Increasing knowledge of Acute Kidney Injury (AKI)

Nicole Blakemore[1], Prof. Sunil Bhandari[2]

[1] 4th year medical student, Hull York Medical School, Hull hynmb1@hyms.ac.uk

[2] Consultant Nephrologist/Honorary Clinical Professor, Hull and East Yorkshire Foundation NHS Trust, Hull Royal Infirmary, Hull

Abstract

Acute Kidney Injury (AKI) is a medical syndrome with a significant risk of mortality and morbidity for patients. Questionnaires were conducted to assess knowledge of the condition in both final year medical students and foundation doctors. Following this, a guideline was produced with information about the treatment of AKI, and given to the same groups. A secondary questionnaire assessment has shown increased awareness amongst final year medical students suggesting usefulness of the simple guidance.

Introduction

Acute Kidney Injury is a syndrome which encompasses a range of injuries to the kidneys, impairing their ability to function normally(1). It is classified as an increase in serum creatinine concentrations of greater than 50% within a week, or less than 35ml/hour of urine production, on average, for a total of 6 hours(2).

To improve outcomes for patients with kidney dysfunction, including AKI, the International Society of Nephrology created the Kidney Disease: Improving Global Outcomes (KDIGO) foundation. They developed new criteria on diagnosing and assessing the severity of AKI in 2012.
AKI is a common medical condition; Public Health England state that 5-18% of those admitted to hospital experience an AKI(3).

Despite this, there have been concerns raised about the level of training that foundation doctors receive on AKI and its management. In both national and more local studies, it has been shown that improvements in educating medical students about AKI are needed(4,5).

Given the importance of AKI and the necessity of accurate diagnosis and rapid treatment, a quality improvement project was conducted to investigate knowledge of AKI amongst both foundation doctors and final year medical students, and to see how it could be improved.

Methods

Questionnaires

Firstly, initial knowledge of AKI was investigated through a questionnaire survey (see Appendix 1). Participants included 5th year (final year) medical students from the Hull York Medical School, from all five training sites (Hull, York, Scarborough, Scunthorpe and Grimsby) and foundation doctors from Castle Hill Hospital (CHH) and Hull Royal Infirmary (HRI).

The surveys were conducted differently for each group to maximise the number of participants in each group. Medical students are distributed throughout the region and are more difficult to meet in person. In contrast, a high number of foundation doctors are based in HRI and CHH and are easier to contact via face-to-face discussion. Therefore, final year medical students were asked to complete questions online using a survey website, whilst foundation doctors were asked on a one-to-one basis on wards in HRI and CHH.

Five questions were included in each questionnaire, and for each one there was a selection of objective answers for participants to choose (Appendix 1). Participants were asked to select as many options as they believed were correct.

Guideline: Development

Following on from this initial research it was decided that a guideline on AKI would be produced to help foundation doctors to recognise AKI.

A broad review of literature was used in development of the guideline. These included the KDIGO guidance on AKI was used, UK Renal Association guidelines on acute hyperkalaemia (6), the London AKI network guidelines(7) and the Oxford Handbooks of both Clinical Medicine and of Nephrology and Hypertension(8,9).

The final guideline was sent to both groups via email.

Guideline: Assessment of effectiveness

Only half of the final year medical students would receive the guideline between questionnaires to identify its effectiveness in

improving knowledge and compare answer selection to that of the control group.

Testing the final efficacy of the guideline

The final questionnaires have already been distributed to final year medical students and are under review. They will be given to foundation doctors to complete the assessment.

Results

For the first set of questionnaires, the response rate was poor at 23%, consisting of 31 responses from foundation doctors (10 FY1, 21 FY2) and 33 responses from final year medical students.

For the second set of questionnaires the response rate was also poor, at 12% with 17 responses from final year medical students.

Foundation doctors

Most respondents could accurately identify that AKI was a reduction in urine or a rise in creatinine, but only 32% could recognise that AKI involved a loss of kidney function with electrolyte retention. 26% incorrectly believed that eGFR was an indicator of AKI.

Most identified patients at risk of AKI (Figure 2) such as the elderly, those using nephrotoxic drug or with a history of use, CKD or diabetics, but they had more difficulty in recognising that patients on the Intensive Care Unit (ICU) and oedematous patients were particularly at risk (6% and 42% respectively).

Acute hyperkalaemia is a medical emergency. It was recognised by over 90% and that a value of >6.5mmol/L would indicate a hyperkalaemia requiring intervention. In contrast, 35% correctly stated that treatment would be needed in the presence of ECG changes which might indicate hyperkalaemia.

Foundation doctors were able to identify the jugular venous pulse, blood pressure and skin turgor as forms of assessment of fluid status (figure 3). Less could identify the radial pulse yet 50% stated that a National Early Warning Score (NEWS) would be an indication, despite this score containing both blood pressure and pulse readings. 19% chose heart sounds (see appendix 1).

87% would correctly prescribe 0.9% sodium chloride solution whilst 62% of respondents chose Hartmann's solution.

52% would consider furosemide as a potential treatment for fluid overload.

Reassuringly none of the participants chose the option of 8.4% sodium bicarbonate solution.

Final year medical students

An improvement was noted between surveys. In the second questionnaire, more were able to identify that an AKI involves a 50% rise in serum creatinine and reduction in urine output. Another improvement was the decrease in numbers selecting the third option, involving eGFR as a definition, as this was incorrect. Unfortunately less could recognise that AKI involves a loss of kidney function and retention of protein and electrolytes in the second questionnaire, although this answer was correct.

For final year medical students the guidance led to some improvement in identification of conditions that were poor in the initial assessment, but their selection remained low relative to other risk factors, such as diabetes (figure 2).

Only 71% stated that a potassium value of >6.5mmol/L was an indication that further treatment was needed. 29% chose >7.0mmol/L as a value. Also only 35% could state that any ECG changes suggestive of hyperkalaemia would trigger treatment.

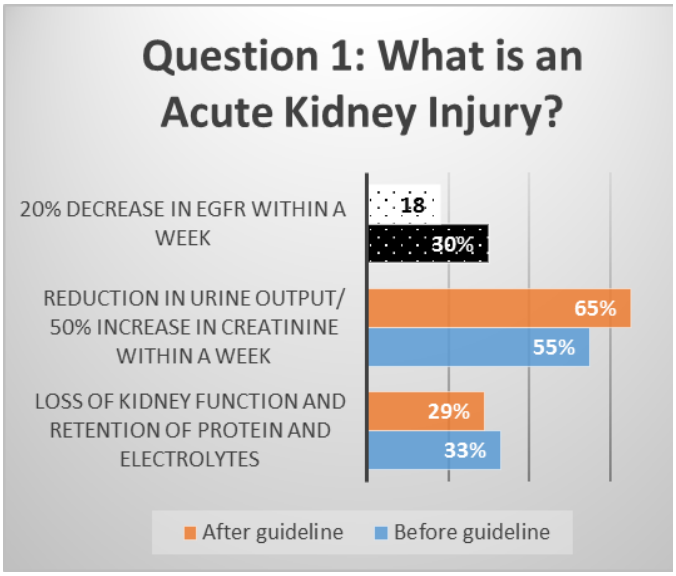
For assessment of fluid status, selection remained at the same percentage. The exception was a decrease of 17% in identifying radial pulse as an indicator after the guideline was introduced. A number also chose heart sounds as an assessment tool (24%).

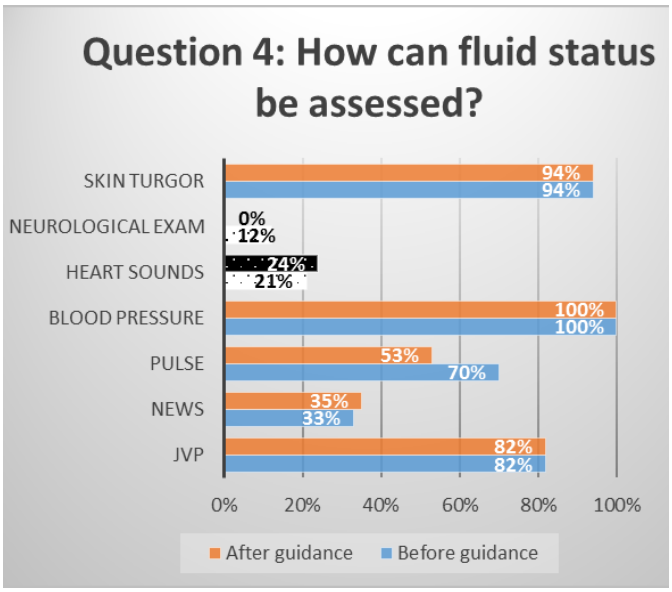
More of the medical students chose 0.9% sodium chloride solution as an option and less picked Hartmann's solution (77%). There was an increase in the number of students selecting correct answers after the introduction of the guideline, including furosemide, which rose from 56% to 70%. In contrast to the foundation doctors, 6% chose 8.4% sodium bicarbonate solution.

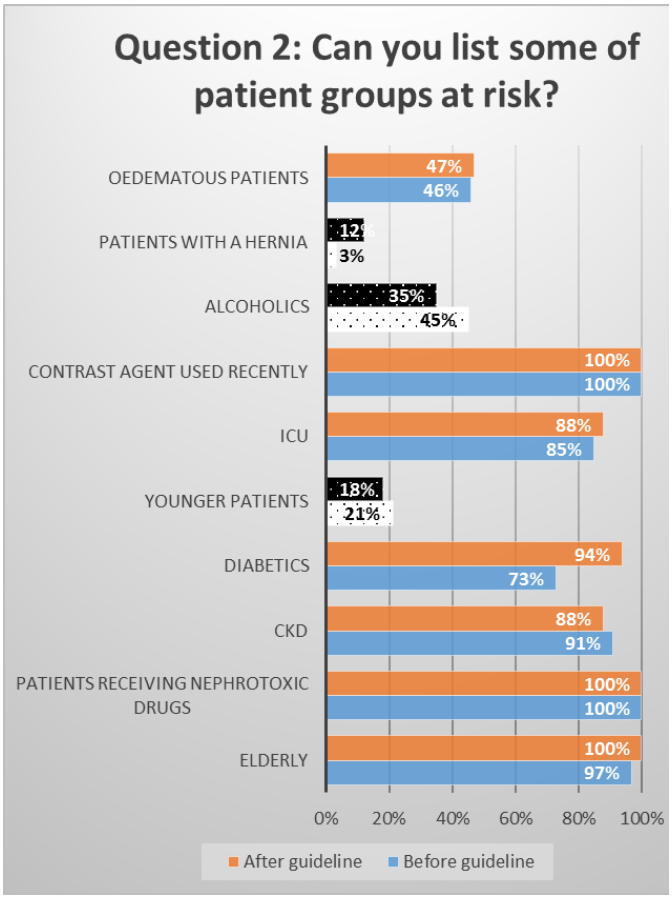
In the second questionnaire there were two extra questions, asking respondents if they had received the guideline and if so, if this had been of use to them.

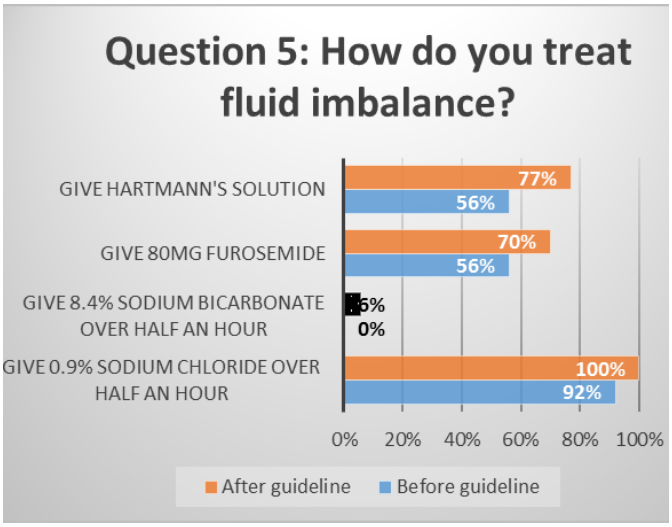
29% of medical students commented that they had received the guideline. However 38% stated that they had found it useful, a larger value than had stated they had received the guideline, meaning that there was an error in the answering by the respondents.

Figures 1-4: Results *All the following graphs represent data for final year medical students. Bars in black and white show incorrect answers.*









* due to an error with question 3, results are not currently available

Discussion

A large proportion of those asked were aware of AKI and some of its complications. There was a rise in medical students choosing all the correct treatment options for AKI.

There was a lack of recognition of fluid overload. Compared to other patients at risk of AKI, oedematous patients were the group least identified. Furosemide was not commonly recognised as a potential treatment. Fluid overload can be as dangerous as fluid depletion due to the potential to cause pulmonary oedema[9].

Another concern was the lack of awareness amongst medical students concerning high potassium levels. The complications of acute hyperkalaemia can be severe, such as heart arrhythmias and myocardial infarction[9].

There are several limitations to this study including the small numbers, a single centre study and the disappointingly poor response rate which would lead to selection bias.

Also, the use of online surveys and then face to face questionnaires for the two study groups may have influenced results. For example, participants could research answers whilst completing the questionnaire online. Foundation doctors would not have this option. However, as the two study groups were not being directly compared to each other I do not feel that this would affect results, when considering the change that the guideline will have made to their answers.

Using online resources is an unavoidable risk but as the answers to the questions were from KDIGO guidelines, a resource mostly unknown to medical students, this should be less likely. Answers could have been sourced from internet search engines but these may not have been correct. Therefore, this would have probably not influenced the increase of correct answers for some questions.

In addition, those who had received the guideline might have been able to read the information as they completed the answers. This could skew data as respondents may not have learnt anything from the guideline, just copied the information. Whilst precautions to avoid this were taken (the guideline was not mentioned until at the end of the questionnaire, when participants may be less likely to go back and change their answers) it could be a source of bias. However this may have achieved the purpose in educating the students.

Conclusion

The introduction of this guideline has led to an improvement in understanding AKI. However, more education and training is needed to ensure a detailed and comprehensive appreciation of its identification and management by junior doctors and soon-to-be doctors occurs.

Results from final year medical students are encouraging but given the potential for bias and the lack of awareness in areas such as potassium levels, more specific training is necessary.

The use of a guideline itself has highlighted several interesting points. Is this effective as a teaching tool? Those who had seen the guideline amongst final year students all commented that it was useful. It has made a difference to the amount of students who gave a correct answer, although this may be subject to bias. Its efficacy amongst foundation year doctors is yet to be determined. A more in depth determinant of its effectiveness would be to review patients who have had an AKI in HRI and CHH since the publication of the guideline. A significant reduction in mortality and morbidity or a change in approach to those with AKI may demonstrate indirectly impact of the guideline.

Further training of foundation doctors is needed and steps have already been taken at Hull and East Yorkshire Hospitals NHS Trust concerning AKI. This guideline forms part of that work to optimise patient outcomes in the future.

Practice points

- Awareness of AKI is variable amongst final year medical students and foundation doctors; this is a recognised problem
- A published guideline is partly effective in raising awareness
- Work in this area needs to be continued to not just increase, but also maintain progress in clinical practice. References

Appendix 1

A copy of the questionnaire given to foundation doctors. The same questions were asked of Year 5 students. The correct answers, according to KDIGO guidelines, are highlighted in yellow.

Hello, I am a fourth year medical student and as part of a quality improvement project I am looking into AKI knowledge in Foundation doctors in HRI and CHH.
Would you be able to answer the following questions?
Your time and help are greatly appreciated!

1) What is an acute kidney injury?
   - Loss of kidney function and retention of protein and electrolytes
   - Reduction in urine output/ 50% increase in creatinine within a week
   - 20% reduction in eGFR within a week

2) Can you list some of the patient groups at risk?
   Elderly Patients receiving nephrotoxic drugs
   CKD Diabetics Younger patients ICU
   Contrast agent used recently Alcoholics
   Patients with a hernia Oedematous patients

3) When should acute hyperkalaemia be treated?
   - >7.0 mmol/L or >6.0mmol/L with ECG changes
   - >6.5 mmol/L or ECG changes
   - Any changes on ECG suggestive of hyperkalaemia

4) How can fluid status be assessed?
   JVP NEWS Radial pulse BP Heart sounds*
   Neurological exam Skin turgor

5) How do you treat fluid imbalance?
   - Give 0.9% sodium chloride over half an hour
   - Give 8.4% sodium bicarbonate over half an hour
   - Give 80mg furosemide
   - Give Hartmann's solution

***Although heart sounds can identify if the patient is fluid overloaded it is not a common investigation for fluid status. However it was interesting to see the perspective of participants on this point.**

Appendix 2

Guideline used:

Acute Kidney Injury (AKI)

H·Y·M·S THE HULL YORK MEDICAL SCHOOL

What is an acute kidney injury?

- Rapid loss of kidney function in less than a week
- Inability to remove excess urea and creatinine
- Lack of regulation of fluid and electrolytes
- **A medical emergency**

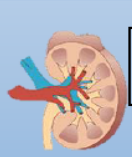


Image from Cancer Research UK

Who is at risk

Acute Kidney Injury can occur in any patient, in any setting. However, those most at risk are:

- Patients with chronic disease: COPD, CKD, IHD, heart failure
- Diabetic patients
- Patients >65 years old
- Critically ill patients
- Dehydrated patients
- Patients taking nephrotoxic medication (NSAIDs, ACE inhibitors, ARBs, gentamicin)
- Patients who have received contrast agent recently

At least 1.5 times increase in baseline serum creatinine in the past week

AND/OR

Patient producing <35ml urine every hour (for a 70kg patient)

AND/OR

A rise of 26 µmol/L in baseline serum creatinine within 48 hours

What to do if AKI is suspected

Simple steps to manage AKI include:

Assess fluid status

NEWS score
JVP
Peripheral oedema
Skin turgor
BP

Treat the cause (SUI):

Stop nephrotoxic agents
Urinalysis to look for infection (give antibiotics if symptomatic) or glomerulonephritis
Imaging (ultrasound) to exclude obstruction or CKD

Acute interventions

If: - Systolic blood pressure <100mmHg

- Pulse rate <50

- Capillary refill >3 sec

Give 250-500mL of 0.9% saline over half an hour

If: - Systolic blood pressure >150mmHg
- Raised JVP
- Peripheral oedema
- Respiratory rate >20/min
- Crepitations in lung bases

Give 80mg IV furosemide if not anuric
100% oxygen through a non-rebreather mask

Hyperkalaemia
(>6.5 mmol/L or any ECG changes suggestive of hyperkalaemia)

10mL of 10% calcium gluconate

IV glucose then insulin: 10 units of actrapid in 50mL of 20% glucose

Reassess regularly and refer to nephrology

Information adapted from London AKI Network guidelines, KDIGO guidelines, UK Renal Association Guidelines and Oxford Handbooks of Clinical Medicine, and Nephrology and Hypertension

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