INTRODUCTION

Potassium ethylenediaminetetraacetic acid (kEDTA) is the recommended and commonly used anticoagulant for collection of samples for the cellular components and morphology of the blood cells. EDTA is also commonly used as an anticoagulant for collection of samples for plasma glucose estimation along with potassium fluoride. Tip of syringe after removing the needle may transfer some kEDTA to serum or lithium heparin tubes used for electrolytes and calcium estimation. This may result in spurious hyperkalaemia and hypocalcaemia. Figure 1 shows two typical cases of EDTA contamination, which occurred in CMH, Peshawar. Correction of filling order of the sample tube is a simple and cost effective method to prevent this error. It is very important to fill EDTA containing tubes after the other tubes. An example of the correct filling order is lithium heparin tubes (used for electrolytes estimation), plain tubes and then blood complete picture, glucose and other EDTA or oxalate containing tubes. A sample showing both critically high potassium and low calcium levels should be investigated for possible EDTA contamination. Awareness of this phenomenon can prevent unnecessary panic and inadvertent treatment.

The present study was, therefore, planned to identify this problem in a tertiary care centre and to evaluate the effects of an awareness campaign on the frequency of EDTA contamination.

METHODOLOGY

A cohort of 200 doctors, nurses and paramedical staff involved in sample collection for laboratory investigations were selected for this three phased study. In all samples with plasma potassium level > 6.0 mmol/L, plasma Ca++ was measured for one month before, during and after a campaign of correct filling order of sample tubes for two weeks. Renal function test and LDH were also measured to rule out chronic renal failure and in-vitro haemolysis, respectively. Fisher’s exact test was used for comparison of frequency of hyperkalaemia.

Results: There was a significant decrease (75%, p < 0.01) in the cases of spurious hyperkalaemia and hypocalcaemia.

Conclusion: EDTA contamination is a common and important source of pre-analytical error which can be prevented to some extent by education of medical and nursing staff.

Key words: EDTA contamination. False hyperkalaemia. False hypocalcaemia.

ABSTRACT

Objective: To measure the effects of awareness campaign on the frequency of EDTA contamination.

Study Design: A cohort study.

Place and Duration of Study: The study was carried out in Combined Military Hospital, Peshawar, from October to December 2008.

Methodology: A cohort of 200 doctors, nurses and paramedical staff involved in sample collection for laboratory investigations were selected for this three phased study. In all samples with plasma potassium level > 6.0 mmol/L, plasma Ca++ was measured for one month before, during and after a campaign of correct filling order of sample tubes for two weeks. Renal function test and LDH were also measured to rule out chronic renal failure and in-vitro haemolysis, respectively. Fisher’s exact test was used for comparison of frequency of hyperkalaemia.

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transferred from the hospital during the whole period of study.

The study was divided in 3 phases i.e. pre-campaign data collection phase which lasted from 1st to 31st October 2008, then an awareness campaign from 1st to 15th November 2008 and finally post-campaign data collection for outcome measures from 16th November to 15th December 2008.

The modes of awareness campaign included lectures, clinico-pathological conferences (for doctors and nurses), comments on electrolytes reports indicating possibility of EDTA contamination and pasting of notices in wards and other places where phlebotomy is carried out. During the campaign the subjects were educated about the cause of EDTA contamination and it was stressed that they should follow the correct filling order after collection of blood sample i.e. lithium heparin tubes, plain tubes, and then blood complete picture and glucose and other EDTA or oxalate containing tubes.

EDTA contamination was defined as hyperkalaemia (> 6.0 mmol/L), hypocalcaemia (ionized calcium < 0.70 mmol/L), normal renal functions and LDH and repeated samples within explainable limits (could not be done in all cases). For detection of EDTA contamination, ionized calcium (Ca++) was determined in all samples of hyperkalaemia even when not requested by the physicians. Blood specimens were received from admitted patients in wards, outpatients visiting laboratory receptions and 2 other receptions located in the hospital. Method of plasma potassium and ionized calcium measurement used was ion selective electrode (ISE), which is routinely used in this hospital laboratory on ISE-based equipment Cobas® 121 and/or Easylyte®. The co-efficient of variation (CV) of quality control for all laboratory tests was within recommended limits. All study subjects were the target audience for awareness campaign. Informed consent of the subjects was obtained.

The data was stored in SPSS version 13. Frequency of EDTA contamination was defined as percentage of hyperkalaemia due to EDTA contamination out of total cases of hyperkalaemia of all causes. Fisher’s exact test was used for comparison of frequencies in 3 phases. P < 0.05 was taken as significant.

RESULTS

Initially 200 subjects were selected for the study. 12 subjects (nurses=2, paramedical staff=10) left the hospital during the study due to unavoidable reasons. Total cases of hyperkalaemia in the first, second and third phases were 88, 43 and 83 respectively. In the second phase the cases were fewer, because it was 15 days duration while first and third phases each lasted for one month. As shown in Figure 2, the frequency of EDTA contamination decreased from first to third phase i.e. 18 (21%), 3 (7%) and 3 (4%). This reduction in frequency of EDTA contamination was also statistically significant (75%) from first to third phase (p < 0.01) and from first to second phase (p < 0.05, Figure 2).

DISCUSSION

EDTA contamination has earlier been reported in the literature3-7 but this was the first study to evaluate the effect of an awareness campaign on the reduction of frequency of this pre-analytical error in a hospital setting. It is important for a Chemical Pathologist or other Laboratory Medical Specialist to consider kEDTA contamination in a hyperkalaemic sample, as true hyperkalaemia is a medical emergency impending cardiac arrest requiring urgent identification and treatment. It should also be kept in mind that sometimes specimen contamination with kEDTA can result into situations much difficult to identify e.g. masking of true hypokalaemia or hypercalcaemia and in some cases true hypokalaemia may even appear as an apparently significant hyperkalaemia, which may result in the initiation of potassium-lowering therapy in an already hypokalaemic individual, with the potential for dangerous consequences.6 Here a simple and cost effective method of detection of gross contamination was used i.e. hyperkalaemia and hypocalcaemia with normal renal functions and normal LDH. In a UK hospital study Cornes et al. used measurement of EDTA as a confident method of detection of EDTA contamination.7 Even with this difference in methods in 2 studies, the frequencies of EDTA contamination detected were quite similar i.e. 21% and 23% in the present and UK study, respectively. The advantages of the method used in this study are simplicity and cost-effectiveness, but it requires awareness on the part of pathologists authorizing the results and treating physicians. Ca++ was used for detection of gross contamination in this study while Cornes et al. have based their study on total
calcium results. The former was employed because it is shown to be more reliable in the detection of calcium abnormalities. A Ca^{2+} assay is available on the same instrument used for potassium measurement and hence, there is no delay in electrolyte results. A recently described EDTA assay in specimens is a more reliable method but requires expensive reagents not suitable in this set up. The awareness campaign resulted in significant reduction in the frequency of gross EDTA contamination but it could not lead to total elimination of this error and cases continued to occur even after completion of the study. There are reasons for this partial failure; firstly a tendency exists in paramedical, nursing and medical staff to fill EDTA tubes first for the fear of clotting of the samples which results in unexplained, puzzling and sometimes life-threatening errors in electrolyte and calcium estimation. During the campaign it was clearly demonstrated to the subjects that a delay of several seconds does not lead to clotting of blood in the syringes, but the habit of filling EDTA tube first, by some of the subjects, was difficult to change. Secondly, rapid turn over of staff peculiar to an Armed Forces Hospital caused dilution of the effects of the campaign.

Keeping in mind the rapid turnover of the staff and the non-availability of a reliable method of detection of subtle contamination, hospital laboratories should keep on reminding hospital staff about this contamination in their feedback comments and during inter-departmental meetings. Moreover, laboratories should also keep a proper record of EDTA contaminations in a non-conformance register. EDTA contamination can also lead to errors in other parameters not included in the present study e.g. magnesium, unsaturated iron-binding capacity, bicarbonate, AST, ALT, LDH, CK, alkaline phosphatase and amylase, serum iron estimation and in some tests carried out for neonatal screening. Inclusion of this issue in the training of paramedical staff and a continuous awareness campaign will reduce frequency of subtle EDTA contamination resulting in reduction in systemic errors, which can not be corrected by usual quality assurance techniques and therefore, will lead to enhancement of reliability of the hospital laboratories.

REFERENCES
EDTA contamination can be reduced by educating medical, nursing and paramedical staff regarding the use of correct order of the filling of sample tubes; however, it can not be totally eliminated in short term.

REFERENCES