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### Cardiovascular Responses after Methylmethacrylic Cement

SIR,—There is concern<sup>1-4</sup> over the cardiovascular changes following the insertion of polymethylmethacrylate bone cement for fixation of major joint prostheses. May we therefore summarize our findings in 50 patients undergoing total replacement of the hip for arthritis, and eight patients undergoing femoral head replacement after subcapital fracture of the femur?

Intra-arterial needles leading to pressure transducers and amplifiers with continuous recorders (Devices M2 for the total hips and Mingograph for the femoral head replacements) have been employed. The polymethylmethacrylate used in all these cases was Simplex Opaque mixed manually by a technique known to eliminate up to 14% of the monomer by evaporation during the mixing process.

The total hip replacements were divided into two groups: 37 breathing halothane spontaneously and 13 under neuroleptanaesthesia. In the former group the mean arterial pressure fell in 31 out of 37 patients after the insertion of the acrylic into the femur, with a subsequent rise in 35 out of the 37. After the introduction of the resin into the acetabulum the mean pressure fell in 33 patients, and later rose in 26. In the latter group the mean pressure fell in 10 out of the 13 cases after insertion of the cement into the femur and the acetabulum, and later rose in 12 out of 13 after insertion into the acetabulum, and in all 13 after femoral insertion.

In the eight patients undergoing femoral head replacement fluothane was initially used as part of the anaesthetic, but had to be withdrawn in six before the actual surgery began because of a major fall in blood pressure. There was a fall in mean pressure, with a later rise, in seven

out of the eight patients after the implantation of the acrylic into the femur. The Table gives details of the extent and times of the pressure changes, related to the time of starting the insertion of the cement. The figures emphasize the wide variation not only in the extent of the pressure changes but also in their time of occurrence. The late rise in pressure (above the preinsertion level) has not previously been commented upon and its cause is uncertain. In the total hip group the onset of this late rise often appeared to coincide with the period of polymerization of the resin, though this was not so in the femoral head replacements. The cessation of intramedullary bleeding after implantation may be of significance in this context.

One of the most interesting features, occurring in all three groups, is the effect on the pulse rate. In the total hip groups the mean pulse rate fell after the implantation of the acrylic except in those patients under neuroleptanaesthesia after the insertion into the femur, where there was no change. In the subcapital fracture group there was an average fall of 8.25/min (S.D. 8.6). D. J. Peebles and others<sup>2</sup> in their study of the effect of the intravenous injection of monomer into greyhound dogs noted a rise in pulse rate after most injections. The fact that the pulse rate fell in the clinical cases reported here suggests that the mechanism of the cardiovascular response in these patients may be different from that suggested by Peebles and others. This is not perhaps surprising when it is appreciated that they were studying the effect of the

intravenous injection of commercial monomer into dogs, while the findings here reported represent the effect of the implantation of the resin dough into man.

Undoubtedly monomer is absorbed from the resin surface *in vivo* and may be responsible for the cardiovascular changes as seen in clinical practice, though through exactly what mechanism is still uncertain. The initial results of animal experimental work in progress in Exeter suggest that the activation reaction which occurs after the mixing of the liquid and powder components of the cement may be important in influencing the cardiovascular response to implanted acrylic. Caution must therefore be exercised in extrapolating the results of animal experiments involving the intravenous injection of monomer into the human situation in which the resin dough is implanted.

At the Princess Elizabeth Orthopaedic Hospital more than 1,000 total hips have been done using methylmethacrylate with no case of cardiovascular collapse or arrest, and we would agree with the sentiments expressed by H. Phillips and D. Dandy<sup>4</sup> that the use of this material in total hip replacement seems safe. In the generally older and more unfit patients undergoing femoral head replacements collapse has been reported after the insertion of acrylic. Though our numbers of femoral head replacements are small the cardiovascular effects which we have seen in these patients seem to be of the same order as those seen in total hip replacement. A very significant