Clinical Cases for AMU – Case Eight: Acute Kidney Injury

Introduction

These cases are designed to support your learning during your time in Acute and General Medicine. You can use them when you have free time on the ward. They can be done either alone, or in a small group. They use fictional scenarios to demonstrate learning points from common presentations to the Acute Medical Unit (AMU) and on the General Medical wards. As you work through the cases, you will find a mixture of case discussions, practical activities, and practice questions to assess your learning.

If there is a knowledge check or interpretation exercise, the answer can be found on the back of the same page that the question is on.

Case History

Brenda is a 73-year-old woman who has been referred to the Medical Assessment Unit with diarrhoea and vomiting. She tells you that she has been unable to keep any food down for the past three days and has been struggling with fluid. She continues to be nauseated. She is having large volumes of watery stools up to ten times a day. There is no blood in the stool. She has abdominal discomfort which is relived by moving her bowels.

Brenda has a past medical history of hypertension, Chronic Kidney Disease Stage 3 (CKD3), osteoporosis and gastro-oesophageal reflux disease (GORD). She is otherwise well, goes out walking regularly and is independent with her activities of daily living.

A printout of Brenda's medicine reconciliation form is included in this pack.

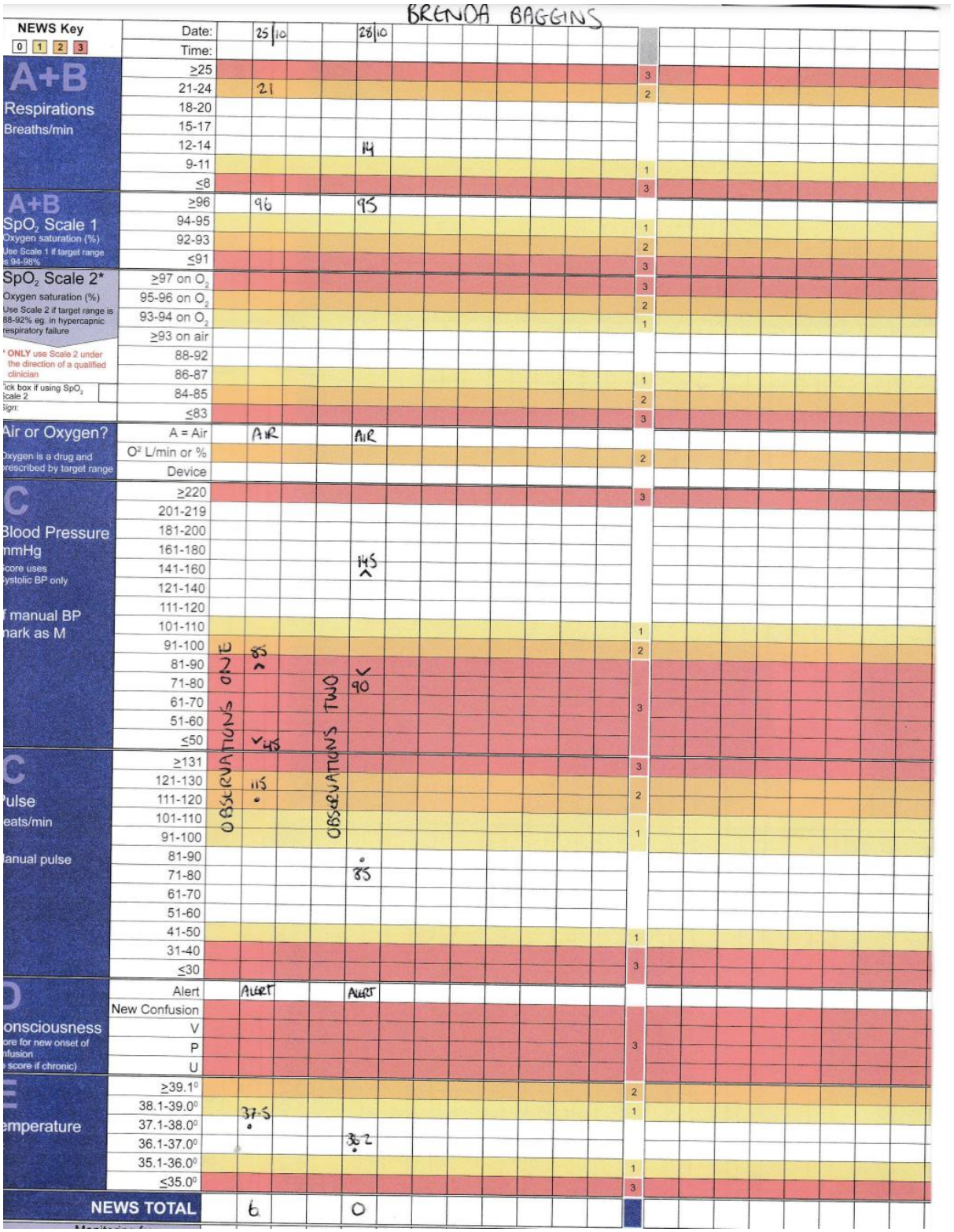
Brenda's observation chart is enclosed (observations one)

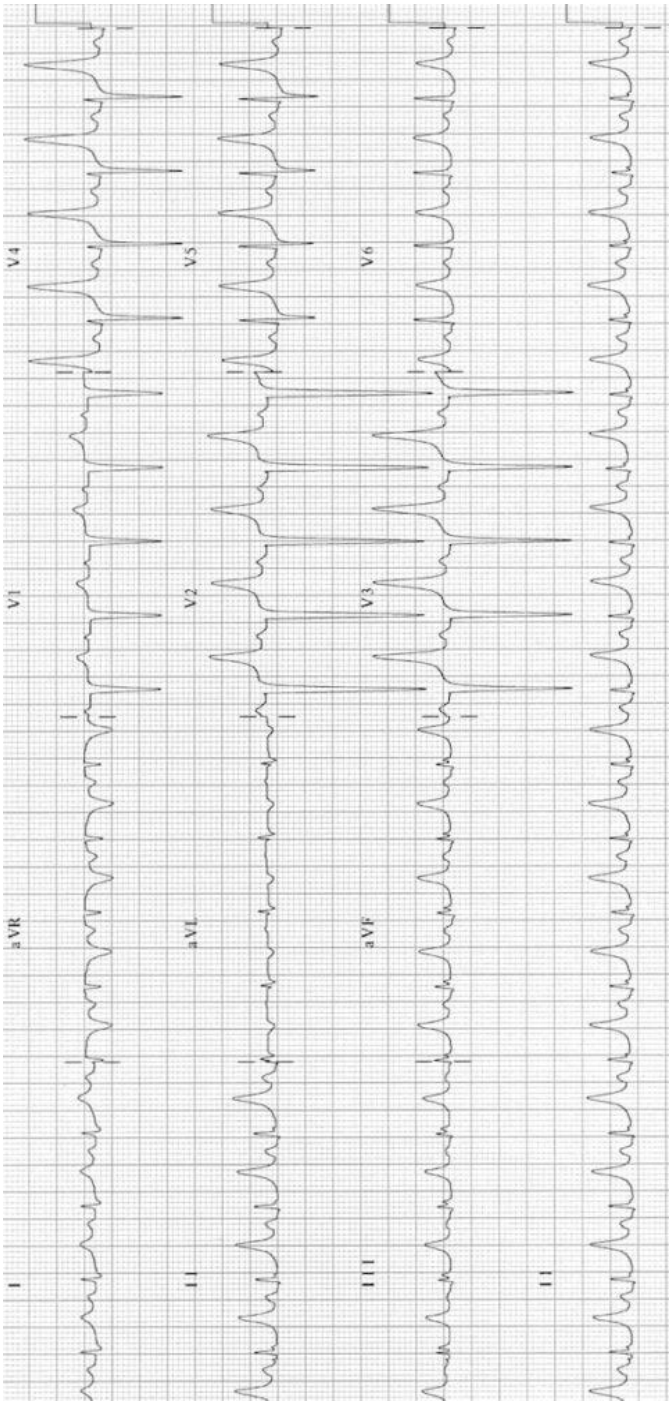
On examination, Brenda is cool peripherally with a capillary refill time of 4-5 seconds. She has dry mucous membranes. Her heart sounds are normal with no added sounds and her chest is clear. Her abdomen is soft, but generally tender. There is no peritonism or guarding, and bowel sounds are present.

As you finish seeing Brenda, you get a phone call from the labs. They give you these blood results:

Test	Result	Normal Range
Na (mmol/L)	138	135 - 145
K (mmol/L)	7.2	3.6 - 5.0
Urea (mmol/L)	31.4	2.5 - 6.6
Creatinine (umol/L)	403	64 - 111
eGFR (ml/min)	10	>60
CRP	35	<10

The nurse looking after Brenda hands you the ECG, which can be seen on the next page.





Interpretation One

1. Interpret the ECG. What abnormality can be identified?
2. What immediate treatment is indicated?
3. What additional treatment for hyperkalaemia is indicated
4. What do the blood results demonstrate? What additional information do you require to confirm this?

Interpretation One - Answers

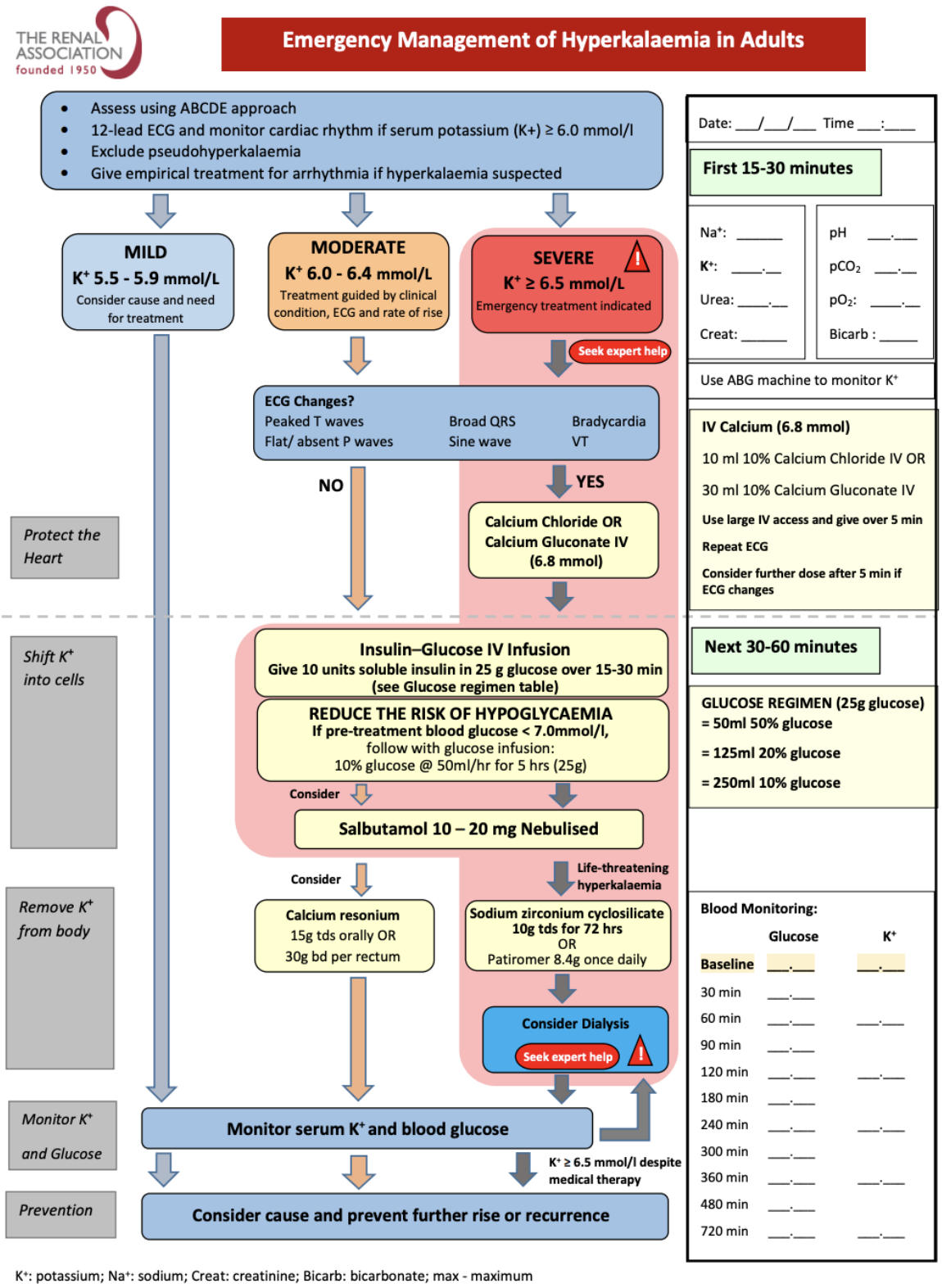
1. The ECG shows sinus rhythm. The axis is normal. The P waves, PR segment and QRS complex appear normal. The ST segments appear normal. The T waves are tall and tented, most notable in V2-V5, but also in II and III. Tall, tented T waves are the first sign of hyperkalaemia on an ECG.

2. In a patient with hyperkalaemia and ECG changes, the priority is stabilising the heart to prevent cardiac arrest. This is done with 10mls of 10% calcium gluconate or 10mls of 10% calcium chloride given IV over a period of 10 minutes. This should be done while the patient is on a cardiac monitor. With this treatment, ECG appearances should improve. If they do not, a repeat bolus may be required. The effect lasts 30-60 minutes, so repeat doses may need to be given.

3. Once the heart is protected, medicines are required to bring the serum potassium down. This is done using medicines that move potassium ions intracellularly. This should be done with a combination of:
    a. A 10mg salbutamol nebuliser
    b. 10 units of Actrapid in 50mls of 50% IV dextrose

    Following this treatment, the serum potassium should be repeated. Further cycles can be repeated if the patient remains hyperkalaemic. The Renal Association has a useful algorithm for the management of hyperkalaemia, which is included in this pack.

4. The blood results demonstrate an Acute Kidney Injury (AKI) with hyperkalaemia. To confirm that the AKI is acute rather than chronic, you need to know Brenda's baseline urea and creatinine, especially as she is known to have CKD. There is also a mild elevation in CRP.



K+: potassium; Na+: sodium; Creat: creatinine; Bicarb: bicarbonate; max - maximum

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Knowledge Check One

1. The causes of AKI are classified into three categories. What are they? Please give examples of a cause for AKI in each category.
2. Using your answers to question 1, what investigations do you think are important when trying to determine the cause of an AKI.
3. Given the information available, what do you think the cause of Brenda's AKI is. Why?
4. What treatment would you initiate at this stage?

Activity One

Included in this pack is an example of a medicines reconciliation form. Go through the medicines reconciliation form, and consider which medicines should be withheld or stopped, and which medication could be continued in a patient who had presented like Brenda. Compare your answers with the completed medicines reconciliation. If you don't recognise one of the medicines, then look it up in the BNF. If they are available. discuss with the pharmacists the importance of an accurate medicines reconciliation.

Patient Name	Date of Birth	Age
Brenda Baggins	14/09/1949	73

Allergies		
Description	Date recorded	Comments
No ECS data exists		

Sources: ☐ ECS ☐ Patient's Drugs ☐ Referrer Kardex ☐ GP Practice ☐ Trak
☐ Patient ☐ Relative/Carer ☐ Referrer Letter ☐ Comm Pharmacy ☐ Other

Actions: C: Continue W: Withhold S: Stop

Acute Medication (including those greater than 30 days)											
Drug ID	Formulation	Dose	Frequency	Medication Start Date	Prescription Date	Source 1	Source 2	Source 3	Action 1	Action 2	Action 3	Comments
No ECS data exists												

Repeat Medication												
Drug ID	Formulation	Dose	Frequency	Medication Start Date	Prescription Date	Source 1	Source 2	Source 3	Action 1	Action 2	Action 3	Comments
Omeprazole	20mg Tablets	One Tablet	Once a Day	12/04/2016	03/10/2022							
Alendronic Acid	70mg Tablets	One Tablet	Once a Week	29/03/2018	03/10/2022							
Adcal D3 Caplets	750mg/200 unit Caplets	One Caplet	Twice a Day	29/03/2018	03/10/2022							
Bendroflumethiazide	2.5mg Tablets	One Tablet	Once a Day	04/04/2019	03/10/2022							
Ramipril	5mg Tablets	One Tablet	Once a Day	10/06/2019	03/10/2022							
Ibuprofen	400mg Caplets	One Tablet	As required for pain, no more than three times a day	27/07/2022	03/10/2022							

Case continued

You give a bolus of 10ml of 10% calcium gluconate, and the ECG appearances improve. 10ml of 10% calcium chloride could have been given as an alternative. Following this, you give IV insulin/dextrose and a salbutamol nebuliser to help lower the serum potassium. You give Brenda fast intravenous fluid to rehydrate her, to raise her blood pressure and to treat her AKI. You insert a catheter to monitor Brenda's urine output. When catheterised, there is less than 100mls of urine in her bladder. With this treatment, Brenda's blood pressure improves. However, since being catheterised two hours ago, she has not passed any more urine.

You repeat a set of bloods, including an arterial blood gas to assess Brenda further. The results can be found below.

Test	Result	Normal Range
H^+ (nmol/L)	64	35 - 45
pO_2 (kPa)	13.4	11.1 – 14.4
pCO_2 (kPa)	3.8	4.7 – 6.4
HCO_3^- (mmol/L)	11	22 - 28
K^+ (mmol/L)	7.0	3.5 – 5.5
Lactate (mmol/L)	1.0	<2

Interpretation Two

1. Interpret the ABG.
2. You give further treatment for hyperkalaemia, and another one litre of IV fluid. When you repeat the blood gas, her potassium and acidosis are worsening, and Brenda remains anuric. What would be your next steps?

Knowledge Check One - Answers

Type of AKI	Causes	Basic Investigations
Pre-renal	Any cause that results in reduced kidney perfusion. For example: • Hypovolaemia • Sepsis • Hypotension • Heart failure • Cirrhosis • Over-diuresis of fluid • Drugs that increase systemic vascular resistance or cause renal vasoconstriction (NSAIDs, ACE inhibitors, Angiotensin receptor blockers	Inflammatory markers Blood culture Urine culture Medicines reconciliation
Renal	• Acute tubular necrosis • Acute interstitial nephritis • Infections (e.g. pyelonephritis) • Ischaemia (e.g renal artery thrombosis) • Toxins (e.g. antibiotics, rhabdomyolysis, haemolysis, NSAIDS) • Glomerulitis (e.g. vasculitis)	Urine dip Vasculitis screen Autoimmune screen
Post-renal	Any cause that results in obstruction or the urinary outflow tract. For example: • Urinary retention • Prostatic hyperplasia • Renal stones • Retroperitoneal fibrosis • Tumours obstructing the renal tract	Bladder scan Ultrasound of the renal tract

1. See above
2. Brenda's AKI is likely pre-renal due to a combination of hypovolaemia from gastroenteritis, and hypotension secondary to fluid losses and antihypertensives
3. In the first instance, treatments would include stopping nephrotoxic medications, catheterising Brenda, and initiating fluid resuscitation to correct hypotension and rehydrate Brenda. Most cases of gastroenteritis do not require treatment with antibiotics, so you would not routinely prescribe antibiotics.

Interpretation Two - Answers

1. This ABG shows a metabolic acidosis, as hydrogen ions are high, and bicarbonate is low. There is evidence of partial respiratory compensation. The acidosis has stimulated hyperventilation to blow off carbon dioxide to try and correct the acidosis. The correction is only partial because the acidosis remains.
2. A patient who has a high potassium, a persistent acidosis and no urine output despite treatment has kidneys which are not working. Though you have given treatment to move potassium into cells, Brenda will not be able to excrete this unless she is able to pass urine. She requires dialysis to manage her AKI.

Knowledge Check Two

1. Can you list some indications for emergency dialysis?

On the renal ward…

Brenda is transferred to the Renal High Dependency Unit where dialysis is initiated. With dialysis and supportive treatment over the next 72 hours, she begins to pass urine and her kidney function improves. Her creatinine stabilises at 150, which is her baseline. A stool culture comes back positive for Norovirus. Dialysis is successfully stopped, her catheter removed, and Brenda is stepped down to the Renal ward for a period of rehabilitation following her acute illness. On the ward she has been eating and drinking well and has not been taking any nephrotoxic medications.

On the ward round several days later, Brenda describes feeling less well. She hasn't moved her bowels for a week, and when she goes to the bathroom, she is struggling to pass urine. Additionally, she has some new dysuria since the catheter was removed.

Her observations are charted (observations two). She looks well hydrated. She has some suprapubic tenderness, with dullness to percuss in the suprapubic area.

You repeat some investigations.

Test	Result	Normal Range
Na (mmol/L)	142	135 - 145
K (mmol/L)	4.8	3.6 - 5.0
Urea (mmol/L)	12.8	2.5 - 6.6
Creatinine (umol/L)	250	64 - 111
eGFR (ml/min)	17	>60
CRP	87	<10

Urinalysis

Blood – Neg

Protein – Neg

Leucocytes - +++

Nitrites - +++

Ketones – Neg

<u>Interpretation Three</u>

1. How would you describe the metabolic abnormality on Brenda's repeat blood tests?
2. What is the most likely cause for the change in Brenda's blood results? Why?
3. What investigation could be done to confirm this?
4. What would be the next steps in management?
5. Based on your previous answers, how would you classify the metabolic abnormality seen on Brenda's blood tests?

<u>Knowledge Check Two - Answers</u>

1. The indications for emergency dialysis are:
    a. Refractory hyperkalaemia
    b. Refractory metabolic acidosis
    c. Fluid overload
    d. Uraemic symptoms (e.g., uraemic pericarditis, uraemic encephalopathy)
    e. Removal of toxins

Interpretation Three - Answers

1. Brenda has a further AKI. On this occasion, there is also a moderate elevation in her CRP.

2. Brenda's history of being unable to pass urine is consistent with urinary retention. Supportive evidence for this is the history of constipation, the recent catheter removal, and symptoms and investigations suggestive of a UTI, all of which are risk factors for urinary retention.

3. A bladder scan can confirm urinary retention.

4. Insertion of a catheter, initiation of antibiotics for a UTI and laxatives for constipation would all be appropriate next steps in management.

5. Urinary retention causes a post-renal AKI.

Activity Two

Urinalysis is an essential component of any assessment of an AKI. Positive leucocytes and nitrites can suggest a UTI, and positive blood and protein can suggest intrinsic renal disease. It is a useful test to be able to perform if you are looking for diagnostic information in a hurry. Identify a patient on the ward who needs a urine dipstick (there is likely to be a few). Either perform the dipstick manually or ask one of the nurses to show you how to use the Point of Care Urinalysis machine so you can receive a printout of the urinalysis result. Don't forget to document the result!

Conclusion

A catheter is inserted to allow Brenda to freely pass urine. She is started on antibiotics to treat a urine infection, and laxatives are initiated to treat constipation. Once the constipation and UTI have both been treated, Brenda has a successful trial without catheter. After a short period of physiotherapy, she is discharged home.

Well done on completing this case. I hope that you have found it informative. If you have any questions, please contact …

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Thank you for completing this long case. As these cases are new intervention, we would really value your feedback.

We would be very grateful if you could complete the feedback form accessed from the QR code below.

