The Spleen

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CRQ (20 marks)

• What is the blood supply to the spleen (1 mark)
• List 5 functions of the spleen with an example for each? (5 marks)
• What conditions are associated with hyposplenism (2 marks)
• What are the indications for a splenectomy? (2 marks)
• Describe your anaesthetic management for this patient? (8 marks)
• What is the current recommended vaccination schedule for patients undergoing a splenectomy? (2 marks)
Anatomy

- Weighs 100-150g
- Posteriorly – diaphragm
- Anteriorly – stomach
- Medially – left kidney
- Inferiorly – splenic flexure of the colon
- Tail of the pancreas attaches to the spleno-renal ligament and extends to the splenic hilum
# Splenic function

<table>
<thead>
<tr>
<th>Function</th>
<th>Examples</th>
</tr>
</thead>
<tbody>
<tr>
<td>Immune</td>
<td>Antigen presentation</td>
</tr>
<tr>
<td></td>
<td>Stores lymphocytes and macrophages and exposes to circulation</td>
</tr>
<tr>
<td>Filtration &amp; metabolism</td>
<td>Removes old/damaged erythrocytes</td>
</tr>
<tr>
<td></td>
<td>Macrophages release haem from haemoglobin</td>
</tr>
<tr>
<td>Storage</td>
<td>240mls red cells</td>
</tr>
<tr>
<td></td>
<td>30% platelets</td>
</tr>
<tr>
<td></td>
<td>Iron</td>
</tr>
<tr>
<td>Production</td>
<td>Opsonins (complement activation)</td>
</tr>
<tr>
<td>Haematopoiesis</td>
<td>Until 5\textsuperscript{th} gestational month</td>
</tr>
</tbody>
</table>
Disorders of the spleen

• Splenomegaly & hypersplenism

• Splenic artery aneurysm

• Hyposplenism & overwhelming post splenectomy infection syndrome

• Splenic infarction

• Accessory spleens
Splenomegaly & hypersplenism

• No agreement on categorising the degrees of splenomegaly:

  • Length:
    • Normal spleens < 12cms in craniocaudal length
    • Moderately enlarged 12-20cms
    • Severely enlarged > 20cms

  • Weight:
    • Splenomegalic – 500-1000g
    • Massive splenomegaly > 1000g
# Causes of Splenomegaly & hypersplenism

<table>
<thead>
<tr>
<th>Causes</th>
<th>Examples</th>
</tr>
</thead>
<tbody>
<tr>
<td>Infection</td>
<td>Infectious mononucleosis, malaria, HIV, TB</td>
</tr>
<tr>
<td>Neoplasia</td>
<td>Leukaemias, lymphomas, myeloproliferative disease, metastatic tumours</td>
</tr>
<tr>
<td>Congestion</td>
<td>Pre-hepatic: Portal/splenic vein thrombosis</td>
</tr>
<tr>
<td></td>
<td>Hepatic – Cirrhosis</td>
</tr>
<tr>
<td></td>
<td>Post hepatic – Right heart failure, Budd-Chiari, pulmonary, tricuspid</td>
</tr>
<tr>
<td></td>
<td>disease</td>
</tr>
<tr>
<td>Increased function</td>
<td>Sickle cell disease, hereditary anaemias</td>
</tr>
<tr>
<td>Immune</td>
<td>RA, ITP, SLE, Sarcoidosis</td>
</tr>
<tr>
<td>Storage</td>
<td>Amyloidosis</td>
</tr>
</tbody>
</table>
Splenic artery aneurysm

• Dilatation of the splenic artery > 1cm diameter
• 3rd most common aneurysm
• Presentation
  • Abdominal pain
  • Incidental finding at angiography
  • Hypotension, sudden collapse following rupture
Splenic artery aneurysm

- Strong association with pregnancy
- 95% ruptures occur during pregnancy
- Most commonly in the 3rd trimester
- Mortality 25% in normal population
- Mortality 75% in pregnancy
- Mimics the symptoms of other obstetric emergencies
- Treatment – endovascular ablation
Hyposplenism

• Characterised by increasing susceptibility to infection by encapsulated microorganisms

• Associated conditions:
  • Alcoholic liver disease
  • Sickle cell disease
  • Bone marrow transplantation
  • Inflammatory bowel disease

• Markers of hyposplenism:
  • Acanthocytes
  • Target cells
  • Howell-Jolly bodies
OPSI

• Characterised by the following:
  • Massive bacteraemia
  • No obvious primary infection source
  • Short prodromal phase
  • Septic shock accompanied by multi-organ dysfunction
  • Waterhouse-Freidrichsen syndrome
OPSI

• Prompt recognition
• Intensive care sepsis treatment strategies
• IV antibiotics
• Vasopressors
• Blood products
• Mortality rate between 40-70%
Antibiotics in asplenic patients

• Offered to those at risk of pneumococcal infection:
  • Aged <16 or >50 yrs
  • Inadequate serological response to pneumococcal vaccine
  • Impaired immune function (malignancy)
  • Previous history of invasive pneumococcal disease
Vaccinations

- Cover common organisms (pneumococcal, Hib, meningococcal, influenza)
- Administered at least 2 weeks before scheduled splenectomy
- Post emergency splenectomy delayed for 2 weeks following surgery
- Delivered 2 weeks before patients commence immunosuppressive treatment
- Repeat vaccination should occur every 5 years
## Splenic infarction

<table>
<thead>
<tr>
<th>Cause</th>
<th>Examples</th>
</tr>
</thead>
<tbody>
<tr>
<td>Malignant</td>
<td>Leukaemia, lymphoma</td>
</tr>
<tr>
<td>Haematological</td>
<td>Sickle cell disease, antiphospholipid syndrome, protein C or S deficiency</td>
</tr>
<tr>
<td>Embolic</td>
<td>AF, endocarditis, LV thrombus</td>
</tr>
<tr>
<td>Trauma</td>
<td>Blunt, torsion of the vascular pedicle</td>
</tr>
<tr>
<td>Iatrogenic</td>
<td>Oesophagectomy, gastrectomy, liver transplant</td>
</tr>
<tr>
<td>Miscellaneous</td>
<td>Splenic vein thrombosis, pancreatitis, sarcoidosis, amyloidosis, ARDS</td>
</tr>
</tbody>
</table>
Splenic infarction

- Third asymptomatic
- Left upper quadrant pain
- Pleuritic chest pain
- Shoulder tip pain (Kehr sign)

- CT best imaging modality
Splendor
tomy

- Indications:
  - Trauma
  - Refractory haematological disease (ITP, hereditary spherocytosis, thalassemia, Hodgkin disease, leukaemia's, myeloproliferative disease)
Traumatic splenic injury

- Clinical signs are unreliable
- Non-operative management mainstay of treatment
- Contrast enhanced CT best imaging modality
- American Association for Surgery of Trauma (AAST) grading system is helpful in stratifying patients
- VTE prophylaxis is important in patients with isolated plenic injuries
<table>
<thead>
<tr>
<th>Grade*</th>
<th>Injury type</th>
<th>Description of injury</th>
<th>AIS-90</th>
</tr>
</thead>
<tbody>
<tr>
<td>I</td>
<td>Hematoma</td>
<td>Subcapsular, &lt;10% surface area</td>
<td>2</td>
</tr>
<tr>
<td></td>
<td>Laceration</td>
<td>Capsular tear, &lt;1 cm parenchymal depth</td>
<td>2</td>
</tr>
<tr>
<td>II</td>
<td>Hematoma</td>
<td>Subcapsular, 10% to 50% surface area; intraparenchymal, &lt;5 cm in diameter</td>
<td>2</td>
</tr>
<tr>
<td></td>
<td>Laceration</td>
<td>Capsular tear, 1–3 cm parenchymal depth that does not involve a trabecular vessel</td>
<td>2</td>
</tr>
<tr>
<td>III</td>
<td>Hematoma</td>
<td>Subcapsular, &gt;50% surface area or expanding; ruptured subcapsular or parenchymal hematoma; intraparenchymal hematoma ≥ 5 cm or expanding</td>
<td>3</td>
</tr>
<tr>
<td></td>
<td>Laceration</td>
<td>Parenchymal depth &gt;3 cm or involving trabecular vessels</td>
<td>3</td>
</tr>
<tr>
<td>IV</td>
<td>Laceration</td>
<td>Laceration involving segmental or hilar vessels producing major devascularization (&gt;25% of spleen)</td>
<td>4</td>
</tr>
<tr>
<td>V</td>
<td>Laceration</td>
<td>Completely shattered spleen</td>
<td>5</td>
</tr>
<tr>
<td></td>
<td>Vascular</td>
<td>Hilar vascular injury that devascularizes spleen</td>
<td>5</td>
</tr>
</tbody>
</table>

* Advance one grade for multiple injuries up to grade III.
AIS, Abbreviated Injury Score.
Splenectomy

• Preoperative:
  • Routine as for any major surgery
  • Liaise with haematologists – patients often anaemic and thrombocytopenic
  • May require irradiated or human leucocyte antigen (HLA), immunoglobulins, steroids
  • Involvement of the MDT (haematologist, oncologist, interventional radiologist, surgeon, anaesthetist)
Surgical approach

- Depends upon splenic size, indication and surgical preference
- Emergency/trauma – open in the supine position with a upper midline incision
- Elective – subcostal incision
- Laparoscopic – anterior or lateral
General intraoperative measures

- Intubate & use orogastric tube to decompress the stomach
- Antibiotic prophylaxis
- Eyes taped, ensure no pressure applied
- Large bore IV access, IABP, CO monitoring
- Positive pressure ventilation
- Ensure ear has not folded on positioning
- Lateral debicutus position
  - Common peroneal nerve
  - Radial nerve
  - Saphenous nerve
- Fluid management, avoid acidosis, temperature regulation
Neuraxial blockade & venous thromboembolism

- Haematological issues may preclude the use of epidural
- Haemato-oncology patients – limited evidence of minimum platelet count to guide catheter placement
- Acknowledged that $>100 \times 10^9$ litre$^{-1}$
- Parnutrient patient – Lower thresholds accepted
Venous thromboembolism

- Increased in post-splenectomy patients
- Multifactorial aetiology
  - Surgery, immobility, trauma, blood transfusions
  - Malignancy
  - Haematological disorders
  - Thrombocytosis, hypercoagulability
- Myeloproliferative disease – Incidence of portal vein thrombosis 40% therefore need for post operative anticoagulation is high
Management of thrombolysis with epidural catheter in situ

- Lowest fibrinogen & plasminogen level is at 5 hours after thrombolytic therapy
- Remain depressed at 27 hours
- AAGBI recommend waiting 10 days after thrombolysis before performing a neuraxial block
- Recommend that thrombolysis should be delayed for 10 days if a neuraxial block has been performed
- If thrombolysis administered, leave epidural catheter in situ, stop the infusion, close neurological monitoring, monitor fibrinogen concentrations to help catheter removal, possible with FFP cover
Partial splenectomy, autotransplantation

- Autotransplantation – leaving splenic tissue deliberately behind in the abdomen after splenectomy
- Partial splenectomy preferable as associated with:
  - Better antibody titres
  - Better pneumococcal uptake
  - Improved survival rates
- Conditions appropriate for partial splenectomy:
  - Iatrogenic splenic injury
  - Splenic cysts
  - Benign tumours
  - Hereditary spherocytosis
Summary

• Highlighted the importance of the spleen

• Presented with trauma patients regularly

• Fundamental role in the diagnosis, resuscitation, operative and post operative management