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Bravo wireless versus catheter pH monitoring systems

Pandolfino *et al* (*Gut* 2005;**54**:1687–92) and Bruley des Varannes *et al* (*Gut* 2005;**54**:1682–6) presented data from simultaneous pH monitoring by wireless Bravo and catheter mounted antimony electrode systems. Both studies demonstrated that the wireless system recorded significantly fewer reflux events; the effect on overall acid exposure was more limited. Further analysis revealed that events ''missed'' by the Bravo system were shorter and less acidic than those detected by both systems. The authors suggested that the different recording characteristics of the two systems explain the apparent ''higher sensitivity'' of the catheter pH system, including the lesser sampling rate of the Bravo system, and the systematic inaccuracy in catheter electrode calibration (not assessed by Bruley des Varannes *et al*).

Beyond these technical concerns, the significance of short ''reflux events'' is questionable because short drops to pH <4 can be caused by factors unrelated to gastro-oesophageal reflux: firstly, ingestion of mildly acidic fluids (despite instruction); secondly, as suggested by Pandolfino *et al*, movement of the catheter relative to the mucosa (that is, ''drying'' or ''loss of contact'' of the catheter electrode—the internal reference of the Bravo reduces this source of error); and thirdly, movement of the catheter relative to the gastro-oesophageal junction (GOJ) during swallowing (fig 1). The last point requires

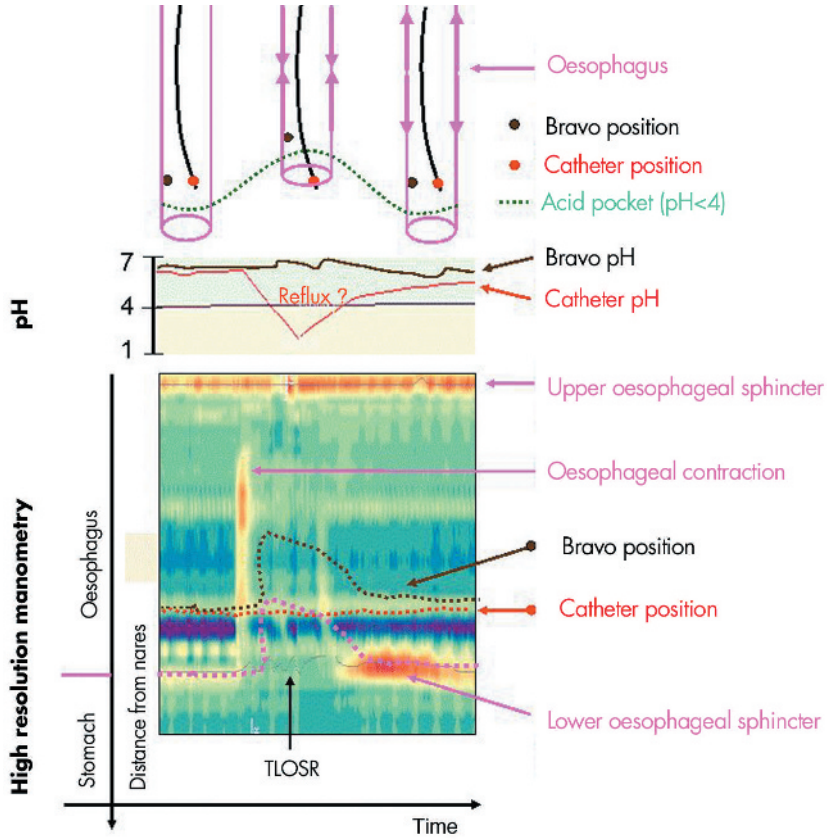

Figure 1 Concurrent high resolution manometry (HRM) and pH recording during a transient lower oesophageal sphincter relaxation (TLOSR) in a normal volunteer. The positions of the Bravo capsule, catheter electrode, and LOS are indicated on the schematic diagram and the HRM plot. TLOSR was associated with brief oesophageal contraction with ~5 cm shortening. The position of the Bravo capsule remained constant relative to the LOS and the Bravo pH recording remained at ~pH 6; however the catheter electrode approached the LOS and recorded a short pH drop to <4 as it entered the ''acid pocket''. Relaxation of the oesophagus restored the position of the LOS and the catheter pH recording normalised without swallowing activity. This ''reflux event'' was an artefact, related to oesophageal shortening rather than gastro-oesophageal reflux. UOS, upper oesophageal sphincter.

explanation: on swallowing, the oesophagus shortens by several centimetres due to longitudinal muscle contraction,[1 2] an event that stabilises the oesophageal wall and increases the effectiveness of peristaltic contraction and bolus transport.[3] Even greater shortening can occur during oesophageal spasm[4] and transient lower oesophageal sphincter relaxation (with or without acid reflux). As the oesophagus shortens, the catheter electrode moves distally towards the GOJ and may pass into the proximal stomach, a region in which highly acidic conditions may be present.[5 6] Thus the catheter electrode may dip into the ''acid pocket''[6] at the GOJ before relaxation of the oesophagus returns the catheter into its original position. This cannot occur with the Bravo because it is fixed to the oesophageal wall. As a result, a short drop in pH is recorded by the catheter electrode but not the Bravo system.

As stated by the authors, pH studies alone cannot explain the discrepancies between the catheter and Bravo systems. Studies that combine pH monitoring (chemical reflux and clearance) and multichannel intraluminal impedance (volume reflux and clearance) with manometry are required to define the physiology of these events and help determine their relevance (if any) in eliciting symptoms. Studies using polymodal measurements have shown that oesophageal volume clearance is considerably faster than chemical clearance.[7 8] Chemical clearance usually progresses by stepwise increases in pH as swallowing activity brings bicarbonate containing saliva into contact with acid reflux. However, short pH drops (often <20 seconds) can occur with peristaltic contractions and resolve without further swallowing activity. Short pH drops are also seen during transient lower oesophageal sphincter relaxation (fig 1), again resolving without swallowing activity. These observations strongly suggest that many short ''reflux events'' recorded by catheter systems may be artefacts, related to oesophageal shortening rather than gastro-oesophageal reflux.

The Bravo system is a well tolerated alternative to catheter based pH measurement, experience with the technique is increasing, and normal values are being established. If the accuracy (specificity) of catheter based detection of reflux events is shown to be limited, the Bravo system may establish itself as the new standard for pH

measurement in the investigation and diagnosis of gastro-oesophageal reflux disease.

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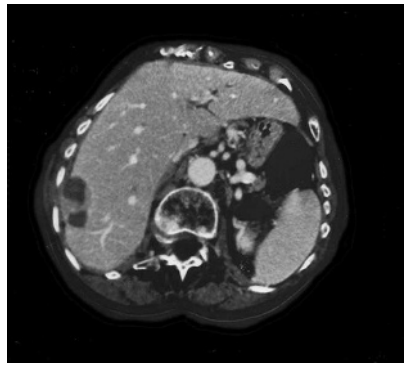
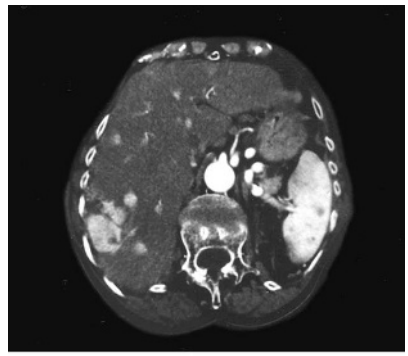
Complications of radiofrequency thermal ablation in hepatocellular carcinoma: what about ''explosive'' spread?

Surgery (resection or transplantation) is the treatment of choice for early hepatocellular carcinoma (HCC) but unfortunately it is feasible in only a minority of patients.[1]





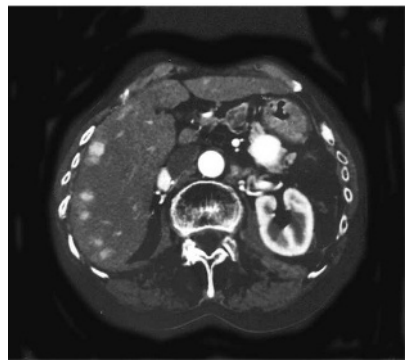


Figure 1 Computed tomography (CT) scan, one month after radiofrequency thermal ablation. The lesion appears to be partially treated with no clearcut residual activity in the arterial CT phase.

Figure 2 After five months, complete reactivation of the original lesion and 13 new additional lesions were evident.

Local percutaneous ablation has therefore dramatically increased in importance and radiofrequency thermal ablation (RFTA) has been shown in recent reports to have global or disease free survival better than that reported for percutaneous ethanol injection (PEI).[2] The recent report in *Gut* apparently also supports the superiority, albeit small, of RFTA over PEI or acetic acid injection in a randomised prospective controlled study (*Gut* 2005;**54**:1151–6). Nevertheless, not all agree on the efficacy of RFTA[3] and major complications have been described.[4] In Lin *et al*'s study (*Gut* 2005;**54**:1151–6), the incidence of major complications was significantly higher than that with the ethanol or acetic acid injection procedures.

We have conducted a multicentre prospective study on the efficacy and complications of RFTA in HCC in North-East Italy, involving 399 HCC patients and a centralised radiological assessment. Overall, 133 patients (33%) experienced some complications, five of which were severe (1.3%). There were two deaths (0.5%), one being procedure related (intestinal perforation) and the other a cerebral infarction.

Some authors have reported rapid intrahepatic progression after RFTA,[5 6] a fact that deserves special attention. We documented nine cases of rapid unexpected spread of HCC after RFTA in our multicentre study. The nine cases (2.3% of the series) are reported in table 1 and examples are given in fig 1 (computed tomography (CT) scan, one month after RFTA; the lesion appears to be partially treated with no clearcut residual activity in the arterial CT phase) and fig 2 (after five months, complete reactivation of the original lesion and 13 new additional lesions were evident).

This rapid unexplained and biologically unclear progression of HCC following RFTA treatment is most unusual considering the natural history of the disease. It may be prompted by increased intratumoral pressure with intravascular spread, seeding due to arterovenus fistula, or to the expandable hooks needles. Suggested risk factors have been high α fetoprotein levels, location near major portal branches, and poor tumour differentiation.[4 5] Also, increased liver concentrations of growth factors (transforming growth factor β1 and β fibroblast growth factor) have been documented in rat liver after thermal coagulation, with increased HCC growth.[7]

Our data show that side effects are relatively frequent following RFTA, with a

Table 1 Nine cases of rapid unexpected spread of hepatocellular carcinoma (HCC) after radiofrequency thermal ablation (RFTA)

Patient No	Sex, age, aetiology	% Efficacy	No of nodules	Size before RFTA (cm)	New nodules (time/months)	Grading	AFP (ng/ml)
1	M, 79, HCV	100%	1	4.6	Satellites + new controlateral HCC node (1 month)	G1	15.7
2	M, 78, HBV	90%	2	2.4–3	3 (3 cm each) (3 months)	G1	32.9
3	M, 61, HBV	100%	1	1.8	Multifocal (>3) (4 months)	G1	32
4	M, 68, HCV	90%	1	4.2	3 (1 month)	G1–G2	10
5	M, 69, HCV	100%	2	4.2–1.5	Multiple (up to 6 cm) (3 months)	–	8
6	M, 73, HCV	100%	1	4	Multiple (>3) (1 month)	–	32
7	F, 73, HCV	70%	1	3.1	13 (5 months)	–	117
8	M, 65, HCV	100%	1	2.0	1 (8 cm) new lesion (7 months)	G1	12.6
9	M, 72, HBV+ETOH	100%	1	2.8	Multifocal (5 months)	G1	4.9

HBV, hepatitis B virus; HCV, hepatitis C virus; ETOH, alcohol; AFP, α fetoprotein.