

Maternal plasma volume and disorders of pregnancy

Maternal plasma volume increases progressively during the second and third trimesters of pregnancy.^{1,2} The extent of the increase depends on the size of the conceptus, tending to be most in women with multiple pregnancies,^{3,4} and least in women with babies small for gestational age.^{1,2,5} Maternal plasma volume is also reduced in women with pre-eclampsia, a common cause of impaired fetal growth,⁶ although factors other than fetal size may contribute to the maternal hypovolaemia.⁷⁻⁹ Pregnant women with chronic hypertension are another group who may have reduced plasma volumes (as do non-pregnant subjects with essential hypertension¹⁰), although in some studies it is not clear whether or not women with superimposed pre-eclampsia were excluded.^{9,11} Thus a raised blood pressure may directly reduce plasma volume, but in pre-eclampsia, a more important factor may be a low concentration of albumin in the plasma, which is characteristic of the disorder.^{12,13} It is assumed that the hypoalbuminaemia is due to albumin loss in the urine, after proteinuria develops, although this has never been proved. The possibility that albumin may leak into the extravascular tissues through abnormally permeable capillaries has not been substantiated.¹⁴ In women with pre-eclampsia the total intravascular albumin mass is reduced, although extravascular albumin remains unchanged and neither the exchange of albumin between the two compartments nor its catabolic rate changes.¹⁵ Though the cause of the low plasma albumin is thus unexplained, its reduced concentration lowers plasma oncotic pressure¹⁶ and predisposes towards loss of fluid from the vascular compartment. This explains the formation of oedema in severe pre-eclampsia and identifies a process which may further reduce the circulating plasma volume.

Plasma volume may be measured by safe dye dilution techniques but these are invasive and not used routinely in clinical practice. Haemoconcentration, however, may be readily assessed by measuring the packed cell volume. This reflects plasma volume depletion provided that the total red cell mass is not also reduced by blood loss or anaemia.^{8,17,18} Thus a high packed cell volume suggests hypovolaemia and increases the likelihood that there is placental insufficiency and impaired fetal growth.¹⁹

It has been claimed that the hypovolaemia associated with pre-eclampsia may be the cause of poor tissue and organ perfusion leading to a maternal condition resembling circula-

tory shock.²⁰ This is exacerbated by the increased blood viscosity which occurs in pre-eclampsia.^{21,22} Some workers have used plasma expanders to increase the plasma volume in such patients and claim that renal and possibly placental perfusion may be improved by such treatment.^{20,23,24} Others disagree and point out that cardiac output is well maintained²⁵ or even increased²⁶ in pre-eclampsia and that, although the plasma volume is reduced, the capacity of the circulation may be reduced to a similar degree so that it is not underfilled. Sudden expansion of the plasma volume increases albumin loss from the capillaries into the extravascular space.²⁷ If the infused plasma expanders (colloids) leak into the extravascular space the oedema will increase and dangerous complications such as pulmonary or laryngeal oedema may ensue. A further potential problem with this form of treatment is the possibility that hypervolaemia rather than hypovolaemia may occasionally complicate pre-eclampsia.²⁸

Goodlin and his colleagues have recently reported the results of plasma volume determinations in 200 women with various complications of pregnancy. Their purpose was to determine if any simple clinical investigation could be used to identify those women with hypovolaemia. Some of the test results (renal function, packed cell volume, serum albumin concentration) are likely to correlate with plasma volume because they measure variables which are directly related. Others, such as the platelet count or changes in liver enzyme activities, should reflect the severity of abnormalities in the clotting system or in the liver in pre-eclampsia but are unlikely to be related directly to hypovolaemia. Not surprisingly, the authors conclude that no routine clinical measurement accurately identified the pregnant women with hypovolaemia; in other words, the only way to determine plasma volume is to do so directly.²⁹

This report assumes that depletion of plasma volume is the cause, not the consequence, of both fetal growth impairment and the maternal systemic disturbances in pre-eclampsia. The authors state that "a major goal of antenatal care should be an expansion of plasma volume in pregnant women." This assumption is unproved but could be tested by a randomised controlled trial to see if expansion of the plasma volume has any beneficial effect on the outcome of pregnancy. No such study has yet been described. The importance of maternal plasma volume in disorders of pregnancy remains unclear. On present evidence, therefore, Goodlin's recommen-

dition that plasma volume estimations should be a part of routine clinical investigation cannot be accepted.

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Changing American medicine

Dramatic changes are taking place in American medicine. In October 1983 the United States government changed the way it reimburses hospitals for Medicare patients (those aged over 65), but the change will eventually affect patients of all ages. The full effects of this new method of reimbursement will become apparent only with time, but the initial reaction of the health professions does allow speculation on the future of medicine in the United States.

By tradition doctors have been accustomed to using their discretion and judgment both in diagnosing and treating patients and in billing for their services. Hospital charges were designed to cover their costs and to generate a modest surplus. In 1965 the United States government introduced Medicare. Hospitals were reimbursed under part A, "covering reasonable costs," and doctors were allowed to make a "reasonable charge" under part B. As might have been predicted, the absence of reimbursement ceilings led to inflation at a rate considerably greater than in other sectors of the economy—though much of the increased cost was due to increased services. In 1983 health care costs in the United States had risen to \$300 billion (£200 000 million) a year, over 10% of the gross national product. The United States government pays for 40% and large employers 30% of the total bill for health care.

Recent changes in the health market place are now exerting pressure on the providers. The demand for hospital beds is diminishing; fewer were occupied in 1982 than 1981. Hospitals generally are losing their monopoly on many forms of health care—and thus are experiencing an erosion of their economic base. For example, much simple surgery is now performed in "surgicenters," which are not necessarily affiliated with hospitals. There is now an excess of doctors in the United States, 18 000 new graduates having entered medical practice in 1983 alone. Doctors' net disposable incomes have declined steadily since 1975. American consumers believe that they have a right to good health care and a right to live. They have come to expect expensive, high technical diagnostic procedures (such as computed tomography) and therapeutic measures such as coronary bypass surgery, renal dialysis, and transplants. Malpractice suits are increasing, pushing insurance premiums ever higher. Doctors are being forced to practise expensive defensive medicine. The United States population is aging and so making increasing demands on the delivery of health care.

In 1982 the United States government responded to pressure to control the costs of health care by passing the Tax Equity and Financial Responsibility Act, which—for the first time—placed a ceiling on reimbursement of hospital costs and redefined the doctors' services which were reimbursable as a hospital cost. The mechanism chosen to accomplish this goal was a system of prospective payments based on diagnosis related groups—a comprehensive set of 467 medical classifications initially developed at Yale University. Hospitals will now be reimbursed for each individual patient's stay at a rate determined by the discharge diagnosis; the actual length and cost of the stay are not taken into account. The sum paid for each diagnostic group is determined by a branch of the United States government, the Health Care Financing Administration. A three year phasing in period has begun, during which reimbursement will be shifted gradually from an emphasis on the hospital's costs, via a rate structure based on nine geographic regions, to a strict