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SURGICAL TECHNIQUE

Use of a hand-held Doppler to avoid abdominal wall vessels in laparoscopic surgery

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Laparoscopy in general surgery is becoming a widespread technique. Substantial anterior abdominal wall haemorrhage is a recognised complication of the laparoscopic technique.

Ten patients were examined with an 8 MHz hand-held Doppler and the anterior abdominal wall vessels were marked on the skin. Colour flow duplex was used to confirm the presence of vessels found in this way. All 40 epigastric arteries were marked accurately and confirmed; 75 other intramural arteries were identified, although the majority were too small for duplex confirmation.

The preoperative use of hand-held Doppler is a quick and non-invasive way to identify the epigastric and larger intramural arteries. Routine use of this technique to mark abdominal wall vessels in the areas of trocar insertion should reduce this complication of laparoscopic surgery.

The use of laparoscopic procedures in general surgery is an area of considerable interest and innovation at present. Although these techniques are generally safe, recognised complications of the laparoscopic approach include visceral and vascular injury, gas embolism and pneumothorax.

Haemorrhage from anterior abdominal wall vessels, although uncommon, is recognised as a source of morbidity in some patients undergoing laparoscopic procedures. We present here a simple, quick, non-invasive method to avoid this complication of minimal access surgery.

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Patients and methods

Ten female volunteers aged between 21 and 48 years (mean 31.8 years) had their abdominal wall vessels mapped using a directional flow, hand-held Doppler (Dopplex, Huntleigh Healthcare, UK) as described below. The course of the vessels identified was marked with an indelible ink marker. Each patient was then scanned with colour flow duplex ultrasonography (Spectra, Diastonics, Sonotron UK).

Method of identification of abdominal wall vessels using a directional flow hand-held Doppler

An 8 MHz hand-held Doppler probe is selected and is held at an angle of about 50° to the skin of the abdominal wall. Coupling gel is used at the point of cutaneous contact as in insonation of peripheral vessels. The probe is then directed towards the expected flow of blood in the anterior abdominal wall vessels. Thus, for supra-umbilical arteries the flow is from the chest and towards the legs, whereas in the infra-umbilical arteries flow is reversed, heading back up the abdominal wall from the groins.

The use of the directional flow indicator on the Doppler is particularly useful for the infra-umbilical arteries,

where the flow is the reverse of that in the iliac and other intra-abdominal arteries. When a vessel is insonated, it is marked on the skin with an indelible skin marker. If the patient is thin or if there is any doubt that the insonated vessel is in the abdominal wall, the patient is rolled onto the side and the marked area insonated once again. Any visceral artery will move during this manoeuvre causing the signal to disappear, whereas abdominal wall vessels are fixed allowing the signal to remain as marked.

Comparison with hand-held Doppler and colour flow duplex

The superior and inferior epigastric arteries were identified and their position compared with the marks on the skin that had been directed by the hand-held Doppler. The remainder of the abdominal wall was then scanned and the vessels identified were grouped as either supra- or infra-umbilical. Once again the position of such vessels was compared with the arteries identified and marked previously.

Results

Ten volunteers provided 20 superior and 20 inferior epigastric vessels. Using the technique described previously, the directional flow hand-held Doppler identified each of these vessels (Table I). The course of each was quickly and easily mapped on the skin with the indelible pen.

Colour flow duplex examination confirmed each of these vessels and found a perfect match with the skin markings.

A total of 32 other supra-umbilical and 43 other infra-umbilical abdominal wall arteries were identified by the hand-held Doppler in these 10 volunteers. These signals were mainly found fairly laterally on the abdominal wall, the signal moving towards the midline. Most of these signals petered out before reaching the rectus sheath.

Colour flow duplex could only confirm the presence of five of the supra-umbilical and four of the infra-umbilical abdominal wall arteries. However, each artery that was confirmed lay below the skin marking, as predicted by the hand-held Doppler.

Table I. Localisation of anterior abdominal wall arteries with 8 MHz hand-held Doppler ($n=20$)

Abdominal wall vessel	*Hand-held Doppler*	*Colour flow duplex*
Superior epigastric artery	20	20
Inferior epigastric artery	20	20
Other supra-umbilical arteries	32	5
Other infra-umbilical arteries	43	4

Discussion

The use of laparoscopic techniques in general surgery is still relatively novel, and as such there is a great deal of recent literature on new operations, techniques, instrumentation and complications. Gynaecologists, who have a much longer experience of pelvic laparoscopy, occasionally seem to feel that general surgeons are merely rediscovering well-known problems *(1)*.

Abdominal wall haemorrhage in gynaecological practice has been quoted to be present in 2.5–6 per 1000 cases *(2)* and these incidents are fairly evenly distributed between injuries to the inferior epigastric artery and other intramural vessels *(3)*. In the gynaecological literature, advice for the detection of these vessels largely depends on anatomical landmarks or transillumination of the wall *(4)*, although it has been noted that most gynaecologists questioned had found transillumination to be of little value *(2)*.

Once a haemorrhage has been caused, suggested remedies are transmural suture ligation, electrocautery and the opening of the abdominal wall for direct suture *(4)*. A technique of tamponading the bleeding vessel with a Foley catheter overnight has been described by general surgeons performing laparoscopic appendicectomies and experiencing this complication *(5)*.

General surgeons performing laparoscopic procedures have to introduce trocars both above and below the umbilicus. Therefore they need to be aware of the position of the superior epigastric arteries, the subcostal arteries and other unnamed intramural vessels in addition to the arteries below the umbilicus.

Our findings show that we were easily able to map the courses of the superior and inferior epigastric arteries using a directional flow hand-held Doppler. Confirmation of this technique was by colour flow duplex, which distinguished and followed the epigastric arteries without difficulty. All of these vessels had internal diameters between 1 mm and 3 mm.

In addition, we were able to detect other arteries which follow the expected courses of intramural segmental vessels and which did not move on rolling the patient. These observations suggest that the signals were indeed from other abdominal wall vessels. However, when trying to confirm the presence of smaller vessels lateral in the abdominal wall, colour flow duplex failed to identify the majority of the vessels. Those that were imaged were in the region of 0.5–1 mm diameter. We believe that the failure to image the others was due to the small size of these vessels and the resolution of the duplex. It is likely that there were intramural vessels present in the positions suggested by hand-held Doppler, owing to the reasons given earlier.

The use of a hand-held Doppler is an inexpensive, quick and accurate way to identify abdominal wall vessels non-invasively. If this was performed preoperatively in the areas favoured for trocar insertion and the vessels were marked on the skin, we believe that abdominal wall haemorrhage could be avoided in laparoscopic surgery.

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