DIAGNOSIS IN THE ANURIC/OLIGURIC PATIENT

INTERMEDIATE DISCUSSION-4 MAY 2011
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INTRODUCTION

- Acute renal failure is characterised by an abrupt decline in renal function resulting in the inability of the kidney to maintain fluid and electrolyte homeostasis, as well as excrete nitrogenous waste.
- ARF is a common clinical entity affecting 7-10% of all hospitalised patients.
- Significant mortality of 20-70%, which has remained unchanged despite renal replacement therapy.
- Patients will commonly present with:
  - Electrolyte disturbances: hyperkalemia
  - Oliguria: urine output of < 400 ml/24 hrs or <0.5 ml/kg/hr for 6 consecutive hours
  - Anuria: urine output of less than 50 ml/12 hours
## RIFLE CRITERIA

<table>
<thead>
<tr>
<th>Loss</th>
<th>Persistent ARF/ESKD</th>
</tr>
</thead>
<tbody>
<tr>
<td>Loss</td>
<td>Complete loss of kidney function $&gt;4$ weeks</td>
</tr>
<tr>
<td>ESKD</td>
<td>End stage kidney disease $&gt;3$ months</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Risk</th>
<th>Increased serum creatinine $\times 2$, or GFR decrease by $&gt;25%$</th>
<th>$&lt;0.5$ mL/kg/hr for $6$ consecutive hours</th>
</tr>
</thead>
<tbody>
<tr>
<td>Injury</td>
<td>Increased serum creatinine $\times 2$, or GFR decrease $&gt;50%$</td>
<td>$&lt;0.5$ mL/kg/hr for $12$ consecutive hours</td>
</tr>
<tr>
<td>Failure</td>
<td>Increased serum creatinine $\times 3$, or GFR decrease by $&gt;75%$</td>
<td>$&lt;0.3$ mL/kg/hr for $24$ hrs, or anuria for $12$ hrs</td>
</tr>
</tbody>
</table>
AKIN CRITERIA

- Rapid time course (less than 48 hours)
- Reduction in kidney function
  - Absolute increase in serum creatinine of ≥ 0.3 mg/dl
  - Percentage increase in serum creatinine of ≥ 50%
- Reduction in urine output, defined as less than 0.5 mL/kg/hr for 6 consecutive hours.
WHY TRY TO IDENTIFY THE AETIOLOGY

- By grouping the aetiology of renal failure into the categories of prerenal, renal and postrenal we try to identify any potentially reversible factors that may be precipitating or compounding the injury e.g:
  - Volume depletion - NB
  - Nephrotoxic drugs
  - Low cardiac output due to cardiogenic shock
  - Urethral obstruction due to a stricture
- Furthermore the therapy will be dictated by the cause
## HISTORY

<table>
<thead>
<tr>
<th>Category</th>
<th>Causes</th>
</tr>
</thead>
<tbody>
<tr>
<td>PRERENAL</td>
<td>Vomiting, diarrhoea, haemorrhage, burns, overdiuresis, pancreatitis, intraoperative fluid loss or hypotension, history of heart disease</td>
</tr>
<tr>
<td>RENAL</td>
<td>Nephrotoxic medications, iv contrast, urti, auto-immune diseases, family history of renal disease, muscle trauma (assault, mva, compartment syndrome), haematuria</td>
</tr>
<tr>
<td>POSTRENNAL</td>
<td>Flank pain, LUTS symptoms (weak strem, dribbling, increased frequency)</td>
</tr>
</tbody>
</table>
# EXAMINATION

<table>
<thead>
<tr>
<th>PHASE</th>
<th>PHYSICAL EXAMINATION</th>
</tr>
</thead>
<tbody>
<tr>
<td>PRERENAL</td>
<td>Orthostatic hypotension, decreased skin turgor, dry buccal mucosa, oedema, signs of</td>
</tr>
<tr>
<td></td>
<td>ccf, signs of liver disease</td>
</tr>
<tr>
<td>RENAL</td>
<td>Oedema, petechiae, palpable purpura, muscle tenderness</td>
</tr>
<tr>
<td>POSTRENAL</td>
<td>Palpable bladder, abdominal or pelvic mass, enlarged prostate</td>
</tr>
</tbody>
</table>
BASIC EVALUATIONS

- **CHECK THE URINARY CATHETER!!** Make sure it is correctly placed in the bladder and that it is not blocked. Flush and replace the catheter if in doubt.

- Evaluate **volume status**. In the ICU setting, this is best done with the aid of invasive monitoring.

- The CVP is of use if it is very low or very high.

- The PA catheter or the vigeleo will help in evaluating the cardiac output as well as give further information about the volume status, for example the SVV in ventilated patients.

- If clinically indicated, measure patients' intra-abdominal pressure. Abdominal compartment syndrome will cause acute renal failure and anuria.
BLOODS

- In addition to the battery of bloods that are done in acutely ill patients in the ICU setting especially the one of the most importance in ARF is the UKE.
- Hyperkalemia is a common and life-threatening abnormality that has to be corrected promptly.
- The ratios of the elevated urea and creatinine can indicate etiology:
- A blood urea/creatinine ratio of more than 15:1 to 20:1 is suggestive of prerenal failure. Hypoperfusion of the kidney leads to reabsorption of urea.
CREATININE CLEARANCE

- **COCKGRAFT-GAULT FORMULA**
  - In men:
  - \[ CR\ CL = \frac{(140-\text{AGE}) \times \text{weight(kg)}}{72 \times \text{serum creatinine (mg/dl)}} \]
  - In women: \( CR\ CL \times 0.85 \)
  - This formula overestimates creatinine clearance as creatinine is also secreted by the renal tubules.
URINE DIPSTICKS

- Easily available and must be done routinely on all new admissions. Useful screening tool.
- PH-alkalosis-urosepsis with urea splitting organisms
- Proteinuria-glomerular injury
- Glycosuria-tubular injury or hyperglycemia
- Haematuria-infection, nephrolithiasis, myoglobinuria, primary glomerular diseases
- Leucocytes-urosepsis, AIN.
- Nitrates-urosepsis
URINE MICROSCOPY

- Easy and inexpensive and can give valuable information.
- Normal - prerenal or postrenal.
- Abundant tubular epithelial cells - ATN
- RBC casts - vasculitis
- Urinary white cell casts - pyelonephritis
- Eosinophils - AIN
- Pigmented casts - myoglobinuria
- Crystals - uric acid, drugs or toxins
SPOT URINE SODIUM

- When renal perfusion is diminished, sodium reabsorption increases in order to try and expand the plasma volume and in so doing improve renal perfusion.
- Renal sodium excretion will therefore decrease.
- Therefore a urine sodium of less than 20 mEq/l will indicate a prerenal aetiology.
- A urine sodium of greater than 40 mEq/l is most likely renal in origin.
FRACTIONAL EXCRETION OF SODIUM

- The fractional excretion of sodium is one of the most reliable parameters in distinguishing prerenal from renal failure.
- The fractional excretion of sodium refers to the fraction of sodium filtered at the glomerulus that is excreted in the urine.
- The normal fractional excretion is less than 1%.
- Therefore if the fractional excretion is $<1\%$ - prerenal
  $>2\%$ - renal

FORMULA: $\text{FE}_{\text{Na}} = \frac{\text{Urine sodium}}{\text{Plasma sodium}} \times 100 \times \frac{\text{Urine creatinine}}{\text{Plasma creatinine}}$
### SUMMARY OF URINARY ANALYSIS

<table>
<thead>
<tr>
<th></th>
<th>PRERENAL</th>
<th>ATN</th>
<th>AIN</th>
<th>OBSTR</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>SEDIMENT</strong></td>
<td>BLAND</td>
<td>BROWN, GRANULAR CASTS</td>
<td>WBC, EOSINOPHILS</td>
<td>BLAND, BLOODY</td>
</tr>
<tr>
<td><strong>PROTEIN</strong></td>
<td>NONE</td>
<td>NONE</td>
<td>MINIMAL</td>
<td>LOW</td>
</tr>
<tr>
<td><strong>URINE SODIUM Meq/l</strong></td>
<td>&lt; 20</td>
<td>&gt;30</td>
<td>&gt;30</td>
<td>&lt;20 ACUTE &gt;40 FEW DAYS</td>
</tr>
<tr>
<td><strong>URINE OSM Mosm/kg</strong></td>
<td>&gt; 400</td>
<td>&lt;350</td>
<td>&gt;400</td>
<td>&lt;350</td>
</tr>
<tr>
<td><strong>FE of NA</strong></td>
<td>&lt; 1</td>
<td>&gt;1</td>
<td>VARIES</td>
<td>&lt;1 ACUTE &gt;1 FEW DAYS</td>
</tr>
</tbody>
</table>
Imaging is of particular value to assess the following:

- **Size and corticomedullary differentiation of the kidneys.**
- **Acute normal size kidneys with normal differentiation.**
- **Chronic small kidneys with poor corticomedullary differentiation.**
- **Assess for any post obstructive causes**
  - Hydronephrosis and hydroureter
  - Renal stones
  - Pelvic/retroperitoneal masses
IMAGING

- Ultrasonography - first line in imaging, non-invasive and available at the bedside. Useful in assessing renal arteries, kidney size and differentiation and possible obstructive causes.
- CT Scanning - useful in diagnosing renal stones or pyelonephritis. Issue of nephrotoxic contrast.
- Retrograde and antegrade contrast studies - not done frequently. Only if underlying pathology necessitates it.
RENAL BIOPSY

- Reserved as a last resort when diagnostic difficulties are present.
- Studies have shown that it is safe to do an ultrasound guided renal biopsy in ICU with no change to morbidity or mortality.
- Remember to check and correct any thrombocytopenia, platelet dysfunction or clotting factor abnormalities prior to the biopsy.
CONCLUSION

- Acute renal failure is a common condition with a high morbidity and mortality.
- It is essential that an aetiological diagnosis is made as early as possible and that any reversible factors be corrected as soon as possible in order to prevent permanent renal damage.
- As discussed, there are multiple diagnostic modalities available in order to do this.
- Involve the nephrologists early!!

THANKYOU
REFERENCES