SOME RECENT ADVANCES IN ANAESTHESIA OF INTEREST TO OPHTHALMIC SURGEONS

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SUMMARY

Some advances in anaesthesia that are of interest to ophthalmic surgeons are discussed. These include local anaesthesia, neuroleptanalgesia and neuroleptanaesthesia, dissociative anaesthesia and methods of reducing operative bleeding.

What aspect of anaesthesia is of interest to the ophthalmic surgeon? I presume his attitude to anaesthesia must be much the same as that of surgeons in general, and that is that anaesthesia is a necessary adjunct to curative procedures. Provided the patient lies down, keeps quiet, presents the ophthalmic surgeon with a quiet eye with a low intraocular pressure, and subsequently wakes quietly without vomiting, little further thought is given to the matter. In these days of specialization, all these objectives can be achieved by the simple expedient of employing a well-trained anaesthetist. How he achieves these objectives is surely his interest and perhaps worry. However, I feel there are some aspects of anaesthesia that may be of more than passing interest and perhaps of use to the ophthalmologist.

LOCAL ANAESTHESIA AND NEUROLEPTANALGESIA

Perhaps the most obvious field in which our interests overlap, is that of local anaesthesia. Though largely replaced by general anaesthesia nowadays in centres where specialized anaesthetic services are available, there is still much eye surgery for which this form of anaesthesia, administered as a rule by the surgeon himself, is employed, and there is a large group of patients in which its use should be retained. Local anaesthesia is a reliable, effective and possibly the safest means of providing anaesthesia for ocular surgery. The drawback, of course, is that the experience of surgery on the eye while conscious, is one that is unpleasant in varying degree for the patient. Happily though, when local anaesthetic techniques are used today, we are in a position with the newer ataractic and narcotic drugs at our disposal, to render the procedure less unpleasant and more acceptable to the patient.

In the past, using opiates alone, or in combination with barbiturates to sedate the patient who was to have an operation under local anaesthesia, it was difficult to steer between the Scylla of too light sedation and a frightened over-reactive patient who retained unpleasant memories of the event, and the Charybdis of over-sedation and the drowsy sometimes unco-operative patient who, on dozing off, would develop airway obstruction and wake with a start and movement at a crucial stage of the operation. The advent of the tranquillizer group of drugs—the phenothiazines, hydroxyzines and the benzodiazepine group—have made it much easier to achieve the state of what one might call 'awake sedation' that is needed during eye surgery under local anaesthesia. The patient appears awake and co-operative but is emotionally detached and subsequently has poor recall of events.

The most recent advance in this direction has brought with it, as did the tranquillizers, a new concept and a new word. This is 'neuroleptanalgesia', a state achieved by the combined use of a neuroleptic with a narcotic analgesic drug.[1] In the state of neurolepsia the patient displays extreme apathy, lack of initiative, and mental detachment from and complete disinterest in his surroundings. The intellect is intact and the patient is easily roused but behaviour is depressed and the patient is slow to respond to external stimuli. The drug currently used to produce this state—dehydrobenzperidol (droperidol)—has two other properties that are useful. It is a powerful antiemetic and it causes adrenergic blockade. This latter property leads to some vasodilatation, slow heart rate and usually great circulatory stability. However, in hypovolaemic patients, hypotension may result. This hypotension responds rapidly to expansion of the vascular volume or to small doses of vasopressor drugs. In excessive dosage, dehydrobenzperidol and other neuroleptic drugs lead to extrapyramidal signs of the parkinsonian type, a fine motor hyperkinesis. These manifestations may be controlled by the administration of atropine. The analgesic component is provided best by the new, highly potent (100 times more so than morphine weight for weight) but short-acting narcotic fentanyl, chemically related to pethidine. This drug, given in a dosage of 2 - 3 μg/kg body-weight, produces profound analgesia lasting approximately 30 minutes. Regrettably, the analgesia is accompanied by respiratory depression, but when given in graded fractional doses, respiration, though slowed, can be maintained at an adequate level.

The neuroleptic component is thought to follow inhibition by droperidol of parts of the extrapyramidal system, the caudate loop, and thereby indirectly depression of the arousal response of the reticular-activating system. The analgesic action of fentanyl, accompanied by little or no effect on consciousness, is thought to follow action of this drug on the thalamus with little effect on the cortex.

When combined with a local anaesthetic technique, the initial analgesia provided by these drugs prevents the patient experiencing even the unpleasantness of the initial injection. Thereafter, the dosage of this drug need not be at the same level as is needed when it is the sole analgesic, and so problems arising from respiratory depression can be avoided. Should undesirable respiratory depression occur, it is easily reversed by the administration of nalorphine, levallorphan or nalloxone. During the operation the patient is indifferent to his surroundings but co-operative, and has sufficient muscle tone and reflex control to maintain a clear airway. Subsequent arousal is quiet and is accompanied by poor recall of events. What may be considered by surgeons a drawback to this technique used in combination with local anaesthesia is that it requires the services of an anaesthetist, as against a local anaesthetic technique in the old style, which can be managed by the surgeon working alone. However, I do think that further experience with this technique will do much to make local anaesthetic techniques more acceptable to patients and surgeons and will lead perhaps once more to an increase in the use of local anaesthesia for ocular surgery.

A further extension of the neuroleptanalgesic technique is provided by the additional administration of nitrous oxide, whereupon anaesthesia—neuroleptanaesthesia—supervenes.[2] This is more of technical interest to anaesthetists, but suffice it to say that neuroleptanaesthesia provides very good operating conditions for eye surgery, especially when combined with intermittent positive-pressure respiration (IPPR). It is followed by rapid, quiet arousal with a very low incidence of postoperative vomiting. The neuroleptic action of droperidol lasts well into the postoperative period. Though easily aroused, patients are tranquil, still and not restless for many hours, and the action of any postoperative analgesic drugs is enhanced.

Before leaving this subject of local anaesthesia, I must bring to your notice a recently introduced local anaesthetic drug which has properties which may be of interest and of use to you. This drug—bupivacaine[3]—is of the same chemical class as xylocaine and carbocaine, which have been in clinical use for many years. The advantage it enjoys over these drugs is a very much longer action—up to 9 hours and maybe longer. Beyond the period of actual surgical analgesia, wound analgesia persists for a further prolonged period of up to 16 hours, giving the patient many hours postoperatively of freedom from pain. More toxic than xylocaine and carbocaine, it is also more potent weight for weight and need be used in a concentration of only 0·25%. The toxic dose is 150 mg but in the quantities necessary for local anaesthesia in and around the orbit, this dose is not likely to be approached.

DISSOCIATIVE ANAESTHESIA

Allied to the state of neuroleptanalgesia is another recently described anaesthetic state quite different to that of classical general anaesthesia. This is the state of so-called dissociative anaesthesia.[4] This state, which appears to follow interruption of afferent impulses in the diencephalon and association areas of the cortex, particularly the frontal cortex, and the drug which induces it, ketamine, evoked a passing spark of interest in surgical circles, for it was virtually billed as the drug that dispensed with the need for anaesthetists. This was because this peculiar state of profound analgesia, catalepsy and psychical dissociation is accompanied by normal, or increased muscle tone, permitting the unconscious patient to maintain a clear airway in virtually any position. Respiratory depression is minimal and some vasoconstriction occurs leading to a rise in blood pressure. Furthermore, the drug is safe in the sense that 16 times the therapeutic dose can be tolerated without ill-effect. From questions I was asked by surgical colleagues, the impression appeared to have been gained that no trained supervision of the patient was necessary, especially for short minor procedures.

Though it sounded as though we might be involved in a redundancy crisis, my department did take a look at dissociative anaesthesia with an unbiased eye. Much of our trial was undertaken in association with ophthalmic surgery, and so the results should be of interest to you.

In general, the results were not impressive when compared with what we can achieve with conventional general anaesthesia. The fact that though the drug is freely available in the hospital, it is used only occasionally now in certain specific circumstances, speaks for itself.

Trial of Ketamine

Three points were of particular interest to us in our general trial of the drug:

1. *Was experienced care needed for supervision of patients when anaesthetized with this drug*? The answer to this was: Yes, occasionally, but often enough to make it unsafe for the surgeon to attempt to operate and give the anaesthetic himself. Eight per cent of the first 100 cases required skilled airway supervision.

2. *Were there any problems in the recovery period*? During the recovery from this state of dissociation the patient goes through a stage of inappropriate reaction, which may be violent, to stimuli. Further, the drug from which ketamine was developed, phencyclidine, was hallucinogenic, and unpleasantly so, in 5% of patients. We found no evidence of hallucination. But to achieve a quiet recovery we found that the patient must be left severely alone and not stimulated in any way. It was on this point that we had most trouble. In the wards of this hospital, we found it all but impossible to achieve the necessary undisturbed conditions for quiet recovery. Beside the general ward noises, nurses seem unable to resist the urge to pat postanaesthetic patients on their cheek to see if they are awake or waking. No sooner had one group of nurses been persuaded that these patients were to be left severely alone, but a change in staff would occur and we would be back to square one with restless maniacal patients. Sustained, even anaesthesia we found best achieved by intramuscular rather than intravenous injection. This mode of administration lengthens the action of the drug and prolongs the recovery period, a circumstance I find undesirable after short procedures. One aspect that was in favour of ketamine was the observation that when children were left unstimulated and quiet, not only was the recovery phase quiet but the children were tranquil and did not try and pull the eye bandages off, nor was there much need for postoperative sedation.

3. *Were there any troublesome untoward reactions*? Our experience was that these were commoner than was described by the original protagonists of this drug. The most troublesome of these was salivation. Tremors and convulsive movements occurred in 3% of our patients.

Extensive use of this drug with eye surgery is described and it is important for you to know that the intra-ocular pressure may be slightly increased. This probably follows the action of ketamine on the blood pressure and the increase in muscle tone. In our small trial we used the drug only for extra-ocular operations.

From our trial my over-all impression is that where the services of a properly trained anaesthetist are available, this drug must have a very limited use, for in general, better results are obtainable by conventional methods. But where trained assistance is not available to the surgeon, for example in the country and underdeveloped areas, it may well be of great use.

CONTROL OF OPERATIVE BLEEDING

In contrast to most operations on the eye which are relatively unbloody procedures, dacryocystorrhinostomy and dacryocystectomy are not only accompanied by a fair amount of blood loss, but such blood loss obscures the surgical field and hampers the surgeon. One of the more radical ways of reducing bleeding in the operative field,

and so making the operation easier, is the induction of hypotension by means of ganglioplegic drugs. The interest of local ophthalmic surgeons in this technique was particularly stimulated by the visit to this department of one of our former registrars, now an eminent consultant in England, who had worked for many years at East Grinstead Hospital. The head of the Anaesthetic Department in East Grinstead Hospital is Dr Enderby, the person who has done more perhaps than anyone else to popularize the technique of induced hypotension. I think that many of our ophthalmological colleagues were saddened to find their enthusiasm was not shared by anaesthetists. The reasons are worth discussing.

If a new drug or technique can be shown to have a marked advantage over existing methods of anaesthesia in the facilitation of certain surgical procedures, this advantage must be carefully weighed against any mortality attributable to the drug or technique itself in relation to (*i*) the general mortality of the surgical procedure itself without its use, and (*ii*) the over-all incidence of anaesthetic contributory mortality.

General anaesthesia, its mishaps and maladministration does itself cause or contribute to patient mortality. Over the last 12 years in this hospital in 250 000 general anaesthetics administered for all types of surgery by the Department of Anaesthetics, the rate of anaesthetic contributory death averages 0·3/1 000 anaesthetics. During this period the Department of Ophthalmology has performed 12 817 operations (I was not able to separate the numbers of local from general anaesthetics). The total anaesthetic contributory mortality, in fact the total operating room mortality from this surgery, is 1—a rate of anaesthetic contributory death in eye surgery of 0·078/1 000 anaesthetics.

If account is taken only of those classed in the statistical records as major operations in ophthalmic surgery, the figure is a little different and comes out at 0·097/1 000 anaesthetics, or approximately 1 death from anaesthetic causes per 10 000 anaesthetics administered. This is a record of safety that is second to none.

Techniques of induced hypotension on the other hand not only carry with them very distinct dangers and consequently a mortality and morbidity of their own, but also enhance the dangers of the general anaesthetic itself which must accompany them. For example, the tolerance of even mild anoxia such as might follow short-lived respiratory obstruction is markedly reduced. The size of the risk depends on 3 factors: (*i*) the state of the patient's vascular system, (*ii*) the degree of hypotension attained, and (*iii*) the skill of the administrator.

Of these three, the factor that most disturbs me as a practising anaesthetist is the fact that we have no simple and accurate way of assessing the state of the patient's vascular system. For in these days it would appear that degenerative vascular disease, overt or occult, is all but universal. The commonest complications of the technique are probably those that follow the decreased margin of error for the ordinary common mishaps of general anaesthesia itself.

Of the technique proper, the commonest complications are vascular and follow either periods of poor perfusion of vital organs, or vascular thrombosis at various sites, cerebral, coronary, spinal artery and other. Of all the reported series of cases in which induced hypotension was used, none have an anaesthetic contributory mortality as low as our prevailing over-all rate, let alone do they come anywhere near the fantastic record of safety pertaining to anaesthesia for ophthalmic surgery in this hospital. From a series of 9 000 cases, Enderby himself reports an anaesthetic contributory death rate of 0·76/1 000.[5] Wyman[6] reported 5 deaths in his first 1 000 cases. Hampton and Little,[7] reporting from a questionnaire responded to by 300 anaesthetists in Great Britain, reported 42 deaths in 21 000 cases, a death rate of 2/1 000. This mortality, however, is but a fraction of the morbidity resulting from this technique. Non-fatal complications occurred at the rate of 1 in every 38 cases in this same survey. A similar American inquiry[8] revealed the staggering mortality rate of 1 death in every 136 patients. It seems to us, therefore, that the risks of the technique of induced hypotension are such that its use should be confined to operations where it would make the impossible possible, rather than just the difficult easier, and furthermore, the seriousness of the patient's condition should be commensurate with the risks of the technique. Dacryocystorrhinostomy we adjudged as belonging to the category in which the use of the technique would simply make the difficult more easy.

Fortunately, there are other methods of reducing haemorrhage from the operative field which carry no greater risk than general anaesthesia itself. Meticulous attention to all the norms of good general anaesthesia will itself lead to a reduction of operative bleeding. If this is combined with a state of respiratory alkalosis induced by hyperventilation, a head-up tilt and the infiltration of the operative site with a dilute solution of a vasoconstrictor drug such as adrenaline, a very acceptable degree of avascularity of the operative field may be obtained. Infiltration of adrenaline contraindicates the simultaneous use of halothane which increases myocardial irritability, and in association with circulating adrenalin may lead to ventricular fibrillation.

Of other anaesthetic agents available, methoxyflurane (Penthrane) is not only compatible with adrenaline but does much itself to reduce haemorrhage from the operative site. The pulse rate is slowed, cardiac output and blood pressure levels are both slightly reduced. The incidence of postoperative vomiting is a little higher than that which follows halothane, but the postoperative analgesia is far superior. I have used this technique of general anaesthesia with methoxyflurane, induced respiratory alkalosis, adrenaline infiltration and head-up positioning of the patient in both microsurgery of the ear and dacryocystorrhinostomy for some years now. I have found that, in general, operating conditions, though not as cadaveric as those which pertain with the use of induced hypotension, are still very acceptable.

A little over a century ago, Sigmund Freud and Karl Koller were investigating the pharmacology of the newly discovered alkaloid cocaine.[9] In the process, Karl Koller accidentally got some of the drug into his eye and noted subsequent anaesthesia. Following further investigation in the eyes of rabbits, of this accidental observation, he demonstrated the clinical application of local anaesthesia of the eye at an ophthalmological congress at Heidelberg. This demonstration of the clinical use of local anaesthesia in ophthalmic surgery was the first clinical demonstration

of the use of local anaesthesia for surgical operations, and started off the whole development of this subject.

Slowly, advances in general anaesthesia made it, with its accompanying oblivion, more acceptable to the patient and surgeon alike, a process that was accelerated by the introduction of relaxants during the 1940s. However, post-operative nausea and vomiting, with its accompanying increase in intra-ocular pressure, left local anaesthesia a large place in intra-ocular surgery until the introduction of halothane and the tranquillizer drugs with their powerful anti-emetic properties set the seal on the triumph of general anaesthesia in patient and surgeon acceptance.

The wheel, however, seems to be travelling full circle. The advent of neuroleptanalgesia, one of the newer concepts I have brought to your attention, when used in combination with a local anaesthetic technique, may yet bring back into prominence, particularly in the field of patient acceptance, a technique of anaesthesia for eye surgery which is still probably the safest for the patient.

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