Horizon Scanning Technology
Prioritising Summary

Infrared spectroscopy for the diagnosis of acute pancreatitis

February 2008
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ISBN
Publications Approval Number:

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The production of this Horizon scanning prioritising summary was overseen by the Health Policy Advisory Committee on Technology (HealthPACT), a sub-committee of the Medical Services Advisory Committee (MSAC). HealthPACT comprises representatives from departments in all states and territories, the Australia and New Zealand governments; and ASERNIP-S. The Australian Health Ministers’ Advisory Council (AHMAC) supports HealthPACT through funding.

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PRIORITYING SUMMARY

REGISTER ID: 000350

NAME OF TECHNOLOGY: INFRARED SPECTROSCOPY FOR THE DIAGNOSIS OF ACUTE PANCREATITIS

PURPOSE AND TARGET GROUP: PATIENTS PRESENTING WITH POTENTIAL PANCREATITIS

STAGE OF DEVELOPMENT (IN AUSTRALIA):

☑ Yet to emerge
☐ Experimental
☐ Investigational
☐ Nearly established
☐ Established
☐ Established but changed indication or modification of technique
☐ Should be taken out of use

AUSTRALIAN THERAPEUTIC GOODS ADMINISTRATION APPROVAL

☐ Yes ARTG number
☐ No
☒ Not applicable

INTERNATIONAL UTILISATION:

<table>
<thead>
<tr>
<th>COUNTRY</th>
<th>LEVEL OF USE</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Trials Underway or Completed</td>
</tr>
<tr>
<td>Russia</td>
<td>✔</td>
</tr>
</tbody>
</table>

IMPACT SUMMARY:
Pathology laboratories would provide infrared spectroscopic diagnosis of patients presenting to general practitioners or hospital emergency departments with symptoms of pancreatitis. The test is an inexpensive, accurate means to rapidly identify patients with pancreatitis so they can be appropriately treated, increasing the quality of patient care and reducing the financial burden of improper treatment.

BACKGROUND
Acute pancreatitis is the inflammation of the pancreas which occurs with a rapid onset and may be caused by several mechanisms. The pancreas produces proteolytic enzymes that are normally in an inactive form within the pancreas. If the enzymes become active within the pancreas, autodigestion of the pancreas may result. This leads to intrapancreatic inflammation followed by extrapancreatic inflammation in more severe cases. This can have severe systemic effects including organ failure or
death. The most common causes of acute pancreatitis are gall stones blocking the common bile duct (45% of cases) and alcohol abuse (35% of cases). Idiopathic causes account for 10 per cent of cases while the remaining 10 per cent of cases are from other causes. Acute pancreatitis is categorised into two classes: mild (85% of cases) or severe (15% of cases). Mild acute pancreatitis is normally self-resolving and does not require hospitalisation. Severe acute pancreatitis requires immediate treatment to prevent death (Baker 2004).

Currently there is no high quality diagnostic test for acute pancreatitis available. A patient presenting with suspected pancreatitis will undergo blood, urine and imaging tests. These tests do not accurately distinguish between mild and severe acute pancreatitis (Baker 2004). Additionally, these tests may require expensive reagents or equipment; take a long time to obtain results; and not elucidate whether the patient is suffering from mild or severe acute pancreatitis. The ability to distinguish mild from severe acute pancreatitis may have a positive impact on patient outcomes and lead to the more efficient use of scarce hospital resources.

**Table 1**  Tests currently used to diagnose acute pancreatitis

<table>
<thead>
<tr>
<th>Test Category</th>
<th>Specific test</th>
</tr>
</thead>
<tbody>
<tr>
<td>Blood</td>
<td>Plasma amylase, Plasma lipase, C-reactive protein, Procalcitonin, Blood gases.</td>
</tr>
<tr>
<td>Urine</td>
<td>Urinary amylase, Urinary trypsinogen activation peptide.</td>
</tr>
<tr>
<td>Imaging</td>
<td>Abdominal X-ray, Abdominal CT with contrast enhancement, Magnetic resonance cholangiopancreatography, Abdominal ultrasound.</td>
</tr>
</tbody>
</table>

Infrared spectroscopy (IRS) measures the absorption or transmission of infrared light through a test sample. If a variety of infrared frequencies are used the absorption or transmittance spectrum of the sample can be measured. The spectrum obtained is reliant on the constituents present in the sample and thus can be interpreted as a fingerprint of the components within the sample. Petrov et al (2007a) propose to use IRS in the 800–1000 nm range to obtain a “fingerprint” of serum components in acute pancreatitis patients. It is claimed that these spectra are specific and are capable of distinguishing between mild and severe acute pancreatitis allowing patients to be triaged due to their clinical needs.

**CLINICAL NEED AND BURDEN OF DISEASE**

In Australia, acute pancreatitis was the cause of 10,142 hospital separations in 2004-05 (AIHW 2007). A recent study conducted in Melbourne found an increasing incidence of acute pancreatitis in paediatric patients during the past decade. The increase in acute pancreatitis was mainly attributed to a rise in the idiopathic form of the disease (Nydegger et al 2007).

One review reported that up to 40 per cent of deaths that occur due to acute pancreatitis were not diagnosed as acute pancreatitis, mainly due to the lack of
abdominal pain on patient presentation (Toouli et al 2002). This highlights the need for a sensitive, specific test to diagnose acute pancreatitis that does not rely on subjective parameters such as pain.

Despite extensive searching, primary data on the incidence, morbidity, mortality and economic burden of acute pancreatitis in Australia was not found.

**DIFFUSION**

No evidence was found indicating the use of IRS for acute pancreatitis diagnosis in Australia.

**COMPARATORS**

The gold standard for the diagnosis of acute pancreatitis is a specific clinical presentation including symptoms of upper abdominal pain, combined with an above normal serum pancreatic enzyme measurement. Enzymes that may be measured are total amylase, the P-amylase and lipase. Although not many high quality studies have been published on diagnosis using pancreatic enzymes, one review reported the sensitivities to be 83, 94 and, 92 per cent for total amylase, the P-amylase and lipase, respectively. These values must be put in perspective, with the knowledge that the tests were performed in a high prevalence population and hence the sensitivities may be overestimated (Toouli et al 2002). Much of the current diagnosis of acute pancreatitis relies on the experience of practitioners and their interpretation of the variety of tests that may be performed on the patient.

**SAFETY AND EFFECTIVENESS ISSUES**

The early diagnosis and classification of acute pancreatitis into mild and severe categories is important for optimum patient outcomes and also to manage hospital resources efficiently. In two studies investigating the applicability of IRS to acute pancreatitis the ability of the technique to distinguish mild from severe pancreatitis cases was tested.

The initial study prospectively recruited 64 patients with acute pancreatitis, 112 patients with acute abdominal symptoms that were of non-pancreatic origin and 40 healthy subjects. The subjects were diagnosed as having acute pancreatitis according to the standard diagnostic criteria of upper abdominal pain combined with urinary and/or serum amylase at three times the normal upper level. The severity of the symptoms was gauged using international standards. The subjects had blood samples taken for serum amylase analysis and also for IRS testing. The IRS sample was centrifuged and then frozen at -70°C until testing was conducted. The serum sample was analysed by a standard scanning spectrometer in the range of 800 to 1000 nm with a 2 nm step. The results were passed through an algorithm to classify the subjects according to their disease status. The IRS technicians were blinded to the patient diagnoses. Of the 64 patients with acute pancreatitis, 14 (22%) were classified as
having severe acute pancreatitis and two of these patients died. When compared to the control subjects the patients with acute pancreatitis showed a lower median IR absorbance (p<0.02). When compared to the reference tests, IRS showed a sensitivity and specificity of 91 per cent, a PPV\(^1\) of 85 per cent and a NPV of 94 per cent (Petrov et al 2007a)(level II diagnostic evidence).

A second study by the same investigators (Petrov et al 2007b) examined whether IRS could be used to triage patients into mild or severe cases of acute pancreatitis. Again the technicians performing the IRS tests were blinded to patient diagnoses. A total of 167 patients with acute pancreatitis were recruited for this study. Acute pancreatitis severity was gauged by Acute Physiology And Chronic Health Evaluation (APACHE) II score and/or a C-reactive protein (CRP) levels. IRS was evaluated against this definition. Using this scheme, 133 patients were judged to have mild acute pancreatitis and 34 were classified as having severe acute pancreatitis. Seven (21%) of the severe acute pancreatitis classified patients died but there were no deaths in the mild acute pancreatitis group. The tests were repeated three times, initially at admission, then 24 and 48 hours post admission. IRS performed better or equal to the other two testing modalities except at 48 hours post admission (Table 2). Given that the aim of IRS is to allow the early triage of patients to facilitate appropriate treatment, the lower accuracy at 48 hours post admission may not be a negative factor when assessing the feasibility IRS (level II diagnostic evidence).

<table>
<thead>
<tr>
<th>Table 2</th>
<th>Accuracy of tested scoring systems for predicting severe acute pancreatitis</th>
</tr>
</thead>
<tbody>
<tr>
<td>Scoring system</td>
<td>Sensitivity</td>
</tr>
<tr>
<td><strong>On admission</strong></td>
<td></td>
</tr>
<tr>
<td>APACHE II score ≥8</td>
<td>56</td>
</tr>
<tr>
<td>CRP &gt;150 mg/l</td>
<td>44</td>
</tr>
<tr>
<td>IR absorbance ≤5.0</td>
<td>74</td>
</tr>
<tr>
<td><strong>24 h post admission</strong></td>
<td></td>
</tr>
<tr>
<td>APACHE II score ≥8</td>
<td>68</td>
</tr>
<tr>
<td>CRP &gt;150 mg/l</td>
<td>65</td>
</tr>
<tr>
<td>IR absorbance ≤5.0</td>
<td>82</td>
</tr>
<tr>
<td><strong>48 h post admission</strong></td>
<td></td>
</tr>
<tr>
<td>APACHE II score ≥8</td>
<td>59</td>
</tr>
<tr>
<td>CRP &gt;150 mg/l</td>
<td>86</td>
</tr>
<tr>
<td>IR absorbance ≤5.0</td>
<td>76</td>
</tr>
</tbody>
</table>

\(^1\) Positive predictive value, \(^2\) Negative predictive value, \(^3\) Area under curve

While the studies reviewed here were prospective, blinded trials measuring diagnostic accuracy, the interventions given to patients were not modified by the outcomes of the IRS testing. It is unknown whether IRS will lead to better patient management or

\(^1\) PPV = positive predictive value. The proportion of people with a positive test result who will be correctly identified as having the disease. NPV = negative predictive value. The number of people with a negative test result who will be correctly identified as not having the disease.
better economic outcomes. Despite this, IRS may be an important tool for the management of the critical early stages of acute pancreatitis. IRS performed at least as accurately as current standard tests and, although this is not reported, the simplicity of the test and low infrastructure costs may lead to savings at both the testing and patient intervention levels.

**COST IMPACT**

No information was found on the economic feasibility of IRS for acute pancreatitis.

**ETHICAL, CULTURAL OR RELIGIOUS CONSIDERATIONS**

No issues were identified/raised in the sources examined.

**OTHER ISSUES**

No issues were identified/raised in the sources examined.

**SUMMARY OF FINDINGS**

Diagnosis of acute pancreatitis using IRS may be an important early-stage tool to assist in administering most appropriate treatment to patients. IRS appears to be at least as accurate as conventional techniques and may surpass these techniques in the diagnosis of the very early, and most critical, stages of the disease. It is predicted, that due to low test and infrastructure costs, IRS will be economically competitive with conventional acute pancreatitis diagnostic tests. Despite this, the studies, while of a high level, do not report on outcomes once patients have been diagnosed with IRS. As yet no cost effectiveness data are available.

**HEALTHPACT ACTION:**

Given the early stage of development and research into IRS for acute pancreatitis, HealthPACT have recommended that this technology be monitored for further information in 12-months.

**NUMBER OF INCLUDED STUDIES**

Total number of studies

Level II diagnostic evidence 2

**REFERENCES:**


**SEARCH CRITERIA TO BE USED:**

Abdomen, Acute/diagnosis
Pancreatitis/ diagnosis
Diagnosis, Differential
Acute Disease
Prospective Studies
Spectrophotometry, Infrared