BARIUM SULPHATE IN DOUBLE CONTRAST RADIOLOGY: ELECTRICAL PROPERTIES

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The development of double contrast (DC) radiology, reviewed by James (1978), in which the whole mucosal surface is imaged in fine detail by means of an even layer of barium sulphate (BS) particles while the viscus is distended by CO_2, requires re-examination of the properties of BS preparations intended for such use. The sensitivity of DC techniques depends on the thickness and uniformity of the mucosal BS layer, hence interaction of BS particles with mucus and their resistance to flocculation are important. Electrophoretic mobility (EM) is one way to study this aspect.

Suspensions of BS preparations (A-E) in current use were examined by particle electrophoresis (Zeta meter; Pt-Ir/Mo electrodes; 25°) at suitable particle concentrations in HCl:0.06, 0.006M; water; $NaHCO_3$:0.006M, 0.06M; and in diluted gastric secretion. The BS preparations were ranked by preference for DC gastric examination (DCGE) by a team of radiologists.

Table 1. Behaviour of barium sulphate preparations

	negative EM (10^{-8} m^2 s^{-1} V^{-1}) in					Gastric	Radiologists'
	HCl(M)		Water	$NaHCO_3$(M)		secretion	preference
Preparation	0.06	0.006		0.006	0.06	(µl/20ml) for EM=0	for DCGE
A	6.84	3.85	2.90	4.20	4.47	441	+++
B	6.24	3.46	2.11	3.76	2.12	251	++
C	3.82	3.29	2.40	3.81	2.67	262	+/-
D	0	1.74	2.71	3.96	2.86	358	+/-
E	0	2.03	2.79	3.16	1.13	~1200	-
pH(approx)	1.5	3.3	5.9	7.8	8.3		

It may be assumed that all BS particles have acquired a coating of a formulation additive. Differences emerge in 0.06 M HCl:A and B have increased negative charge suggesting the presence of basic groups in the coating; A has increased negatively at pH 8.3 suggesting acidic groups also in the coating. Clearly the preferred preparations are strongly negative in 0.06 M HCl and they would, by particle repulsion, resist flocculation which is known to give uneven mucosal coating and reduce diagnostic precision. D and E, electrically discharged by 0.06 M HCl could have carboxyl groups in the coating, unionized at pH 1.5.

In gastric secretion, particles of all preparations lose their charge at pH ~3 but for EM=0 each requires different amounts of gastric secretion to be added. E was very resistant in this experiment; the number of negative centres interacting with protein of the gastric secretion was apparently greater than in A-D. Suitability for DCGE will, of course, be influenced by other properties such as flow over the mucosal surface, particle size range, and others, operating simultaneously. Also, in the stomach the flocculating effect of undiluted secretion with its lower pH, will be more pronounced.
A=X-opaque; B=E-Z-paque HD; C=Barosperse; D=Baritop; E=Micropaque.

James, W.B. (1978). Clinics in Gastroenterology, 7, 397-430.