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Blood tests: One too many? Evaluating blood requesting guidance developed for acute patients admitted to trauma and orthopaedic units

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ABSTRACT

In a recently published report from the Academy of Medical Royal Colleges, around 20% of clinical practice which encompasses blood science investigations is considered wasteful. Blood tests including liver function tests (LFTs), C-reactive protein (CRP), coagulation screens, and international normalising ratios (INR) are frequently requested for patients who undergo emergency hospital admission. The paucity of guidance available for blood requesting in acute trauma and orthopaedic admissions can lead to inappropriate requesting practices and over investigation.

Acute admissions over a period of one month were audited retrospectively for the frequency and clinical indications of requests for LFTs, coagulation screens/INR, and CRP. The total number of blood tests requested for the duration of the patient's admission was recorded. Initial auditing of 216 admissions in January 2014 demonstrated a striking amount of over-investigation. Clinical guidelines were developed with multidisciplinary expert input and implemented within the department. Re-audit of 233 admissions was carried out in September 2014.

Total no. of LFTs requested: January 895, September 336 (−62.5%); coagulation screens/INR requested: January 307, September 210 (−31.6%); CRPs requested: January 894, September 317 (−64.5%). No. of blood requests per patient: January (M = 4.81, SD 4.75), September (M = 3.60, SD = 4.70). Approximate combined total cost of LFT, coagulation/INR, CRP in January £2674.14 and September £1236.19 (−£1437.95, −53.77%).

A large decrease was observed in admission requesting and subsequent monitoring ($p < 0.01$) following the implementation. This both significantly reduced cost and venepuncture rates.

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Introduction

Emergency admissions to trauma and orthopaedic units frequently have blood tests to complement clinical assessment, aid in pre-operative optimisation, and screen for possible post-operative complications. They are often requested by junior members of medical staff, and are usually part of a set of initial investigations for non-operative admissions. Blood tests commonly requested on admission include the full blood count (FBC); urea and electrolytes (U&Es); liver function tests (LFTs); International Normalising Ratio (INR) for patients on warfarin; coagulation screens; C-reactive protein (CRP); lactate and a blood grouping and antibody screen if peri- or post-operative blood loss necessitating future transfusion is anticipated.

Current guidelines available from the National Institute of Clinical Excellence (NICE) detail the pre-operative blood tests recommended for scheduled surgical patients based on the nature of the planned operation and the patient's physical status under the American Society of Anaesthesiologists (ASA) classification system [1] Despite this framework, no guidelines currently exist for blood requesting for acute trauma and orthopaedic admissions. Auditing appropriateness of investigations is an essential component in maintaining the standards for unscheduled surgical care [2] and blood tests are expensive both in terms of economic costs of laboratory and equipment resources, in addition to increased workload incurred on junior medical staff and phlebotomists [3].

Current evidence on pre-operative blood investigations indicates that inappropriately requested blood tests fail to predict peri-operative complication, rarely influence anaesthetic management,

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and may provide many false positive, false negative or spurious results [4–6]. It must also be borne in mind that venepuncture is not a benign procedure and repeated attempts are common in older patients.

The enormous value of blood tests is not in dispute. The majority of patients admitted under trauma and orthopaedics are elderly with multiple co-morbidities including hypertension, diabetes, chronic kidney disease, and anaemia [7,8]. These patients' admissions can be complicated by factors such as polypharmacy, particularly with antihypertensive medication such as angiotensin-converting-enzyme (ACE) inhibitors or anticoagulants (e.g. warfarin) which can predispose or lead to the development of post-operative complications such as acute kidney injury (AKI), sepsis or venous thromboembolism (VTE) [8].

Using the NICE guidelines as a framework for best practice, there exists a rationale for requesting a baseline FBC and U&Es for the majority of patients admitted to trauma and orthopaedics taking into account patient demographics, co-morbidities, and type of operation they are likely to have. There is no consensus that coagulation screens are appropriate pre-operatively in scheduled patients and guidance for LFTs and CRP are not included. CRP in particular is an investigation that is often over requested due to its perceived sensitivity and specificity in identifying post-operative infection. Among varying surgical disciplines the consensus is that a CRP measurement on day 4 is most clinically useful at identifying possible infection [9–11]. In the case of trauma, there is potential merit in obtaining a baseline CRP pre-operatively, at day 2 and day 4 due to its sensitivity in identifying deep wound infection [9]. Table 1 lists the clinical indications for these particular blood tests.

We sought to audit blood requesting practices at the two main hospitals in our region in Scotland, UK: Ninewells Hospital, Dundee which is the equivalent to a level II trauma centre and Perth Royal Infirmary which is the equivalent of a level III trauma centre. Both hospitals serve just over 400,000 people covering both rural and urban populations, in addition to serving patients in neighbouring regions. The initial audit cycle revealed striking differences between requesting practices and the appropriate clinical indications for the blood tests in question; for example 895 LFTs were requested, when only 4 out of 216 patients had a documented history of liver disease and 176 CRP tests were carried out within 72 h of a patient's operation.

Design and methods

A retrospective audit for all admissions to the Department of Trauma and Orthopaedics at Ninewells Hospital, Dundee, UK and Perth Royal Infirmary, Perth, UK was carried out during the month of January 2014. Daily trauma admission lists saved electronically on the departmental computer drive were used as the source of patient admission details and an injury severity score (ISS) was calculated for each patient. The local trust electronic patient records were used to access patients' medical history, medication history, and length of hospital stay. The electronic clinical investigation requesting and reporting software (ICE) was used for data collection regarding blood tests. The frequency of LFTs, coagulation screens/INR and CRP were recorded for all patients on admission and for subsequent monitoring. The clinical indications for these blood tests were also noted. The number of blood requests the patient had during their admission was recorded. Cost analysis was performed using the prices quoted by the blood sciences department at Ninewells Hospital to run the test through the analyser and excludes material costs or labour.

Through extensive consultation between the trauma and orthopaedic consultants, anaesthetic consultants, and consultant clinical biochemists within the blood science department in line with current evidence, a consensus was established as to which blood tests should be requested on admission for all patients admitted with an acute injury which ranged from isolated injuries to polytrauma patients (Fig. 1). An additional guideline for subsequent monitoring purposes was also developed for patients admitted for ward-level care (Fig. 2). All changes were made in line with our established pre-assessment guidance for scheduled admissions.

Following this a multi-modal approach was implemented in order to encourage a change in practice. Posters demonstrating the guidelines were displayed clearly in all doctors' rooms in the trauma and orthopaedic wards at both hospital sites and a presentation was given. This information was made available to medical staff as well as nursing staff, and nurse practitioners who perform venepuncture who were unable to attend. Additionally, the guidelines were implemented in the computer requesting system (ICE) for reference by all practitioners involved in blood requesting. A second audit cycle was undertaken for a month after the guidelines were introduced. Figs. 1 and 2 demonstrate the final guidelines agreed and implemented within the department. Ethical approval was not required on the basis this was a clinical audit.

Patients included had to be admitted and discharged to the trauma and orthopaedic department. For those operative admissions they needed to have one single operation. Exclusion criteria included the following: patients who were still inpatients at the time the audit was undertaken; patients who had multiple operations; patients who were admitted following scheduled procedures due to post-operative complications; non-orthopaedic medical or surgical patients admitted to the wards; patients who died whilst as an inpatient in the department; and patients who required an orthopaedic review whilst admitted or discharged by a different team in the hospital.

Statistical analysis was performed using the Statistical Package for Social Sciences (SPSS) software. Admission blood requesting frequencies in guideline and no guideline conditions were analysed with a chi-square test with a Cramer's V strength of association test. A Mann-Whitney U test was conducted to compare rates of blood requesting in guideline and no guideline conditions in patients after admission.

A significance level of $p < 0.05$ was set for all analyses.

Results

216 patients were included in January 2014 and 233 patients in September 2014. Sex of patients January 126 females, 90 males;

Table 1
Clinical indications for additional blood investigations [12].

Indications for liver function tests (LFTs)	Indications for INR/coagulation screen	Indications for CRP
History or examination findings suggestive of liver disease e.g. poisoning (paracetamol), jaundice, alcohol abuse, haemochromatosis, NASH	Suspected or history of coagulation or bleeding disorder	Screening for suspected infection or inflammatory disease
Screening populations at high risk for blood borne viruses e.g. contact tracing for hepatitis, illicit drug use	Patient on anticoagulant medication such as warfarin or rivaroxaban	
Monitoring effect of medications e.g. methotrexate, valproate, isotretinoin	Monitoring intrinsic liver function	
Significant non-liver disease that may affect liver function e.g. malignancies		

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