

HALOTHANE FOR CONTROLLED HYPOTENSION IN BACK SURGERY*

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THE LARGEST proportion of industry in our area is devoted to the forest and its harvesting; hence many of our workmen engage in activity which involves strain to the lumbar spine. For this reason there is always a plentiful supply of ruptured and extruded discs requiring surgical intervention: and our surgeons have not hesitated to rise to the challenge.¹

Because of this intense surgical interest, we have attempted to provide anaesthesia which, with minimum hazard to the patient, would provide maximum visibility, relaxed musculature, minimal blood loss, and rapid and quiet recovery. Of these four, the most important objective is to minimize blood loss, for excessive oozing leads not only to prolongation of the surgery due to poor visibility and to greater chance of surgical misadventure, but also to the administration of transfusions that would be unnecessary with proper technique. The transfusion of blood is not without its own risks.²

There are many choices of anaesthesia for operations on the lumbar spine. The use of one type or another depends on the patient, length of procedure, and experience of anaesthetist and surgeon. Epidural anaesthesia is useful, either alone or combined with light general anaesthesia.³ Spinal anaesthesia has also been used.³ These techniques both provide excellent relaxation, and the former, using Xylocaine® with adrenaline, reduces bleeding from epidural vessels by means of the local vasoconstricting effects of the adrenaline.⁴ Disadvantages of epidural anaesthesia are (*a*) inadequate duration for difficult spinal fusions, particularly if performed by resident staff, (*b*) occasional incomplete analgesia,⁵ (*c*) poor control of ventilation, (*d*) lack of patient acceptance, (*e*) occasional restlessness necessitating induction of general anaesthesia in the prone position.

The problem of duration may be solved by use of a peridural catheter,⁶ and those describing this technique claim to have had no troubles. However, the problem of controlling ventilation remains.

General anaesthesia with various agents but using ganglionic blocking drugs such as trimethaphan camphor sulfonate or hexamethonium bromide has enjoyed some popularity, particularly in England,⁷ but has been associated with a considerable incidence of serious complications.^{8,9} These drugs will, however, usefully reduce bleeding.

Thus we have evolved the method which is the subject of this paper: controlled hypotension produced by halothane.

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CONDUCT OF ANAESTHESIA

Patients are heavily premedicated and arrive in the operating room well sedated. Thiopental induction is followed by succinylcholine and decamethonium, then endotracheal intubation.

The prone position on longitudinal cylindrical bolsters is used at operation. Proper positioning is of considerable importance to the success of the technique, as pressure on the abdominal contents will be transmitted to the inferior vena cava, and thence to the epidural venous system with increased bleeding. The bolsters must be checked after the patient is turned to ensure there is adequate space for the abdominal contents to hang between.

Anaesthesia is maintained with nitrous-oxide-oxygen and halothane. Initially, a concentration of halothane in excess of 3 per cent is necessary to achieve the desired reduction in systolic blood pressure of greater than 30 mm. Hg. The time necessary to achieve this reduction varies, but is usually 10 to 15 minutes. A maintenance level of 1 to 1.5 per cent halothane will then keep the blood pressure at the desired level. Should the pressure fall to a level lower than desired, reduction in halothane concentration will usually cause a return to maintenance blood pressure level in 5 minutes. Severe bradycardia may be combatted with small doses (0.3 mg.) of atropine.

Ventilation should be controlled by means of an automatic ventilator, since a more even arterial concentration of halothane can be maintained in that way. Anaesthesia may be rapidly lightened as the lumbar fascia is being closed by discontinuing halothane. Thus when skin closure is effected, blood pressure will be close to normal. In all the cases reported in this paper, blood loss was measured by weighing swabs, measuring suction, and estimating loss on drapes.

RESULTS

Table I presents data regarding ages and numbers of patients for the three operative procedures; laminectomy, spinal fusion, and the combined procedure: of the 152 operations 140 had charts with sufficient information to be included in this study. All patients were males.

The most interesting feature of these cases is the correlation between blood loss and anaesthetic technique. However, it did seem likely that in procedures

TABLE I
SUMMARY OF TYPE AND NUMBER OF CASES, AND
RANGE OF AGES OF PATIENTS

	Number of cases	Age range (years)
Laminectomy	44	20-70
Laminectomy and fusion	46	21-61
Fusion	50	21-56
Incomplete records	12	—
Total	152	

lasting a longer time the patient would lose more blood. Ranges of time and blood loss are presented in Table II, and these are grouped in Table III into periods of less and greater than two hours, with the average blood loss shown for each period. It will be noted that the length of time taken to perform the operation of laminectomy and removal of disc does not significantly affect the blood loss. Results for the combined laminectomy and fusion procedures cannot be adequately assessed due to the paucity of short cases. Blood loss during spinal fusion, on the other hand, is clearly related to length of procedure, as the average loss (520 c.c.) in those procedures lasting longer than two hours was almost twice that (266 c.c.) in procedures lasting less than two hours.

TABLE II
DURATION OF PROCEDURE AND BLOOD LOSS

	Range of time (hrs.)	Range of blood loss (c.c.)
Laminectomy	$\frac{3}{4}$ -3	25-650
Laminectomy and fusion	$1\frac{1}{2}$ -4	150-1200
Fusion	2-4	73-2200

TABLE III
BLOOD LOSS IN PROCEDURES LASTING VARYING LENGTHS OF TIME

	0-2 hours		> 2 hours	
	no. of cases	average blood loss (c.c.)	no. of cases	average blood loss (c.c.)
Laminectomy	36	165	8	225
Laminectomy and fusion	1	450	45	475
Fusion	28	266	22	520
Total	65		75	

A scan of the rough data indicated that a depression in systolic blood pressure of 30 mm. Hg below the patient's normal level was a convenient level below and above which to tabulate results (Table IV). The laminectomy procedure done with any of the three techniques has no significant difference in blood loss; and the blood pressure level, whether below or above the 30 mm. Hg depression level, also causes no significant change. Combined laminectomy and fusion, and fusion alone done under epidural and nitrous-oxide-relaxant techniques, are not present in numbers sufficient to analyse statistically. However, these latter procedures done under halothane anaesthesia relate a significant advantage to hypotensive technique. The blood loss for combined laminectomy and fusion is reduced by hypotension from an average of 525 c.c. to 380 c.c., and for fusion from an average of 760 c.c. to 365 c.c. Both these reductions in blood loss assume statistical significance when tested by the Wilcoxon Rank Sum Test.¹⁰ It should

TABLE IV
BLOOD LOSS (IN C.C.) RELATED TO HYPOTENSION IN PROCEDURES
DONE WITH THREE TECHNIQUES

	Laminectomy	Laminectomy and fusion	Fusion
Epidural			
B.P. drop < 30 mm. Hg	185 (12 cases)	605 (6 cases)	325 (3 cases)
B.P. drop > 30 mm. Hg	50 (1 case)	580 (2 cases)	200 (2 cases)
N ₂ O-relaxant			
B.P. drop < 30 mm. Hg	225 (7 cases)	445 (3 cases)	—
B.P. drop > 30 mm. Hg	—	1200 (1 case)	375 (1 case)
N ₂ O-O ₂ -halothane			
B.P. drop < 30 mm. Hg	135 (13 cases)	525 (11 cases)	760 (7 cases)
B.P. drop > 30 mm. Hg	165 (11 cases)	380 (23 cases)	365 (37 cases)

be noted that procedure time was not a factor in this analysis, the average times for procedures done at either blood pressure level being almost identical.

One operative complication occurred. A 42-year-old patient developed a severe circulatory depression on induction. Details are scanty on the chart, but circulation was re-established and the operation began and proceeded without further incident. Postoperative complications were also minimal. No wound haematomata are recorded.

DISCUSSION

Conspicuous clinical circulatory effects of halothane are bradycardia and hypotension. The bradycardia was once thought to represent direct myocardial muscle depression, but its response to atropine makes vagal sensitivity the most likely reason.¹¹ Intensive study has also revealed that the hypotension is not the result of direct cardiac depression either.¹² Cardiac output studies^{11,13} tend to indicate no direct relationship between cardiac output and blood pressure.

Thus the reduction of blood pressure is probably due to decreased peripheral resistance related to three factors: depressed vasomotor control, ganglionic blockade, and direct relaxation of vascular smooth muscle. Tissues would therefore appear to be well supplied with blood and not subject to ischaemia. This is borne out by the appearance of the patient, who is warm, dry, and with a brisk capillary refill time.¹⁴

Therefore, because of the lack of direct cardiac depression, use of halothane to produce deliberate hypotension would appear to be safe and easily reversible. This has proven to be true, both in our series and in others.^{14,15} In all, 71 patients out of 103 anaesthetized with halothane were maintained at a level of systolic blood pressure 30 mm. Hg or more below normal level and no problems were encountered. Hypotension was easily reversed by reducing the halothane concentration in the inspired mixture.

The degree of depression of the blood pressure is significant in the reduction of blood loss. With a hypotensive level of more than 30 mm. below normal the average blood loss for the combined procedure of laminectomy and fusion, and for fusion alone, is reduced almost to half.

Comparison may be made with a previous series of similar operations reported from our centre by Matheson³ in which epidural anaesthesia was indicated as the method of choice. That series included other techniques, but not the deliberate use of hypotension. Just as in the present series, there was little difference in blood loss during laminectomy in patients anaesthetized by various techniques.

For the combined operation of laminectomy and fusion, Matheson gives an average blood loss of 298 c.c. with epidural anaesthesia and 664 c.c. with halothane. This may be compared with the average loss in our series of 380 c.c. using halothane hypotension and of 525 c.c. using halothane without undue hypotension. Spinal fusion under general anaesthesia is clearly best done with hypotension. The average blood loss of 365 c.c. using hypotension is less than half the average loss of 760 c.c. under normotension.

Postoperative complications were certainly not a great problem. No haematoma appeared, or at least none significant enough to be recorded in the patients' records.

The possible hepatotoxicity of halothane¹⁶ has caused considerable recent concern.¹⁷ Since the incidence of postoperative jaundice (4.1 per thousand halothane anaesthetics¹⁸) is so low, the fact that we have no cases in this series is not significant. Hypotension under halothane anaesthesia has been found to cause greater abnormality of B.S.P. retention than halothane with normotension,¹⁹ and hypercarbia still more. Therefore, to avoid hypercarbia we advise control of ventilation at optimal or slightly greater levels.

Deliberate hypotension with halothane would therefore appear to be a safe technique, easily controlled by the anaesthetist, and producing an acceptable operating field for the surgeon.

SUMMARY

A technique is described for utilizing halothane and controlled ventilation to produce deliberate, controllable hypotensive anaesthesia for laminectomy, spinal fusion, and the combined operation. A series of 140 cases is presented, in 102 of which patients were anaesthetized with halothane. Seventy-one patients had a systolic blood pressure drop of 30 mm. Hg or greater during the procedure, and had significantly less bleeding than those whose operations were performed with a pressure drop of 0-29 mm. Hg. Possible adverse side-effects are discussed.

RÉSUMÉ

Nous décrivons une technique utilisant l'halothane avec ventilation contrôlée pour provoquer une anesthésie hypotensive volontaire et contrôlable lors de laminectomies, greffes lombaires ou des deux opérations à la fois. Nous présentons une série de 140 cas, dont 102 ont été anesthésiés à l'halothane. Durant leur intervention, 71 malades ont subi une baisse de pression sanguine de 30 mm. Hg ou plus; ils ont beaucoup moins saigné que ceux dont la pression a baissé de 29 mm. ou moins. Nous évaluons la possibilité d'effets secondaires désagréables.

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