What will I try to address?

- HUTT test responses
- Assessment of autonomic function with tilting
- Heart rate variability in normal and abnormal
- QT variability
- Scientific and clinical correlations
- Current advice for use of testing
My response to hearing my talk title...

- Because I don’t use tilt testing in my practice
The standard referral

- Dear Doctor, please will you see this teenager who presents with multiple episodes of collapse. I have referred her case to the neurologists who are convinced that this is “syncope” and need you to review her
Syncope

- **Medical dictionary definition**
  - *Syncope*: Partial or complete loss of consciousness with interruption of awareness of oneself and one's surroundings.

- So, yes, the collapsing child has “syncope”
- BUT that doesn’t necessarily mean there is anything wrong with their heart
Investigation of a child with Syncope

• Initially a full detailed history of the collapse episodes should be taken
• Include a full family history of any similar collapse events
• Perform a full detailed examination of the cardiovascular system

• Perform a 12 lead ECG
• Echo if any clinical evidence of structural heart disease
Investigation of a patient with syncope

• NICE guidance for investigation of syncope (currently only for adult patients) suggests that tilt table testing should NOT be performed if the diagnosis of vaso-vagal syncope is clear from history and examination.

• Also suggests that 24 hour tape should be performed before tilt-testing is considered in cases where there is an unclear cause.
What is a HUTT

Stage 1: Lie down and relax with monitors attached.
Stage 2: Dr tilts the bed, reads the monitors and watches your reactions.
Stage 3: Dr lies you down again when they have the info needed, or you've had enough.
Stage 4: Lie down and recover.

- There is variability in angle of tilt (60-80 degrees), length of tilt 20-150mins and drug usage
- No consensus on best combination at present
Results of tilt-table testing

- Syncope or not
- Difficult to interpret importance of non-specific (such as pre-syncope sensations) results though
- Up to 15% of normal patients (with no previous episodes of syncope) will have a positive response – this is particularly with Drug augmented tilts.
Responses to tilt table testing

Hemodynamic Responses to Tilt Table Testing

- Vasovagal response
  - Type 1: Mixed
  - Type 2: Cardioinhibitory
  - Type 3: Vasodepressor
- Dysautonomic response
- Postural orthostatic tachycardia syndrome (POTS)
Type 1 syncope – Mixed response

- Heart rate falls at the time of syncope BUT the rate remains above 40bpm or falls to less than 40bpm for 10 seconds or less
- BP falls before the heart rate falls
Type 2 syncope – Cardio-inhibitory response

- Subtype A – inhibition without asystole – HR falls to below 40bpm for more than 10s, but asystole of over 3s does not occur before the heart rate falls

- Subtype B – inhibition with asystole – There is asystole of over 3s. BP falls with the HR fall
Type 3 Syncope - Vasodepressor

- Heart rate does not fall more than 10% from peak at time of syncope

- However – in some patients there is chronotropic incompetence Poor HR rise from baseline) or excessive HR rise at the onset of tilting – this makes interpretation of heart rate drop difficult
POTS response to tilting

- Diagnostic criteria suggest a rise of heart rate of over 30bpm from baseline
- This is without significant orthostatic hypotension
- IE. Not just a vagal response
### Frequency of responses

<table>
<thead>
<tr>
<th>Type of response</th>
<th>Groups</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Children</td>
</tr>
<tr>
<td>Negative</td>
<td>21 (58.3%)</td>
</tr>
<tr>
<td>Mixed positive</td>
<td>10 (27.7%)</td>
</tr>
<tr>
<td>Positive vasodepressive</td>
<td>4 (11.1%)</td>
</tr>
<tr>
<td>Positive cardioinhibitory</td>
<td>1 (2.7%)</td>
</tr>
<tr>
<td>Tachycardic postural syndrome</td>
<td>0 (0%)</td>
</tr>
</tbody>
</table>

\[ P = 0.669 \text{ (chi-square test)} \]
QT response to head up tilt testing

• We know that QT shortens in response to sympathetic stimulation (particularly demonstrated on exercise or adrenaline testing)

• HUTT achieves brisk sympathetic stimulation (both adrenaline and nor-adrenaline levels rise rapidly with tilting)
QT response to HUTT in normal patients

- Significant shortening of the RR interval ($p<0.001$)
- Moderate shortening of the absolute QT interval ($p=0.001$)
- Therefore corrected QT interval actually lengthens with tilting in normal patients, with some patients going from normal to abnormal values
QT interval changes in HUTT in Long QT patients

• With genetically confirmed long QT syndrome, there is some evidence (small studies) to suggest that there is not as much shortening in the absolute QT interval as in normal patients (and therefore QTc prolongs by even more than in normals)

• Patients with long QT syndrome also seem to be particularly susceptible to neurally mediated syncope – collapse in these patients isn’t always VT
Heart rate variability changes

• There is some evidence that in patients with a positive tilt table test and a cardio-inhibitory response that they have an abnormal degree of heart rate variability at baseline.

• There appear to be two different models of this change - one relates to a progressive increase in cardiac autonomic modulation until the sudden onset of bradycardia.

• The other model sees an inhibition of the sympathetic component and concomitant increase in vagal modulation.
Assessing the evidence for HRV in tilting

• Analysis of Heart Rate Variability Before and During Tilt Test in Patients with Cardioinhibitory Vasovagal Syncope

• Cláudia Madeira Miranda (1) and Rose Mary Ferreira Lisboa da Silva (2)

Brazil
Effect of tilting on variability

• Heart rate variability was assessed using spectral analysis computer software and 3 lead ECG
• Assessment in the 5\textsuperscript{th} minute of the supine phase and the 5\textsuperscript{th} minute of the tilted phase and the 5\textsuperscript{th} minute of lying flat again (either at the end of the test or following syncope)
• Analysis of each stage was performed with the Low frequency, High frequency and LF/HF ratio assessed
• Assessed cases with prior +ve tilt against controls with no history of syncope and –ve tilt
Effect of tilting

- Overall (total study population only 64 patients), Low Frequency is maintained (8.9 supine, 10.0 tilted)
- High Frequency decreases significantly (6.2 to 2.7, p value 0.0001)
- LF/HF ratio increases significantly (4.1 to 7.1, p value 0.0001)
Effect of tilting on HRV in syncopal patients compared to controls

- LF, HF variability and LF/HF ratio is significantly higher both prior to the test and following a positive tilt than in negative controls without syncope (p values 0.001-0.01)

- During the tilt period, the differences from the normal population reduce and although all aspects are still higher in the syncopal group they are no longer significant (p value around 0.2)
Heart Rate Variability

• A further mixed study of similar size (69 patients) suggested that the low frequency/high frequency ratio is persistently reduced throughout the entire period of inclination in patients with positive results.

• There is some suggestion that by simply measuring the heart rate variability early in the test rather than prolonged or drug sensitised tilting we can predict the response.
Current advice for use of testing

• Both the American Heart association (2017) and the European Society of Cardiology (2018) have recently revised guidelines on the investigation and treatment of syncope
• Neither recommend tilt testing as a first line investigation
• Both recommend prolonged ECG monitoring (including implantable recorders) in patients with severe unexplained syncope
• The ESC suggest tilting where syncope may be due to a reflex or orthostatic cause
Guidance for testing in syncope

- Full history and examination. ECG is useful (class 1)
- Echo only if indicated by abnormal clinical findings (Class 1). Echo if normal findings is Class 3
- Reassurance in cases that suggest vaso-vagal syncope. Patient education of prognosis is beneficial
- Prolonged ECG monitoring if syncope is severe and unexplained
- Tilt testing is an alternative option to invasive loop recorder monitoring to guide therapy
Tilt Training
Tilt Table Testing...
Sometimes even superheroes need a lie down!
Any Questions?

THANK YOU