

## THE DISADVANTAGES OF HYPOTENSIVE ANAESTHESIA\*

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THE PROBLEMS involved when studying alterations of blood pressure are innumerable and many of the present ideas on the subject are questionable.

When considering hypotension it first appears there is marked disagreement among medical men as to the influence of periods of lowered blood pressure on the well-being of a patient. Secondly, it is not clear whether the systolic, the diastolic, or the mean pulse pressure reading is the most significant value. And thirdly, if a patient's usual blood pressure is to be taken as optimal it is not decided under what conditions or period of time it should be recorded to be reliable.

While forming my opinion of hypotensive anaesthesia I have been influenced by the difficulties which have occurred during the conduct of my own cases and by the views expressed in the literature. I shall try to show briefly from these two sources the importance of the disadvantages.

In my own experience I have been singularly unsuccessful in producing a totally bloodless field. I have also the impression that, provided a properly sedated patient is induced very smoothly, minimal elevation of blood pCO<sub>2</sub> is permitted, and smooth anaesthesia is maintained through a perfect airway, the bleeding will not vary greatly from that which will occur during safe induced hypotension, provided the surgery is efficient.

I apologize for giving my impressions of this fact but I have been able to find little statistical proof that measured blood loss can be greatly reduced in comparable series of cases.

Recently Griffith (1) has shown that the bleeding time as estimated by the "Modified Ivy" technique is equally prolonged by general anaesthesia or a systolic blood pressure between 65-80 mm. Hg.

Shackman and his co-workers (2) believe that skin and muscle blood flow during maintenance of general anaesthesia is virtually unchanged despite a 45 per cent reduction of mean arterial pressure.

It is agreed that the normal clotting mechanism may operate satisfactorily in the dilated vessels because of the low head of pressure but there is no support for the view that a surgical incision will lose less blood from small paralysed vessels unless extreme posture is used. The larger vessels should be controlled by classical means always—if not, reactionary haemorrhage is inevitable.

It is possible that I have been less successful in my cases because an undue number of patients have been resistant to the blocking agents, or a majority may have had a blood dyscrasia of minor nature which gave rise to the

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"bleeder," or my patients have been exposed to one of the many bad influences on capillary fragility; but we must all come across such patients and hypotension is then of little help. For safety, it is essential that a full circulating 100 per cent volume of blood and 100 per cent oxygenation be maintained; it is very hard to obtain such perfection and the lower the blood pressure the less is the margin of safety. As we have heard, the controllability of many of the described methods is not simple: they necessitate much experience and entail some strain on all but the most imperturbable anaesthetist.

We are still unable to ascertain blood volume quickly and correctly as a routine, and too few centres accurately measure blood loss. Yet this is essential if the dire result of inadequate replacement is to be avoided. It has been said that, provided the venous pressure is maintained, there is little danger—whenever I have recorded venous pressure it has been reduced with the arterial pressure.

If the use of hypotension is avoided in unsuitable conditions, particularly during uncontrolled haemorrhage, one is often faced with a request by the surgeon merely to take the head off the pressure. This is not only dangerous but can be futile as it may aggravate the bleeding, owing, presumably, to the presence of relaxed vessels within which there is still considerable pressure.

On the rare occasions when it is thought desirable to use hypotension to make the impossible possible it is often ruled out for one reason or another. For instance, no essential organ or tissue which is impaired should be exposed to further strain, so that any gross pathology of brain, heart, liver, or kidneys must exclude its use; as the operation site should be elevated, it is unsuitable for some operations, it seems unwise to maintain the hypotensive state for very long periods of time even when possible; the very old or the very young are poor subjects; the anxious youth or thyrotoxic patient, undoubtedly owing to their excess of endogenous adrenaline, are most resistant; the foetal anoxia which would result excludes its use during pregnancy; the diabetic is subject to an hypoglycaemic response to insulin if hexamethonium is given because the compensatory sympatho-adrenal discharge is prevented.

These are some of the practical difficulties involved in the application of the technique and I shall now review some of the reports of the outcome of its use.

The Yale University report (3) of the sequelae which occurred when hypotensive anaesthesia was employed in 27,930 operations, disclosed the appalling over-all mortality of 1/291 with complications in 1/31 cases. This unbiased analysis was compiled from questionnaires returned by 464 specialist anaesthetists.

It is generally agreed that hypovolaemic hypotension with the associated, reduced cardiac output, intense peripheral constriction, and plasma skimming will give rise to hypoxia. Investigations centred around normovolaemic hypotension are more conflicting.

During hypotension, despite a decrease of the cerebrovascular resistance, there seems to be a reduced blood flow to the brain but owing to an increased oxygen uptake compensation may be adequate in the anaesthetized patient. Even when anoxia is avoided, however, thrombosis with subsequent embolism

is an ever-present danger whenever circulation is so reduced. As the general circulation time is increased whatever the degree of hypotension, this danger applies to all parts of the body.

When hypotension is induced, cerebrospinal fluid is decreased and the brain shrinks and changes its consistency; the resultant soft couch is easily compressed and slow to regain its normal conformity. This leads to so-called "retractor" anaemia which can cause widespread damage and be followed by oedema or thrombosis.

Other reports of the electroencephalography, flicker fusion tests, retinal changes, etc., are not complete enough to be conclusive. Likewise, electrocardiographic changes are not constant but tend to incriminate the procedure by the frequency with which tracings resembling those due to anoxia occur. Myocardial infarction must be an ever-present danger as coronary disease can occur in young, apparently healthy patients. If the occlusion occurs gradually over a period of months or years, with the concomitant development of anastomatic circulation, the condition is clinically undiagnosable, but clearly the coronary reserve is reduced. Since oxygen extraction by heart muscle is almost maximal, it is nearly as vulnerable as the brain.

The renal haemodynamic response to blood pressure reduction leads to a fall in filtration rate with temporary anuria at 50-70 mm. Hg. level and some hypotensive agents are known to be eliminated unchanged only in the urine. Thus a precipitation of uraemia and prolonged hypotension can occur respectively.

Investigation of the effects of hypotension upon the liver, has not yet been properly reported.

If the parasympathetic system is blocked, gastric motility and emptying are impaired and cases of distention and ileus are reported. I reflect that the present method of anaesthesia recommended for cardiac surgery leaves the sympathetic system in the most responsive state to counteract any insult; my experience of severe stimulation applied to patients without a functioning autonomic system has been most disturbing.

To apply controlled hypotension safely it has been said that anaesthetists of physiological outlook and great skill are required before, during, and after the operation, but I am still unconvinced that they can regularly in this way provide the best operation conditions or avoid considerable risk to every patient.

These techniques are of great interest and can be applied to many other fields, so it is imperative to experiment more in the hope that some day we can control the blood pressure with as little obvious upset, as occurs when we now control respiration.

#### RÉSUMÉ

Les problèmes suscités par l'étude des différentes altérations de la pression sanguine sont incalculables et plusieurs des idées actuelles sur le sujet sont aptes à être étudiées.

Il existe un désaccord marqué dans le monde médical au sujet de l'influence des épisodes d'hypotension sur l'état général du malade et il n'y a rien de précis

à savoir si la pression systolique, la diastolique ou la pression sanguine moyenne est la plus importante. Si la pression sanguine habituelle d'un sujet est considérée comme "idéale," il est à se demander dans quelles conditions elle sera considérée comme "fiable."

Selon l'auteur, pourvu que l'anesthésie soit donnée "avec douceur" et que l'élévation du  $pCO_2$  sanguin soit maintenue au minimum, la perte de sang ne sera pas plus considérable que celle qui serait observée si l'hypotension avait été amorcée, ceci au cours d'une intervention chirurgicale adéquate. Griffith (1) et Shackman (2) ont publié des notes intéressantes sur ce sujet. Le mécanisme normal de coagulation fonctionnant de façon satisfaisante dans les vaisseaux dilatés, il n'y a rien qui laisse prévoir qu'une incision chirurgicale entraînera moins de pertes sanguines à moins d'être en face de positions favorisant la stase.

Pour être du côté "sécurité" quand il s'agit d'hypotension, il est essentiel qu'un volume sanguin circulant total et une oxygénation adéquate soient maintenus. Nous sommes encore incapables, de routine, de contrôler rapidement un volume sanguin et trop peu de centres mesurent les pertes sanguines. Les organes essentiels qui sont souvent le site de troubles importants ne devraient pas être soumis à cette nouvelle épreuve: l'hypotension. Dans de rares occasions où il serait désirable d'employer l'hypotension pour rendre possible l'impossible elle est souvent contre indiquée pour une raison ou pour une autre.

Le rapport de l'Université Yale sur les séquelles de l'anesthésie avec hypotension révèle un nombre terrifiant de morbidité et de mortalité associées à cette technique

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