinical prognosis as well as the use of MRA and axial T1W imaging for the evaluation of dissections and vascular injury [1]. Pajcini et al. proved that MR had a high frequency of positive findings (most commonly ligamentous injury) despite negative C-spine CT. Whether or not the MR findings impacted clinical management was not assessed [2].

Spence et al. studied the effect of body mass index on cervical spine injury incidence. Their data showed a statistically significant decreased relative risk of cervical spine injury in the obese population compared to patients who are underweight or normal weight [3].

The craniocervical junction region and clivus portion of the skull base were discussed in detail in three separate posters. In their discussion of the clivus, Zhang et al. discussed the poor prognosis of longitudinal clivus fractures, which has a high incidence of mortality. It was also noted that clivus fractures

are only rarely isolated fractures. They are frequently associated with maxillofacial and temporal bone fractures [4].

The remainder of the cervical spine spectrum was discussed in detail by Shlapak et al., noting the importance of the AOSpine classification system for the purposes of communication of pertinent clinical information among physicians [5]. Madhuripan et al. provided additional detail on the mechanisms of these fractures with the purposes of better detection of all fracture components and appropriate further imaging when needed [6].

A minority of posters focused on thoracic trauma. Tayyab et al. provided an insightful discussion on upper airway trauma. The thyroid is the most commonly fractured component of the larynx. Occult injuries may be suggested indirectly, when there is massive subcutaneous emphysema, which is out of proportion to an associated pneumothorax [7]. Multiple CT indications for surgical exploration were also discussed. Kumar et al. reviewed the entire airway but also emphasized the importance of multiplanar reformats and lung windows to better detect these injuries [8].

Multiple posters focused on abdominopelvic trauma. Two focused on bleeding in pelvic fractures, both by Dreizen et al. In one study, they concluded that classic predictors of arterial extravasation at angiography, namely IV contrast "blush" on CT, are both insensitive and nonspecific. Hematoma volumes, determined using segmentation software, are more highly predictive of a true positive on angiography. In a second study, they concluded that the pelvic binders, the accepted noninvasive stabilization in pelvic fractures might not always be beneficial. While it is likely that the improved reduction with binders results in reduced hemorrhage in rotationally unstable fractures, in vertically/globally unstable injuries, binders not only fail to reduce any of the caliper measurements, but worsened AP and vertical distortion about the pubic symphysis. This consequently leads to poor tamponade [9, 10].

Another two posters raised the issue of single contrast versus triple contrast CT in evaluating hemodynamically stable patients with penetrating abdominopelvic trauma. While not yet proven without doubt, Jawad et al. favors a single contrast technique at this time with flexibility for the administration of enteric contrast in equivocal cases [11, 12].

A scientific poster by Song et al. nicely confirmed previous notions that the AAST splenic trauma classification is insufficient for making decisions regarding invasive intervention, without the support of CT findings. In their study, despite a low AAST score (grade 1–2), logistical regression analysis showed a significantly higher intervention rate when the key word "active" (extravasation) was present in the radiology report [13].

Comprehensive educational posters were also submitted describing traumatic retroperitoneal hemorrhage and multimodality genitourinary trauma.

In the musculoskeletal trauma arena, two similar educational posters were presented reviewing thoracolumbar spine injuries. Wertz and Hunt reviewed the AO Classification System [14]. Caruso and Lo reviewed the newly described TLICS system. The latter classification emphasizes the importance of the posterior ligamentous complex in addition to the bony fractures in directing the optimal surgical approach [15].

Mansouri et al. studied Lisfranc fractures and concluded that the ACR recommendation for plain film work up may be inefficient for fracture detection, seeing that up to 20% of studies in their data set and other literature studies were initially reported as negative. The recommended work up with CT/MR instead when patients were representing to ED with persistent or worsening symptoms suspicious for a Lisfranc fracture [16].

Educational reviews by Irish et al. and Rhea et al. focused on the classification systems for scapular and clavicular fractures, respectively, with their consequent management implications [17, 18]. Mehta et al. discussed with rib fractures and surgical management. Clinical indications for surgical rib fixation in the acute setting include three or more rib fractures with displacement greater than one rib width, flail segment, or uncontrolled pain despite adequate analgesia. Surgical stabilization is contraindicated in patients with severe pulmonary contusion [19].

Posters dedicated to pathology in and around specific bones/joints were also presented. This included the hip, knee, ankle, foot, talus, and heel. Wilson and Habra demonstrate the utility of MR imaging in acute hip pain, noting that MR provides a comprehensive assessment beyond detection of occult fracture [20]. Two posters by Mandell et al. and Mehta et al. describe the gamut of lower extremity stress fractures in detail on multiple modalities [21, 22].

Nontraumatic emergencies

As expected, a number of exhibits in this subsection focused on the topic of cerebral ischemia. Of note, Lane et al. presented a thorough review of the state of the art imaging and clinical triage for evaluation of stroke at their institution. They reemphasized the now central idea that IV thrombolytic therapy in appropriately selected patients with proximal vessel occlusion is beneficial. Multiple large trials including MR CLEAN, ESCAPE, SWIFT PRIME, EXTEND 1A, and REVASCAT all show benefit for endovascular intervention when criteria are met and AHA recommends endovascular treatment in the acute setting. In addition to imaging with CTA and CTP, the Alberta Stroke Program Early CT Score (ASPECTS), Modified Rankin Scale, and NIH Stroke Scale were emphasized as complementary to the triage of these patients [23]. Bardon et al. presented a poster on acute ischemic stroke secondary to calcific cerebral emboli, a topic which is unknown to many radiologists. Identification of calcific embolus is important since it allows immediate diagnosis of stroke. Additionally, stroke due to calcific emboli may require

modified approach to investigation, treatment, and secondary prevention [24].

The remaining exhibits covered a wide breath of topics including a review of neck spaces by Arneja et al. [25]. Bordia et al. noted coagulopathy as the most common and recallable cause of subdural hemorrhage in their discussion of atraumatic etiologies of subdural hemorrhage [26]. Non-ischemic (cranial nerve) pathology mimicking strokes by Goodin and Peterson discussed entities such as pseudoaneurysm, Bell's palsy, metastatic disease, and nerve root avulsions as important pathologies to diagnose, since their identification would prevent unnecessary and potentially dangerous thrombolytic therapy [27]. Goodin and Peterson also discussed postoperative complications following transphenoidal surgery. Some of the main complications postsurgery best detectable by imaging includes CSF leak, tension pneumocephalus, meningitis, and carotid cavernous fistula [28].

Multiple practical educational posters were submitted in this section. A few posters focused on the cardiac box region including pericardial and myocardial emergencies as well as typical arterial and venous vascular lesions. As emphasized by the Archer-Arroyo et al. poster, MDCT is the workhorse for diagnosis of these pathologies in the emergent setting, being both highly sensitive and accurate [29].

In evaluating pulmonary edema, Cusma and Perone nicely point out the most important limitations of imaging in distinguishing the etiology of the edema (i.e., cardiogenic versus non-cardiogenic in nature). In particular, there is an overlapping imaging appearance when it comes to "batwing edema." Additionally, both cardiogenic and non-cardiogenic causes can occur in the same patient simultaneously [30].

Uncommon but important chest infections were discussed by Droukas et al. Many of these entities including empyema would require more than simple antibiotic medical management. This knowledge would be of critical importance to the ED providers in the acute setting [31].

Fulwadhva et al. nicely described some of the newer cardiovascular procedures/devices and their normal appearance as well as complications seen on imaging. This included cardiopulmonary bypass and left ventricular assist devices [32].

By far, the largest number of posters was in the realm of atraumatic abdominal and pelvic imaging. Multiple posters focused on non-pregnant woman's pelvic imaging diagnoses including ovarian torsion on ultrasound, but also importantly on CT. In the near future, MR will also be used more readily. Regardless of modality, unilateral ovarian enlargement (greater than 4 cm) is the most consistent finding, as described in the Lopez-Araujo et al. poster [33]. Other common and rare female acute pelvic pathologies were also described with teaching points and follow-up. The educational poster by Tran-Harding and Owen emphasized CT appearances of gynecological pathologies, since CT may be more expeditious in a busy emergency department. They reviewed normal variations in uterine enhancement patterns as well as the more common and diverse pelvic pathologies on CT including sigmoid ovarian fistulas and postablation synechiae [34].

A detailed poster by DeMaris et al. reviewed the rare but hyper acute condition of uterine rupture. Given that the standard treatment of uterine rupture with decelerated heart rate is delivered within 18 min, it is imperative that sonographers and radiologists be aware of the possibility of this entity in cases where the uterus has some form of scarring and can be at risk of rupture [35].

Numerous posters evaluated the gastrointestinal tract, with the greatest emphasis placed on the appendix. Krishna et al. poster on the equivocal appendix emphasized the use of the Likert Scale when reporting cases of appendicitis to describe the likelihood of appendicitis based on the scan. This helps the surgeon in their decision-making and reduces the likelihood of miscommunication [36]. Fulwadhva et al. presented a scientific poster whereby they reported that most of their patients with pathologically proven appendicitis had an Alvarado score greater than or equal to four. They also suggested that the Alvarado score could be used to determine which imaging exam is the most appropriate first step in the work up of appendicitis [37]. Bokhari et al. scientific poster showed greater sensitivity with the use of a pediatric head probe (compared to a standard adult linear probe) for the diagnosis of appendicitis when performed by experience radiologists [38]. Moving beyond the appendix, Choe et al. demonstrated multiple cases of bowel pathology using ultrasound. It appears that the value of ultrasound in evaluation of bowel is underestimated with a common misconception that only little information can be obtained about bowel with ultrasound. In fact, diseased bowel can be easily imaged with ultrasound [39]. Fernandez et al. submitted a very informative poster on colonic diverticulitis, suggesting the use of a Modified Hinchey Classification for selecting between medical and surgical management of diverticulitis patients. Preliminary data at their institution suggests that specific CT findings like pericolonic fluid collection, Hinchey classification >Ib, and presence of fistula correlate with a higher likelihood of need for surgery as compared to free fluid and free air, which play a more limited role than previously thought [40, 41]. Two posters focused on opiate abuse complications in what is now seen to be an epidemic in the USA. Both used a multisystem, multimodality approach.

A small subset of posters revisited biliary emergencies. Spain et al. focused on CT features of these pathologies. Of note, the NPV of CT for acute cholecystitis is 89%, allowing relative exclusion of the disease in the setting of low clinical suspicion [42].

Another subset of posters focused on the genitourinary tract. Fani et al. submitted a poster that suggested that urinalysis and ultrasound would be better for the work up of urolithiasis in women as compared to non-contrast CT. This was

based on their data (and other previous studies) that showed that the likelihood a positive diagnosis of a ureteral calculus using non-contrast CT of the abdomen and pelvis was statistically significantly higher in men compared to in women presenting with flank pain/clinically suspected urolithiasis [43]. Krishna et al. comprehensively reviewed testicular ischemic pathologies unrelated to classic torsion, with multiple useful clinical pearls [44].

A comprehensive exhibit was set forth by Kumari et al., providing a single resource for up to date guidelines on the appropriate management of the most commonly encountered incidental findings in the ED [45].

With regard to emergency department abdomen/pelvis protocols, Li et al. questioned the utility of IV contrast versus non-contrast technique in patients with bacteremia. They found that among patients with bacteremia, non-contrast CT is not inferior to contrast enhanced CT of the abdomen and pelvis, with exception of *Klebsiella pneumoniae* bacteremia, which showed a higher yield. However, this was in the setting of a small sample size [46].

Sarcopenia is an objective measure of frailty that can be measured by CT and used to identify vulnerable elderly patients. Uyeda et al. evaluated sarcopenia via CT and found that all sarcopenia assessment methods were predictive of 1-year mortality in elderly patients undergoing emergency abdominal surgery [47].

A handful of exhibits in this section reemphasized the importance of diagnosing infectious processes, including cellulitis, pyomyositis, osteomyelitis, and necrotizing fasciitis. Patel et al. note that IV gadolinium is useful but not essential for diagnosis of osteomyelitis. It is however, helpful in the identification of abscess and sinus tracts [48]. As shown by Rhea et al., the necrotizing soft tissue infections are well characterized by CT. Gas within fascial planes is the most characteristic finding (pathognomonic in the absence of penetrating trauma and biopsy) but is not a requisite for necrotizing fasciitis [49].

The previously less-discussed pathologies of acute myositis (due to poor sensitivity on plain film) are now well visualized by MRI and can be readily diagnosed by ED radiologists. Israr et al. included the full of spectrum infectious, inflammatory, and posttraumatic myositis as well as diabetic myonecrosis in their poster [50].

Two posters described the growing role of musculoskeletal ultrasound in the acute setting. As shown by Sever et al., this has even grown to include ultrasound in the diagnosis and management of acute crystalline arthropathy. They cite the 2012 American College of Rheumatology gout guidelines, which were expanded to include sonography for the depiction of early anatomic changes. In a dedicated multimodality poster on gout, Sever et al. also report that the "double contour sign" on ultrasound is 83% specific and 76% sensitive for detection of urate arthropathy. When coupled with suggestive clinical features, ultrasound shows a promising role in early detection. This is of great importance given that radiographic manifestations of gout typically lag considerably behind the inaugural clinical symptoms [51, 52].

A number of posters in this area focused on common areas of confusion including pediatric fractures and their normal variants, appendicitis, and gastrointestinal obstruction, especially intussusception. England et al. describe in detail how to evaluate intussusception, the most common cause of small bowel obstruction in children. They also review the key facets of air and contrast enema for treatment [53, 54].

The increasing role of MRI in evaluation of the pediatric abdomen and pelvis was also emphasized. Aglan et al. describe a 10–25-min protocol of only T2 weighted images without sedation or contrast, which is useful and effective not only for appendicitis but also for appendicitis mimics [55]. Boyce and John describe a 30-min protocol without sedation and contrast that also includes DWI. This yielded a diagnostic performance of 97, 96, 92, and 98% for sensitivity, specificity, positive predictive value, and negative predictive value, respectively [56].

Scientific exhibits also focused on the evaluation of appendicitis. Trexler et al. posit that abdominal wall thickness rather than body mass index (BMI) is a better predictor for successful visualization of the appendix on ultrasound. As such, they propose a more liberal allowance of patient BMI when using ultrasound in children [57, 58].

In addition to the repeat offender, ectopic pregnancy, educational posters also focused on the promising results of MRI utilization during pregnancy. As stated by Vinu-Nair et al. interstitial ectopic pregnancies are the highest risk form of ectopic, due to life-threatening hemorrhage from rupture of myometrial arcuate vasculature. Other more exotic locations for ectopic pregnancies such as the ovary, abdomen, and scar bed were described in detail [59]. Mansoori et al. note that based on ACR (American College of Radiology) data, there is no deleterious effects of MR imaging at 1.5T on the developing fetus [60]. Admoni et al. describe the imaging for non-hemorrhagic adrenal infarction in pregnancy on MR, an uncommon but important cause of pain. This is hypothesized to be due to the intrinsic hypercoagulable state of pregnancy, which predisposes to renal vein thrombosis and ultimately adrenal infarction [61].

Educational posters reviewed the gamut of vascular pathology, ranging from the head and neck, the aorta, the abdomen and pelvis, and the peripheral vascular system. George et al. thoroughly discuss blunt injuries in the head and neck and their management implications. Antithrombotic therapy with anticoagulant or platelet inhibitors for at least 3–6 months is recommended in patients with extra cranial carotid or vertebral dissection associated ischemic stroke or TIA. If ischemic neurological symptoms do not respond to antithrombotic therapy, stenting may be considered for acute carotid artery dissection [62]. Baumel et al. discuss traumatic aortic injuries and

their management based on the Vancouver simplified grading system. All but grade 1 injuries (intimal flap, thrombus, or hematoma <1 cm) require surgical intervention. Atraumatic aortic disease, namely aortic aneurysms, is already known to be deadly when they rupture [63]. Sever et al. review the MDCT features of unstable aneurysms before frank rupture. Signs of potential instability seen at CT imaging including hyperattenuation of mural thrombus, rapid aneurysm expansion, low thrombus to lumen ratio, disrupted intimal calcifications and saccular outpouching, as well as draping of the posterior aortic contour over the spine [64].

In patients requiring angiography for GI bleeding, a poster by Hsu et al. posit that CT angiography results in a faster time to angiography than tagged RBC scan. This suggests a continued expansion in the role of CT angiography in the work up of GI bleeding [65].

An enlightening poster by Munce et al. attempts to assess novel risk factors for development of a type A dissection. Their work demonstrates that aortic length, the aortic diameter at the LAD take-off, the cardiac apex angle, and the left ventricular outflow tract angle are statistically significant different between case and control groups and may represent independent risk factors [66]. Further study in this area will be necessary.

A minority of posters discussed quality and safety. Important issues centered on IV contrast risk (including and beyond contrast induced nephropathy) and how to manage a mass casualty incident. Winsor et al. discussed physician knowledge regarding lactation in patients undergoing contrast enhanced imaging studies. Importantly, physicians in surgery and emergency medicine are least likely to be familiar with current guidelines, as are residents when compared with their attending counterparts across all specialties. This is an area where ED radiologists can further educate their fellow ED colleagues [67]. Wuerdeman et al. successfully designed a mass casualty simulation. The most important conclusions they drew were to know the maximum hourly throughput in CT, as it may be a bottleneck for patient flow, to have a process for non-standard communication of critical results that will work in a mass casualty, and to try to conduct a small mass casualty simulation with minimal impact on normal business operations [68].

A poster by Farrell et al. showed that the implementation of lectures based on the ACR Appropriateness Criteria for blunt cardiothoracic and abdominopelvic trauma is an effective tool for educating emergency medicine providers on ordering appropriate imaging related to traumatic injuries. Of note, this data was statistically significant [69].

Gerard et al. reviewed nuclear medicine study risks. ALARA principles were emphasized as a standard precaution. Overall, diagnostic nuclear medicine studies present minimal risks to care givers [70].

A sobering but highly relevant poster by Hoff et al. discussed the issue of radiology burnout, particularly in ED radiology. In the past, radiologists have typically reported low rates of burnout and high rates of job satisfaction; however, recent studies have documented a concerning rise in burnout rates, now affecting up to 49% of radiologists. In a 2010 survey, radiologists had rates of burnout that were higher than the mean for all physicians (46%). Nonetheless, solutions were presented on the individual radiologist, division, and departmental levels to help alleviate this problem [71].

Multiple comprehensive exhibits detailed the use of dual energy CT in the emergency department. Wortman et al. focused on abdominal and pelvic trauma. Their poster reviewed how virtual non-contrast and iodine overlay images can characterize sites of active extravasation and may eliminate the need for delayed imaging in some patients. Additionally, virtual non-calcium images may improve detection of fractures by demonstrating underlying bone marrow edema [72]. Caton Jr. et al. focused on adnexal lesions using dual energy CT. It appears that dual energy may be of particular utility in diagnosing ovarian torsion and reduce delay to surgical management [73]. Uyeda et al. focused on dual energy evaluation CT evaluation of acute cholecystitis. DECT can detect increased pericholecystic hepatic parenchymal and gallbladder wall iodine content in patients with acute cholecystitis. However, further work is needed to determine appropriate threshold values of iodine content that may aid in the diagnosis of acute cholecystitis [74].

Scientific posters

Danda et al. surveyed radiologists on the topic of tort reform, the majority of who believed that reforms currently in place for Emergency Department physicians should also apply to Emergency radiologists as the liability shared by these groups reflects similar work-related risks [75].

Hansberry et al. described that members of the general public likely do not fully benefit from online radiology-based patient educational material due to their lack of familiarity with the medical references used by such resources. They suggested that creating patient educational material that is widely accessible and coherent to the general public will likely improve health outcomes [76].

Kessler et al. described the contrasting viewpoints between residents who have taken overnight call both with and without an attending and residents who have only taken call without attending coverage. The difference in resident experiences suggests that further investigation comparing various overnight attending call structures would be beneficial [77].

Patel et al. suggest that a patient's clinical status is likely a more accurate indicator for the necessity of angiographic intervention rather than the results or time interval from tagged RBC scan to angiography [78].

Steenburg et al. suggest that postmortem CT improves detection of injuries otherwise undetected by physical exam, presents a non-invasive method to identify the cause of death in patients with external injuries that would otherwise not typically result in traumatic death as well as helps create a more thorough and accurate trauma registry [79].

Robinson et al. discovered that trauma transfer patients were more likely to have a major interpretive discrepancy that would affect management than non-trauma patients, thus justifying routine overreading of pre-transfer CTs [80].

Almeida et al. described that MR and CT are more sensitive than radiographs (even weight bearing) in detection of Chopart fractures and should be considered in the initial investigation when such injuries are suspected. MR/CT also detected additional fractures that were missed even when radiographs were diagnostic of a Chopart fracture [81].

Kumar et al. described that while the 3D SPACE STIR sequence is comparable to a 2D STIR in detecting injuries in the postganglionic brachial plexus, the 3D STIR sequence provides better anatomic correlation. Diffusion-weighted neurography correlates well with the STIR sequence and can increase the confidence level [82].

Lanier et al. introduced the "Emergency/Critical Care Imaging Simulation" as an objective assessment tool that can be used to identify both individual resident weaknesses as well as more broad knowledge deficiencies across resident classes and institutions. The study suggests more training is needed in the areas of emergent neuroradiology and chest X-ray interpretation [83].

Beckmann described a higher rate of Morel-Lavallee lesions in patients with pelvic fracture as well as a correlation between the location/incidence of such lesions with specific pelvic ring injury patterns. The study also suggests a male predominance and possible increased incidence with higher BMI [84].

Baghdanian et al. described that trauma patients who undergo damage control surgery upon presentation typically have clinically significant injuries not detected at laparotomy and would therefore benefit from CT imaging in the first 24 h [85].

Baghdanian et al. suggested that active hemorrhage in renal trauma is a significant indicator for surgical/endovascular therapy despite AAST grade. Collecting system injuries are frequently not detected on initial CT, justifying the need for repeat imaging in cases with large perinephric hematomas [86].

Agrawal et al. suggested that an experienced radiologist likely does not require much clinical information to reach an accurate diagnosis in the emergent setting [87].

Keller et al. described a growing concern that due to high false positive rates of ED ultrasound that require subsequent evaluation by the radiology department, reimbursing ED physicians for EDUS actually increases cost with little clinical benefit [88].

Kelleher et al. described that few ED patients obtain a recommended lung nodule follow-up and of those, the majority are insured patients. This suggests that reporting and communicating is not enough and alternative strategies are necessary to ensure follow-up [89].

Rajput et al. reported that infection, inflammation, and malignancy were the most commonly proposed etiologies on CT studies ordered to evaluate hemoptysis [90].

Nagle et al. reported that pulmonary MRA is a safe alternative to CTA for the diagnosis of pulmonary embolism [91].

Robinson et al. reported that an abbreviated interpretation of ED coronary CTA studies, including limited interpretation of axial images, can identify patients with no/minimal coronary artery disease, deliver results to clinicians in a more timely fashion as well as improve access to CCTA while maintaining data for postprocessing if needed [92].

Compliance with ethical standards

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

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