Is intravenous cholangiography an alternative to the routine per-operative cholangiogram?

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**Summary:** Ultrasonography, although an accurate method of detecting stones within the gall bladder, is unreliable for the detection of bile duct stones for which per-operative cholangiography remains the standard investigation. Fifty seven patients undergoing elective cholecystectomy had both a pre-operative intravenous cholangiogram and per-operative cholangiography. The pre-operative investigation is shown to be at least as effective in the detection of common bile duct stones and only missed a duct stone in one patient. The substitution of pre-operative intravenous cholangiography for routine per-operative cholangiography would result in a significant reduction in operating time, may provide advance knowledge on the biliary anatomy and would allow advance planning of the likely procedure. It is suggested that pre-operative intravenous cholangiography, carried out on the day of admission, should be considered as a preferred alternative investigation to per-operative cholangiography.

**Introduction**

Per-operative cholangiography, first introduced by Mirizzi in 1932, is now a commonly performed procedure. It is considered by many authorities to be an investigation which should be routinely performed at the time of cholecystectomy in order to identify those patients who have stones within the common bile duct. In the past, intravenous cholangiography has been considered to be both unreliable and to have an unacceptable complication rate. Recently, however, the introduction of improved and safer contrast media has prompted a reappraisal of the place of this investigation in patients with gall stones.

**Methods**

Fifty seven patients who underwent cholecystectomy under the care of a single surgeon (JAS) during a 42-month period from March 1984 were included in the study. They had both a pre-operative intravenous and a per-operative cholangiogram.

Ultrasound examination was the standard pre-operative investigation of the gall bladder, although this examination was not ordered if the patient had already undergone an oral cholecystogram prior to referral. The ultrasound examinations were performed in the standard fashion on a Siemens RA 1 real time scanner using a 3.5 MHz probe.

An intravenous cholangiogram was performed as an outpatient procedure before admission for cholecystectomy. A control film was taken prior to infusion of 100 ml of meglumine iodoxamate (Endobil, E. Merck Ltd.) over 20–30 minutes. A single plain film was taken of the right upper abdomen and tomography routinely performed. Patients with a history of iodine allergy did not undergo this investigation.

Per-operative cholangiography was performed by injection of 10–20 ml of 25% sodium diatrizoate (Hypaque, Sterling Research Laboratories) through a Stoke on Trent cannula placed in the common bile duct via the cystic duct. The patient was screened using an image intensifier during injection of contrast and films were taken after infusion of 2, 5 and sometimes 20 ml of contrast in order to have a permanent record of the investigation.

The pre-operative investigations were reported by consultant radiologists but the per-operative cholangiograms were assessed by the surgeon performing the operation and recorded in the operation notes made at the time. In this study the findings of the pre-operative intravenous cholangiogram are compared to those of an operative cholangiogram and the findings on exploration of the bile duct if performed. Each patient acted as their own control.

**Results**

The bile duct was investigated by both pre-operative intravenous cholangiography and per-operative
cholangiography in 57 patients. There were 22 males and 35 females. The mean age was 58 (range 24–90) years. The common bile duct was explored in 12 (21%) and stones found within it in 8 (14%).

The result of the two investigations were in agreement in 51 cases (89%). The results are summarized in Table I. There was a mean delay of 91 days (range 1–272 days) between the pre-operative investigation and surgery.

Of the 6 patients in whom the investigations differed 2 patients had an abnormal pre-operative investigation but a normal operative cholangiogram and did not have the duct explored. It is therefore not possible to determine which of the investigations was correct. Neither of these patients has had recurrent symptoms. The remaining 4 patients in whom the two investigations differed proceeded to exploration of the duct. In 2 of these the intravenous investigation showed a normal duct but operative cholangiogram suggested the presence of stones resulting in exploration, but no stones were found. In a third patient no stone was detected on the pre-operative cholangiogram although the duct was noted to be dilated, the operative X-ray suggested a stone but again none was found on exploration. In the fourth case the intravenous investigation suggested a normal duct but a per-operative cholangiogram demonstrated stones which were found at exploration.

No patient was clinically jaundiced at the time of cholecystectomy. Thirteen patients had a history of clinical jaundice of whom 4 subsequently had their bile duct explored and were found to have an intraduct stone. Three underwent a negative duct exploration on the basis of either the pre-operative intravenous cholangiogram or the per-operative cholangiogram.

Table 1 Summary of the radiographic findings and the results of bile duct exploration in the patients who had both a pre-operative intravenous cholangiogram and a per-operative cholangiogram.

<table>
<thead>
<tr>
<th></th>
<th>Number of patients</th>
<th>Number of stones seen/found</th>
<th>Number of stones not seen/found</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pre-operative intravenous cholangiogram</td>
<td>57</td>
<td>10</td>
<td>47</td>
</tr>
<tr>
<td>Per-operative cholangiogram</td>
<td>57</td>
<td>11</td>
<td>46</td>
</tr>
<tr>
<td>Bile ducts explored</td>
<td>12</td>
<td>8</td>
<td>4*</td>
</tr>
</tbody>
</table>

*Two -ve intravenous cholangiogram, +ve per-operative cholangiogram; one +ve intravenous cholangiogram, –ve per-operative cholangiogram; one dilated ducts on intravenous cholangiogram, + ve per-operative cholangiogram

Sixteen patients had abnormal liver function tests at some time. Four of these had their common bile duct explored and were found to have duct stones. Another 4 patients underwent a negative duct exploration.

Ten patients had a common bile duct which was considered by the surgeon to be dilated. Five of these were found on exploration to contain stones. Three further ducts were explored on the basis of a cholangiogram and no stones were found. The remaining two ducts were not explored.

In a separate group of 83 patients who underwent both a pre-operative ultrasound examination and a per-operative cholangiogram, 10 had stones demonstrated within the common bile duct by the operative X-ray and confirmed by exploration of the duct. Only one of these duct stones was correctly predicted by the ultrasound scan, in the remaining 9 the duct was said to be of a normal calibre and no intraduct stones were identified.

Discussion

There have been a number of studies which have suggested that pre-operative intravenous cholangiography might be a suitable alternative to an operation cholangiogram but despite this, operative cholangiogram remains the most commonly performed investigation of the bile ducts.

Ultrasound, which reliably predicts the presence of stones within the gall bladder, cannot be relied upon to demonstrate the presence of stones within the bile ducts. This was confirmed in our group of 83 patients who underwent both ultrasound examination and a per-operative cholangiogram. Conversely, intravenous cholangiography has proved to be at least as reliable as the current standard investigation, per-operative cholangiography, and in this series would have only missed one common duct stone amongst 57 patients. In addition, exploration of the common bile duct would have been avoided in two patients who had a normal intravenous cholangiogram but an abnormal per-operative investigation and in whom no abnormality was found on exploration.

Definitive pre-operative investigation of the bile ducts will reduce the length of the operation. An operative cholangiogram will add at least 10 minutes to the operating time although in practice this is often much longer as repeat films may be required in order to adequately demonstrate the biliary tree or there may a delay in the arrival of the radiographer. Alinder et al. showed a 17 minute reduction in the mean operating time when operative cholangiogram was performed selectively on those patients in whom the pre-operative X-ray was inconclusive. The pre-operative intravenous procedure involves the patient attending the X-ray department for approximately
one hour and this would ideally be performed on the
day of admission to hospital for surgery. During that
time a radiographer and an X-ray room are required
for approximately 50 minutes. A radiologist needs to
be in the department to supervise the infusion and to
monitor the films produced but will be able to attend
to other matters at the same time. Only about 10
minutes of his time will actually be devoted to the
investigation and this is comparable to an intravenous
urogram.

An additional bonus of the pre-operative investiga-
tion is the delineation of the biliary anatomy and
possible demonstration of any unusual situation.
Although the quality of films obtained by intravenous
cholangiography is inferior to those produced at
operation, they have proved to be adequate to reliably
predict duct stones and to demonstrate the major
biliary anatomy. Alinder et al.7 reported that the only
major anatomical abnormality in their series was
correctly predicted by pre-operative intravenous
cholangiography.

The pre-operative intravenous cholangiogram does
not preclude the subsequent performance of a per-
operative investigation in those cases where the
findings are inconclusive. In this respect the two
investigations would complement each other although
the number of occasions where this is necessary is
likely to be small. In our series 3 intravenous cholan-
ghiograms were described as being poor studies and
such patients would undergo a per-operative cholan-
ghiogram. Other series have reported an equivocal
intravenous cholangiogram rate of about 10%.8,11

The third advantage of an intravenous cholangio-
gram is that the films are available prior to surgery.
This improves planning of operating lists and allows
the patient to be informed in advance of the procedure
planned and how long they are likely to be in hospital.
After a pre-operative investigation the films are
reported and if there is any doubt the surgeon and
radiologist may discuss the films together.

Intravenous cholangiography is an investigation
which has been sparingly used in the past. This is
largely due to the reputation of the earlier contrast
media for producing allergic reactions. In this series of
57 investigations there were no adverse reactions
noted. This confirms the experience of other inves-
tigators. Daly et al.9 reported no serious allergic
reactions to the contrast (Endobil or Biliscopin) in 300
investigations over a period of 6 years and Alinder et
al.6 reported two major reactions in 200 investigations.
In their paper they discuss the safety of modern
contrast media. Of course, patients who have a history
of allergy to iodine-containing contrast media should
not undergo the investigation.

In our group of patients the intravenous cholan-
ghiogram was booked when the patient was first seen in
the outpatient clinic and was carried out prior to
admission for surgery. There was, therefore, a period
(range 1–272, mean 91 days) after the investigation
during which it was possible for stones either to
migrate from the gall bladder into the bile ducts
producing a false negative result (of which there was
one in this series) or for stones which had previously
been seen in the common bile duct to pass sponta-
neously, producing a false positive result. It is,
however, interesting to note the remarkably few
instances in which stones appear to have migrated
from the gall bladder into the bile ducts despite the
long interval between investigation and surgery and
this has also been noted previously.11 If intravenous
cholangiography is to be adopted as the prime
investigation to demonstrate duct stones then it should
be performed as close as possible to the time of surgery.
Ideally this should be on the day of admission for
cholecystectomy which would also have the advantage
of saving the patient an extra visit to hospital.

On the basis of the findings of this study it is
suggested that pre-operative intravenous cholangio-
graphy be performed routinely and that per-operative
investigation need only performed selectively in those
few instances where doubt remains. Ultrasonography
is not an effective investigation in this situation.

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