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Optimizing the use of CT scanning for pulmonary embolism in the emergency department

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Introduction: Diagnosing pulmonary embolism (PE) can be challenging because the signs and symptoms are often non-specific. Studies have shown that evidence-based diagnostic algorithms are not always adhered to in the Emergency Department (ED), which leads to unnecessary CT scanning. In 2013, the American College of Chest Physicians identified CT pulmonary angiography as one of the top five avoidable tests. One solution is to use a clinical prediction rule combined with the D-dimer, which safely reduces the use of CT scanning. The objective of this study was to compare the proportion of patients tested for PE in two emergency departments, who 1) had a CT-PE and 2) whose diagnosis of PE was missed. We compared these rates to those if the Wells rule and D-dimer had been applied as standard. **Methods:** This was a retrospective chart review of ED patients investigated for PE at two hospitals from April 2013 to March 2015 (24 months). Inclusion criteria were the ED physician ordered CT-PE, Ventilation-Perfusion (VQ) scan or D-dimer for investigation of PE. Patients under the age of 18 were excluded. PE was defined as CT/VQ diagnosis of acute PE or acute PE/DVT in 30-day follow-up. Trained researchers extracted anonymized data. The rate of CT/VQ imaging and the false-negative rates were calculated. The false-negative rate was calculated as the number of patients diagnosed with PE within 30 days as a proportion of those patients who did not have a CT/VQ scan at initial presentation. **Results:** There were 1,189 patients included in this study. 55/1,189 patients (4.6%; 95%CI 3.6-6.0%) were ultimately diagnosed with PE within 30 days. 397/1,189 patients (33.4%; 95%CI 30.8-36.1%) had CT/VQ scans for PE. 3 out of 792 who were not scanned had a missed PE resulting in a false-negative rate of 0.4% (95% CI 0.1-1.1%). 80 patients had an elevated D-dimer or high Wells score but were not imaged. Furthermore, 75 patients who did not have an elevated D-dimer nor a high Wells score were imaged. Had Wells rule/D-dimer been adhered to, 402/1,189 patients (33.8%; 95%CI 31.9-36.6%) would have undergone imaging and the false negative rate would be 0/727, 0% (95%CI 0.0-0.5%). **Conclusion:** If the Wells rule and D-dimer was used in all patients tested for PE, a similar proportion would have a CT scan but fewer PEs would be missed.

Keywords: pulmonary embolism, D-dimer, diagnosis

LO82

The accuracy and prognostic value of point-of-care ultrasound for renal colic: a systematic review

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Introduction: Point-of-care ultrasound (POCUS) has been suggested as an initial investigation in the management of renal colic. Our objectives were: 1) to determine the accuracy of POCUS for the diagnosis of nephrolithiasis, and 2) to assess its prognostic value in the management of renal colic (PROSPERO: 42016035331). **Methods:** An electronic database search of MEDLINE, EMBASE, and PubMed was conducted utilizing subject headings, keywords, and synonyms that address our research question. Bibliographies of included studies and narrative reviews were manually examined. Studies of adult emergency department patients with renal colic symptoms were included. Any degree of hydronephrosis was considered a positive POCUS finding. Accepted criterion standards were CT evidence of renal stone or hydronephrosis, direct stone visualization, or surgical findings. Screening of abstracts, quality assessment with the QUADAS-2 instrument, and data extraction were performed by two reviewers, with discrepancies resolved by conference with a third reviewer.Test performance was assessed by pooled sensitivity and specificity, calculated likelihood ratios, and a summary receiver operator curve (SROC). The secondary outcome of prognostic value was reported as a narrative summary. **Results:** The electronic search yielded 627 unique titles. After relevance screening, 25 papers underwent full-text review, and 8 articles met all inclusion criteria. Of these, 5 high-quality studies (N = 1773) were included in the meta-analysis for diagnostic accuracy, and three yielded data on prognostic value. The pooled results for sensitivity and specificity were 70.2% (95% CI = 67.1% to 73.2%) and 75.4% (95% CI = 72.5% to 78.2%), respectively. The calculated positive and negative likelihood ratios were 2.85 and 0.39. The SROC generated did not show evidence of a threshold effect.Three studies examining prognostic value noted a higher likelihood of a large stone or surgical intervention with positive POCUS findings. The largest randomized trial showed lower cumulative radiation exposure and no increase in adverse events in those who received POCUS investigation as the initial renal colic investigation. **Conclusion:** Point-of-care ultrasound is of modest accuracy for the diagnosis of nephrolithiasis. While positive POCUS findings are associated with larger stones and greater likelihood for intervention, the clinical importance of this is unclear.

Keywords: point-of-care ultrasound, nephrolithiasis

LO83

Effectiveness of implementing evidence based interventions to reduce C-spine imaging in the emergency department: a systematic review

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Introduction: Unnecessary imaging of adult cervical spine (C-spine) injury patients in the Emergency Department (ED) is a concern. Guidance for C-spine image ordering exists; however, the effectiveness and safety of their implementation in the ED is not well studied. This review examines their implementation and effectiveness at reducing C-spine imaging in adults presenting to the ED with stable neck trauma. **Methods:** Six electronic databases and the grey literature were searched. Comparative studies examining interventions to reduce C-spine imaging were eligible for inclusion. Two independent reviewers screened for study eligibility, assessed study quality, and extracted data. Data were analyzed using RevMan (Version 5.3) to explore the effectiveness of these interventions in safely reducing C-Spine radiography. **Results:** A total of 848 unique citations were screened of which six before-after studies and one randomized controlled trial were included. The study population varied with respect to injury severity (i.e., stability status). None of the studies were assessed as high quality. The interventions employed included locally developed guidelines and clinical decision rules, specifically the National X-radiography Utilization Study (NEXUS) criteria and the Canadian C-Spine Rule (CCR). Various implementation strategies, such as teaching sessions, pocket reminder cards, posters and computerized decision support were used. Several studies used multi-faceted interventions. Overall, of the five study groups that examined change in x-ray ordering, three groups reported a significant reduction in c-spine radiography. The remaining two showed no change in imaging. A pooled estimate of the effectiveness of the interventions was prohibited by significant heterogeneity.

Conclusion: The evidence regarding the effectiveness of interventions to reduce C-spine imaging in adult ED patients with stable neck trauma is inconclusive. Given the national and international focus on improving appropriateness and reducing unnecessary imaging through campaigns such as Choosing Wisely®, additional interventional research in this field is warranted.
Keywords: diagnostic imaging, cervical spine, intervention

LO84

Computed tomography use for headache presentations to emergency departments in Alberta: regional, site and physician level variation

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Introduction: Headaches are a common emergency department (ED) presentation. Evidence demonstrates that computed tomography (CT) imaging varies significantly within and across sites. This study explored CT ordering and variation among headache presentations across Alberta EDs. **Methods:** Administrative health data for Alberta were obtained from the National Ambulatory Care Reporting System (NACRS) for all adult (>17 years) headache (ICD-10-CA: G44, G43, R51) ED visits from 2011-2015. Patients with a primary or secondary diagnosis code of headache were included. Exclusions were: sites without CT scanners, Canadian Triage and Acuity Scale score of 1, patients with trauma or external mechanism of injury (e.g., ICD-10-CA S,T,V,W,X,Y), or enhanced/contrast CTs. NACRS data were linked with Alberta Health Services' (AHS) diagnostic imaging data. Preliminary analysis on imaging variation at the zone, ED site, and physician level was completed using SAS (v.9.4). Physicians who saw less than an average of 10 headache patients per year were excluded. **Results:** Overall, 98,804 headache presentations were recorded (~20,000/year; 8.5% average annual increase) in 30 EDs. The average proportion of visits receiving CT was 25.1% with an average 6.2% increase per year. CT ordering varied across AHS zones (Variation [V]:23%; range:9.6-32.7%). Site ordering variation was more dramatic (V:45%; range:1.4-46.5%). The greatest variation was observed among physicians (V:84 %; range: 0.0-83.7%) with mean ordering proportion of 28.7%. **Conclusion:** From 2011-2015, headache presentations and CT imaging for these patients in the ED increased. Substantial variation in CT ordering exists at multiple levels in Alberta. Further exploration of CT appropriateness is urgently needed.
Keywords: diagnostic imaging, headache, emergency department

LO85

Substantial variation in CTPE ordering patterns and diagnostic yield in a large group of specialty-trained emergency physicians

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Introduction: Computerized tomography for pulmonary embolism (CTPE) has come under increased scrutiny with recommendations for evidence-based use found on Choosing Wisely lists in both Canada and the US. However practice variation in ordering patterns and diagnostic yield have not been well-reported for the Canadian context. Our objective was to investigate practice variation in CTPE ordering and rule-in rates within a large group of specialty-trained emergency physicians. **Methods:** We undertook an analysis of a computerized physician order entry database from four tertiary care EDs covering a 12-month period from August 1, 2016 to July 30, 2016 with 31 419 visits for potential pulmonary embolism (PE) as determined by a previously validated algorithm based on presenting complaints. CTPE utilization and diagnostic yield were determined for 149 physicians who ordered at least 10 studies over that time period. Outcomes of interest included CT utilization as determined by electronic order entry and a confirmed diagnosis of PE based on ICD-10 coding of the emergency visit. Descriptive statistics using medians, IQR and 95% confidence intervals are reported. This study is approved through REB14-0650 and is a component of a larger cluster RCT to improve CTPE utilization. **Results:** During the study period 2670 CTPE studies were ordered for potential PE patients representing 8.5% of the total with relevant complaints. We observed a 10-fold variation in CTPE ordering among physicians with rates as low as 2.7% and as high as 25%. The median rate of CTPE ordering for potential PE was 8.8% with an IQR of 6.0% to 11.7%. A total of 4146 CTPE studies were ordered during the study period with physicians ordering an average of 28 CTPE studies each; range 10-90. In terms of diagnostic yield, 591/4146 studies, or 14.3% (95% CI 13.2-15.3%) were associated with a diagnosis of PE. Diagnostic yield per physician ranged from 0 to 50%, with a median of 13.5% and an IQR of 7.6% to 21.4%. **Conclusion:** In this large, robust administrative dataset from four Canadian urban EDs, threshold for CTPE ordering varies widely among physicians as does diagnostic yield. Efforts to improve appropriate utilization are justified with an eye to reducing unnecessary radiation, costs and incidental findings.
Keywords: computerized tomography, Choosing Wisely, pulmonary embolism

LO86

Overutilization of computed tomography as a first-line investigation for patients presenting with suspected recurrent nephrolithiasis in the emergency department: a retrospective cohort study

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Introduction: Computed tomography (CT) has increasingly been used as a standard initial investigation for patients presenting to the Emergency Department (ED) with suspected nephrolithiasis. Compared to ultrasound, CT has increased system-level costs, ionizing radiation exposure and frequently does not alter management. For these reasons, Choosing Wisely (CW) recommends avoiding CT imaging of otherwise healthy patients younger than age 50 years presenting with symptoms of uncomplicated renal colic that have a known history of nephrolithiasis or ureterolithiasis. We aimed to evaluate the degree of utilization of CT imaging for this subgroup of patients in a tertiary care centre ED. **Methods:** A retrospective chart review was performed for all patients younger than 50 years who visited Sunnybrook Health Sciences Centre ED for six months between December 2015 and May 2016 with renal colic symptoms and a history of nephrolithiasis. Demographic data, relevant past medical history, clinical presentation, lab values, urology consultation, ED treatments administered, diagnostic imaging orders and dispositions were recorded for each eligible patient. **Results:** Out of 130 reviewed patient charts, 73 patients were identified with a previous history of nephrolithiasis and a presentation consistent with uncomplicated renal colic. 54 patients received ultrasound, KUB x-ray, or no imaging. The other 19 (26.0%) of these patients received an abdominal/pelvic CT with an indication of looking for renal or ureteral stones. Of the patients that received CT, none demonstrated significant findings warranting hospital admission or leading to identifiable changes in ED management. Five (26.3%) of these 19 patients had received a total of three to four CTs for renal colic during past Sunnybrook ED visits, while one had previously received 13 CTs. **Conclusion:** CT scans are often used as an initial diagnostic modality for suspected renal colic

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