Editorial

Induced hypotension and blood loss during surgery

During a time of great social and political change in the Europe and North America of the mid-19th century, there began a remarkably productive period in medicine. The most significant medical change was the introduction of general anaesthesia and this event may still be regarded as the greatest single advance in the history of surgery. It was soon observed that patients operated on under general anaesthesia appeared to lose rather more blood than formerly, but at that time this must have seemed a disadvantage of comparatively little importance. Attempts to reduce blood loss were made by increasing the depth of anaesthesia, but these were abandoned when the dangers of this practice became evident. The first observations on the haemostatic mechanism were made by Claude Bernard in 1851, when he divided the nerves surrounding small arteries and noted that the vessels dilated. The importance of this observation was confirmed in 1853 when Sequard stimulated these same nerves and reported that the vessels constricted (Learmonth 1953). In 1879 Lord Lister elegantly demonstrated the effect of posture on blood vessels in a successful attempt to reduce blood loss during surgery.

When spinal anaesthesia was introduced at the end of the century, an early pioneer of this technique observed in 1912 that 'nice dry wounds' were common and that falls of arterial pressure were frequent and unpredictable and could reach 'nothing over zero' (Pitkin 1928). Slowly, the idea evolved that there may be a relationship between blood pressure and blood loss (Babcock 1928), but this could not be established until a reliable method of measuring blood loss was described (Gatch & Little 1924). It was to be many years before efforts were made to establish this relationship.

More recently, attempts to reduce blood loss during surgery have concentrated on combining posture with control of arterial pressure. The impetus for this initiative was provided by three papers. The first of these described a technique of 'induced hypotension' by arteriotomy (Gardner 1946); the second, a method of high spinal anaesthesia to reduce blood pressure (Griffiths & Gillies 1948); and the third introduced ganglion-blocking agents into clinical practice (Enderby 1950). This initiative was powerfully reinforced when the use of a short-acting intravenous agent, trimetaphan, was described (Magill *et al.* 1953, Nicholson *et al.* 1953). By now it was possible to induce fairly predictable and reasonably safe hypotension during surgery, and contemporary practice was directly influenced by this consideration. In the two decades, 1946–1966, there is an abundant literature on the physiology of spinal anaesthesia in particular, and hypotension in general, with particular reference to blood flow measurement through vital organs. As usual, in the early flush of enthusiasm, there was no lack of reports of clinical impressions, technical minutiae and unsubstantiated claims for particular techniques.

By contrast, simple blood loss measurements made during comparable operations performed with and without hypotension were slow to appear. Only five such studies during these first twenty years have been traced (Safar 1955, Ditzler & Eckenhoff 1956, Bodman 1959, Bruce *et al.* 1960, Eckenhoff & Rich 1966). By today's standards, all these studies had major flaws in experimental design, statistical analyses, or execution, so that it is fair to state that in 1966 the evidence that induced hypotension actually reduced blood loss during surgery was, at best, flimsy.

In the following two decades or so, the history of induced hypotension was dominated by the introduction of sodium nitroprusside (Moraca *et al.* 1962), and descriptions of techniques of profound hypotension (Littlewood & Robinson 1963, Kerr 1977). Once more, there was no lack of physiological and pharmacological studies, but reports of blood loss measurements made during surgery performed with and without hypotension appeared fairly infrequently. In particular, it is disturbing to note that no blood loss measurements have been made during profound hypotension and compared with similar measurements made during more orthodox hypotension. Thus, there is still no evidence that profound hypotension has any effect on blood loss during surgery.

Of the blood loss and arterial pressure studies which have been reported, most showed that induced hypotension appeared to reduce blood loss during surgery, but this was not a consistent finding (Deacock 1971, Renck 1969, Diaz & Lockhart 1979). Unfortunately such studies were all too frequently marred by obvious errors in statistical analysis, questionable accuracy in blood loss measurements and an uncritical acceptance of the accuracy of noninvasive methods of estimating arterial pressure. In addition, too many papers published since 1966 show clear evidence of bias.

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Blood loss measurements were often made a secondary object of the experiment, suggesting that the authors assumed that hypotension reduced blood loss and that further evidence was barely worth recording. One group of workers who found that hypotension did not reduce blood loss in their series commented to the effect that they could not understand their own results (Thorud *et al.* 1975). Today it is still possible to argue that induced hypotension does not have any significant effect on blood loss during surgery.

However, the weight of evidence indicates fairly strongly that induced hypotension does reduce blood loss to some extent. By how much is blood loss reduced? There is some degree of unanimity to be found in most published reports that hypotension reduced mean blood loss by about 50% from that found during normotensive anaesthesia.

What is the relationship between arterial pressure and blood loss during surgery? Is this relationship linear, or does the effect of hypotension appear at higher or lower levels of arterial pressure? There is no answer to this question in the published papers. In an attempt to investigate this problem, Donald & McKenzie (1982, unpublished) analysed the blood loss and arterial pressure estimations made in their clinical practice. Data were examined from 155 patients who had pelvic floor repair performed and 41 patients who were subjected to microsurgery for middle ear disease. The results showed that there was no general relationship between arterial pressure and blood loss, but instead a 'step-down' phenomenon occurred when blood loss was reduced significantly at systolic arterial pressures of 80–100 mmHg. Below this level of pressure no further reduction of blood loss was observed. A similar result was obtained when these same measurements were analysed by relating blood loss to a fall of arterial pressure which was induced. A significant fall of blood loss was observed when arterial pressure was reduced by 20–40 mmHg, but below this level no further reduction in blood loss occurred. If this result is confirmed, and there is some evidence to support it (Urquhart-Hay *et al.* 1969), there can be no justification for reducing arterial pressure below these modest levels in order to reduce blood loss.

A third, apparently simple, question remains to be answered. This is, does spinal or epidural anaesthesia reduce blood loss more than can be accounted for by the fall of arterial pressure? The literature is ambiguous on this point. In two papers, the authors found that there was no difference in blood loss during surgery performed when hypotension was induced to comparable levels by drugs or by epidural anaesthesia (Urquhart-Hay *et al.* 1969, Donald 1969). In two other papers, the authors reached a different conclusion and estimated that epidural anaesthesia did reduce blood loss more than would have been expected by conventional hypotension, but did not compare their results with any other hypotensive method (Louden & Scott 1960, Moir 1968). McGowan & Smith (1980) have found that subarachnoid anaesthesia had no effect on blood loss, but they did not refer to arterial pressure. An editorial in the *British Journal of Anaesthesia* alleged that spinal anaesthesia reduced blood loss whether or not hypotension occurred (Scott & Thorburn 1975). Jensen & Stokke (1978), while admitting to deficiencies in their experimental design, found that when epidural anaesthesia was used to induce hypotension, there was no reduction of blood loss. Bond (1969) obtained similar results but, to add confusion, Thorburn *et al.* (1980) showed that spinal anaesthesia, which induced hypotension, did reduce blood loss.

That the relationship between hypotension and blood loss is unclear after thirty-six years of intense activity in this relatively simple field of study must be a matter for concern. Particularly disturbing is the early uncritical acceptance, based on minimal evidence, that induced hypotension actually reduced blood loss during surgery and the later implication, based on no evidence whatsoever, that the lower the arterial pressure was reduced, the greater would be the reduction in blood loss.

Perhaps the most interesting observation in blood loss studies is the wide range of results which occur. This fact undoubtedly accounts for many of the different conclusions reached in so many reports. In McGowan & Smith's (1980) interesting study, the range of blood loss measured during prostatectomy was from 6 ml to well over 2 litres, a finding not especially unusual in its magnitude.

Why do some patients show such a small blood loss during surgery? Frankly, it is not easy to propose a hypothesis to explain this strange phenomenon. It is tempting to suggest that a factor exists with which some patients are better endowed than others, and that the possession of this factor in some way limits traumatic blood loss. This factor would have considerable survival value to an individual in a species and may be genetically determined.

The clue may lie in quite another direction. When the blood loss which occurs at operations performed under general anaesthesia is compared with that lost during surgery with local anaesthesia, an interesting picture emerges. Donald recently constructed a histogram of blood lost at 34 comparable operations performed under local anaesthesia. Of these results, 30 clustered

around a small area low on the scale and only 4 results were inconsistent. This is quite different from the wide scatter of results which could be expected from the same series of operations performed under general anaesthesia. It would appear that general anaesthesia may interfere with the normal haemostatic mechanism in many patients. The most obvious effect of general anaesthesia is that it depresses the central nervous system, including the vasomotor centres, so that the first critical stage of haemostasis, intense vasoconstriction, may be inhibited.

It remains a fact that some patients show remarkably little blood loss during surgery. It is demonstrably not due to induced hypotension, or any other factor known to influence blood loss. If some research effort were to be directed towards an understanding of this curious phenomenon, it could have a profound influence on surgery in the future.

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Pain relief clinics

There are now 120 pain clinics in the United Kingdom and in addition there are some 15 pain relief centres (Lloyd 1980). The latter all have their own inpatient facilities and are virtually autonomous. This rapid growth over a period of 12 years is testimony to the interest being shown generally, and especially by anaesthetists.

The objective is to treat intractable pain, which by definition is pain which has been present for over a month and is unremitting despite treatment. This has spread to include pain from any system in the body, irrespective of the cause. Such pain has long ceased to have an alerting function. This is pain that has now become useless and, to quote Bonica (1953), 'Is a pathologic destructive phenomenon which has reached the doubtful dignity of a disease'.

In the Oxford Regional Pain Unit in 1970, 80% of the admissions were patients with cancer pain: in 1981 patients with cancer formed only 28% of the total. Far from signifying a decrease in the overall number of cancer patients being treated, it was only a measure of the widening of the spectrum. At present back pain is the single most common cause for admission to the unit, constituting over 36% of the total.

In the UK 95% of pain units are run by anaesthetists, who very often work single handed.

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