Evaluation of the Sonographic Murphy's Sign: Is it Necessary?

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Purpose

Acute cholecystitis is defined as acute inflammation of the gallbladder wall that in the vast majority of cases is precipitated by gallstone obstruction of the neck or cystic duct\(^1\). The clinical need to rule out or confirm the presence of gallbladder inflammation formulates the basis of common surgical referral to the radiology department.

The diagnosis of acute cholecystitis can be exquisitely difficult and is based upon the constellation of multiple specific signs, one of which is the Sonographic Murphy's Sign (SMS). The SMS is defined as the presence of maximal tenderness that is elicited over a sonographically localised gallbladder\(^2\).

Traditional axioms, based on early literature suggest that in isolation, the SMS is insensitive and non-specific. However, when combined with sonographic evidence of gallstones and gall-bladder wall thickening (>3mm) the sensitivity increases\(^3\). Gall-bladder enlargement, peri-cholecystic fluid and demonstration of an impacted stone in Hartmann's pouch in combination with a high clinical suspicion have also been described as supporting evidence which also increase sensitivity and specificity\(^4\).

The purpose of our project is to prospectively evaluate the SMS in patients referred for the sonographic assessment of the upper abdomen in both painful and non-painful conditions. The inclusion of patients with non-painful indications such as investigation of deranged liver functions tests, follow up of a solid liver mass or hepatoma screen was essential as this established our inherent negative control group.

Our aim is to evaluate the incidence of tenderness elicited in both the inflamed and non-inflamed gallbladder and establish whether the background incidence may contribute to the accuracy (or inaccuracy) of the SMS in patients with upper abdominal pain in pathologically proven cases of cholecystitis.

Within our institution it has been observed that referral habits have changed. A common observation is the absence of any documentation of a bedside Clinical Murphy’s sign (CMS) The CMS is defined as palpation under the right costal margin while a patient deeply inspires. A positive result is when the patient feels pain with the deep inspiration and arrests the breath\(^5\). A further aim of our project is to evaluate if a positive CMS correlates with the SMS and if its omission is significant in aiding the diagnosis of acute cholecystitis.
Methods and Materials

Ethical approval with waived informed patient consent was obtained prior to data collection.

Prospective consecutive examination was performed of 1221 patients referred to the St. Vincent's Hospital and Central Melbourne Medical Imaging (CMMI) departments for upper abdominal ultrasound (regardless of indication) over a four-month period from the 1st of November 2011 - until 29th February 2012.

Prior to the collection of data, a meeting was held with the departmental team of sonographers. A technically standardised technique to elicit the SMS was discussed and a consensus opinion was agreed upon. It was agreed that a SMS would be considered positive when a patient exhibited maximal tenderness over a visualized gallbladder only. If no tenderness was elicited, or if tenderness was the same in adjacent regions the sign was considered negative. This technique was performed on all patients as an extension of the routine sonographic abdominal assessment regardless of indication.

The studies were acquired on two Phillips IU22™ machines within the St. Vincent's hospital department of medical imaging and on the General Electric LOGIQ™, and Siemens Sequoia™ machines within CMMI.

Prospective data was collected and stratified into the parameters of patient identifier, sex and age, and indication. For every case the presence of a positive SMS was noted as per the strict discussed technique, as well as gall-bladder wall thickening, peri-cholecystic fluid, cholelithiasis, choleodocholithiasis and common bile duct dilatation. The request forms were consecutively reviewed for the documentation of CMS and tabulated.

Patients where the direct assessment of the gallbladder was not possible were not included.

The data was analysed and subsequent pathology reviewed.

The incidence of positive Murphy's sign amongst the population and the true positive, false positive, true negative and false negative populations established. Sensitivity,
specificity, positive predictive vales and negative predictive values with the 95% confidence interval calculated.

Our population definitions are as follows:

**True positive:** Patient’s who fulfilled the defined criteria for a positive SMS with cholecystitis\(^v\).

**False positive:** Patient’s who fulfilled the defined criteria for a positive SMS with no cholecystitis\(^v\).

**True negative:** Patient’s who did not fulfill the defined criteria for a positive SMS with no cholecystitis\(^c\).

**False negative:** Patient's who did not fulfill the defined criteria for a positive SMS with cholecystitis\(^v\).

\(^v\) Proven pathologically.

\(^c\) Proven by pathology and Imaging. As most cases of cholecystitis require imaging diagnosis prior to surgery, it was deemed suffice that any patient those did not exhibit any imaging features of cholecystitis was negative. Patients who exhibited 2 or more features of the diagnostic criteria for cholecystitis described above were stratified and pathology reviewed.
Results

Over the four-month collection period 1221 patients presented for abdominal ultrasound at St. Vincent's and CMMI departments.

Technical factors such as poor patient cooperation due to clinical state (dementia, intellectual difficulty and unconsciousness) and difficulties in body habitus, obstruction of view due to overlying gas and intercostal scanning resulted in 14 patients unable to be assessed.

The SMS was assessed as part of the routine in 3 patients being investigated right upper quadrant pain and these patients also not included.

The ages of patients ranged from 6 - 99 years with a mean age of 52.2 years and a median age of 52 years.

Of the 1221 consecutively examined patients, 335 presented for investigation of abdominal pain. 17 patients demonstrated a positive SMS declaring an incidence of 1.4% amongst the general population and 5.1% of those presenting for investigation of upper abdominal pain.

Of the 17 patients, 11 were associated with pathologically proven cholecystitis that established our true positive population. The other 6 patients who demonstrated a positive SMS were associated with other conditions such as biliary colic or choleodocholithiasis confirmed by clinical notes and other imaging modalities and consequently established our false positive population.

Of the patients who exhibited a negative SMS, 10 were noted to have pathologically proven cholecystitis and made up the false negative population. The remaining 1180 patients were SMS negative and did not have cholecystitis and deemed our true negative population. Overall, 14 patients were unable to be assessed due to technical factors.

The sensitivity and specificity quoted amongst the most current literature, encompassing both prospective and retrospective studies is widely variable ranging from 0.17 - 0.97 for SMS sensitivity, and 0.35 - 1.0 for SMS specificity $^{6,7,8,9}$. Amongst all estimated parameters, all studies quote NPV of at least 0.82, ranging up to 0.93 $^{6,7}$. 
Our sensitivity of 0.54 and specificity of 0.99 are thus concordant with the ranges and NPV of 0.98 is also concordant suggesting that the SMS is an excellent, accurate and robust clinical test to exclude cholecystitis.

**Table 1**: Patient parameters.

<table>
<thead>
<tr>
<th></th>
<th>Sonographic Murphy’s Sign</th>
<th>Clinical Murphy’s Sign</th>
<th>Cholelithiasis (Including impaction within neck)</th>
<th>Pericholecystic fluid</th>
<th>GB Wall Thickening</th>
<th>Pathology (Proven Cholecystitis)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Positive</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>17</td>
<td>1</td>
<td>14</td>
<td>3</td>
<td>11</td>
<td>11</td>
</tr>
<tr>
<td><strong>Negative - Painful abdomen at time of assessment</strong></td>
<td></td>
<td></td>
<td></td>
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<td></td>
</tr>
<tr>
<td></td>
<td>62</td>
<td>1</td>
<td>26</td>
<td>8</td>
<td>14</td>
<td>6</td>
</tr>
<tr>
<td><strong>Negative - No pain elicited at time of assessment</strong></td>
<td></td>
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<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>1128</td>
<td>6</td>
<td>392</td>
<td>17</td>
<td>33</td>
<td>4</td>
</tr>
<tr>
<td><strong>Unable to assess GB</strong></td>
<td></td>
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<tr>
<td></td>
<td>14</td>
<td></td>
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**Table 2**: Breakdown of statistical populations.

<table>
<thead>
<tr>
<th>Statistical Population</th>
<th>N = 1221</th>
</tr>
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<tbody>
<tr>
<td>True Positive (TP)</td>
<td>11</td>
</tr>
<tr>
<td>True Negative (TN)</td>
<td>1180</td>
</tr>
<tr>
<td>False Positive (FP)</td>
<td>6</td>
</tr>
<tr>
<td>False Negative (FN)</td>
<td>10</td>
</tr>
</tbody>
</table>
Table 3: Sensitivity, Specificity, Positive predictive value and negative predictive values for positive sonographic Murphy’s sign at St. Vincent’s and CMMI 1/11/2011 - 29/2/2012.

<table>
<thead>
<tr>
<th>SMS associated with cholecystitis.</th>
<th>N (95% CI)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sensitivity</td>
<td>0.54 (0.3 - 0.74)</td>
</tr>
<tr>
<td>Specificity</td>
<td>0.99 (0.98 - 0.99)</td>
</tr>
<tr>
<td>Positive Predictive Value</td>
<td>0.65 (0.39 - 0.85)</td>
</tr>
<tr>
<td>Negative Predictive Value</td>
<td>0.98 (0.98 - 0.99)</td>
</tr>
</tbody>
</table>
Conclusion

In our population the SMS demonstrates a high specificity for cholecystitis. It is rarely elicited in non-inflamed gallbladders and has an excellent negative predictive value, being able to rule out cholecystitis in 98% of cases.

It however demonstrates a poor sensitivity, observed in just over one half of all patients with cholecystitis. The clinical Murphy's remains to omitted from radiology referrals and in our population, and contributes little to the detection of cholecystitis.

Based on our study the SMS is necessary in assessing patients with suspected cholecystitis.
Personal Information

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References