

HUMAN MISADVENTURE IN ANAESTHESIA

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THIS PAPER is based on data obtained by two of the authors (T.C.G. and F.C.S.) from the records of the anaesthetic accidents reported to the Medical Defence Union of the United Kingdom (M.D.U.) during the eight years from 1970 to 1977. The M.D.U. represents some two-thirds of the medical practitioners in the United Kingdom and Eire and many more in Australia, Canada, and other countries. Its total strength, including dental practitioner members, is 87,000.

No member is bound to report an accident and this account is, therefore, in no way comprehensive. It is probable, however, that with one important proviso most of the more serious mishaps are reported, although the incidence of reporting of minor matters such, for example, as the loss of a tooth, is probably relatively low.

The proviso about reporting serious mishaps is necessary because it is probable that many deaths were not reported because it was realised that they were due to the disease concerned, rather than to anaesthesia. Though the records are not comprehensive, they probably represent a reasonably reliable account of situations in which the anaesthetist has realised that something unfortunate or disastrous has happened to a patient and that, as a result, there is a danger of legal action. This, in itself, seems to make them of some interest.

It must also be pointed out that the judgements on what happened in these cases, though expert, are still liable to dispute. All that can be said in this regard is that the judgements are those of peers in the speciality who viewed the facts with particular reference to what might be expected in a court of law. Doubtless some few of these individual judgements will be wrong but almost cer-

tainly, in the majority of cases, they will be correct.

ACCIDENTS REPORTED

The total number of anaesthetic accidents reported to the M.D.U. over the eight years 1970 to 1977 is shown in Table I. There was a total of 602 accidents (in the order of one every five days) produced by something in the order of 2,000 anaesthetists who are members of the Union.

Some of these accidents are relatively trivial; one in five of them, for example, concerns *damage to teeth*; this may be inconvenient and annoying to the patient but it is not a matter of life and death, nor of serious permanent injury, although when complex orthodontic treatments have been involved these accidents may be expensive as far as litigation is concerned. As has been pointed out, the incidence of reporting is probably low; many anaesthetists damage teeth but avoid medico-legal trouble, especially if in appropriate circumstances they have forewarned the patient and if they seek immediate advice from a dental colleague if damage has been done.

Most cases, however, are far from trivial. There were 108 cases involving *neurological damage*. Of these 71 were cases of *cerebral damage* and these, together with the 277 *deaths*, con-

TABLE I
ANAESTHETIC ACCIDENTS REPORTED TO
M.D.U., 1970-1977

Deaths	277
Damage to teeth	127
Neurological damage	
Cerebral	71
Spinal cord	8
Peripheral nerves	29
Superficial thrombosis thrombophlebitis	32
Epidural foreign bodies (needles and catheter tips)	27
Awareness	11
Extravasation of injected drugs	8
Pneumothorax	5
Burns	3
Others	4
Total	602

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stitute 60 per cent of all the cases; an account of these two groups will constitute the main part of this paper. Other cases of neurological damage involved the *spinal cord*. In this connection, for example, a patient developed the anterior spinal artery syndrome following epidural analgesia in which, initially, there had been an accidental dural tap with leakage of cerebro-spinal fluid. The epidural was established with lignocaine and adrenaline at the same level and there was marked systolic hypotension. As might be expected, damage to the *peripheral nerves* is still common and, in this connection, it may be said that it is remarkable how often, even now, the ulnar nerve is injured by pressure. The risk of nerve damage, moreover, is not confined to the period of operation; there is considerable danger during the recovery and even later postoperatively.

Superficial thrombosis and thrombophlebitis remains a problem; and this problem has, perhaps, been exacerbated by the use of diazepam. The reports of 27 cases in which an *epidural foreign body* has been introduced shows an interesting side-effect on the increased popularity of this form of analgesia, especially in mid-wifery.

There were 11 cases of *awareness*. This unpleasant condition is now probably less common than it was: this is just as well, since it can have very severe psychiatric sequelae. There has been an increasing realization of its importance and probably anaesthetists have become more careful and meticulous in their technique in an effort to avoid it.

Extravasation of injected drugs and burns are each a small group, though certainly complaints of both have been made for many years. *Pneumothorax*, however, is relatively new. It can be caused, for example, by mis-connecting anaesthetic circuits and screwing expiratory valves hard down so that the lungs are subjected to gas at high pressure.

Finally, it must be mentioned that there is a relatively tiny number of *other accidents*. In this case the group included arterial thrombosis, dislocated temporo-mandibular joint, corneal abrasion and a case in which a suction tube was left in the trachea.

DEATHS

During the years 1970 to 1977 a total of 277 anaesthetic deaths was reported to the M.D.U. The presumptive causes of these deaths are given in Table II. It has already been stated that re-

TABLE II
FACTORS INVOLVED IN 277 DEATHS REPORTED TO M.D.U., 1970-1977

	No. of Cases	%
Faulty technique	120	(43.3)
Co-existing disease	34	(12.3)
Unknown	29	(10.5)
Failure of postop. care	28	(10.1)
Drug overdose	15	(5.4)
Drug sensitivity	12	(4.3)
Halothane hepatic failure (?)	12	(4.3)
Hyperthermia	8	(2.9)
Failure of preop. assessment	5	(1.8)
Blood loss and hypotension	5	(1.8)
Drug error	4	(1.4)
Embolism	3	(1.1)
Anaesthesiologist failure	2	
Total	277	

porting may be incomplete and that this may be particularly so in the case of deaths classified as being due to co-existing disease. Doubtless on many occasions patients were anaesthetized in the full knowledge that the possibility of death was a very real one. When a patient died the death might well have been reported to the coroner but not to the Union, if it were thought that the relatives of the patient realized that no error was involved in the death.

CEREBRAL DAMAGE

The causes of the 71 cases of cerebral damage are given in Table III. Severe cerebral damage resulting from anaesthesia can be more appalling than death. The relatives may be subjected to the harrowing experience of seeing the patient living on with varying degrees of intellectual impair-

TABLE III
FACTORS INVOLVED IN 71 CASES OF CEREBRAL DAMAGE REPORTED TO M.D.U., 1970-1977

	No. of Cases	%
Faulty technique	43	(60.6)
Failure of postop. care	5	(7.0)
Unknown	7	(9.9)
Drug sensitivity	4	(5.6)
Co-existing disease	3	(4.2)
Drug overdose	3	(4.2)
Anaesthesiologist failure	3	(4.2)
Drug error	1	(1.4)
Blood loss	1	(1.4)
Clot in by-pass	1	
Total	71	

ment, the worst of which will leave the patient little better than a vegetable.

All anaesthetists of experience have seen such cases, but probably the suffering implied for both patient and relatives can only be appreciated by those who have experienced it. One further point must be made, however, even if it be on a purely materialistic level. The sum awarded in damages to some of the most unfortunate patients has, by the standards of English litigation, been enormous.

Modern resuscitative techniques must surely represent one of the great advances in modern medicine: many are now alive and well who would otherwise be dead. Nevertheless there are undesirable side-effects of resuscitation as of any other medical technique. In this context, too, the effect of ill-advised resuscitation must be mentioned. Indiscriminate charity has been described as a device of the devil and so, too, must be injudicious resuscitation.

MAJOR CATASTROPHES

A comparison of Table II with Table III shows at once that the two lists of causes (deaths and cerebral damage respectively) are closely similar; so similar, indeed, that it seems both possible and reasonable to deal with them together, regarding both as major catastrophes. The pooled data of 348 cases of death or cerebral damage are, accordingly, shown in Table IV.

Faulty technique

The most striking fact which emerges from Table IV is that it was deemed that nearly half the

TABLE IV
MAJOR CATASTROPHES: CAUSES OF DEATH AND CEREBRAL DAMAGE TREATED TOGETHER

	No. of Cases	%
Faulty technique	163	(46.8)
Co-existing disease	37	(10.6)
Unknown	36	(10.3)
Failure of postop. care	33	(9.5)
Drug overdose	18	(5.2)
Drug sensitivity	16	(4.6)
Halothane hepatic failure (?)	12	(3.4)
Hyperthermia	8	(2.9)
Blood loss	6	(1.7)
Failure of preop. assessment	5	(1.4)
Drug error	5	(1.4)
Anaesthesiologist failure	5	(1.4)
Embolism	3	(0.9)
Clot in by-pass	1	(0.3)
Total	348	

TABLE V
CASES OF FAULTY TECHNIQUE RESULTING IN DEATH OR CEREBRAL DAMAGE

	No. of Cases	%
<i>General Anaesthesia</i>		
Endotracheal intubation	50	(30.7)
Misuse of apparatus	40	(24.5)
Acid aspiration syndrome	22	(13.5)
Induced hypotension	16	(9.8)
Hypoxia	11	(6.7)
N ₂ O in place of O ₂	6	(3.7)
Obstructed airway	4	(2.4)
CO ₂ in place of O ₂	4	(2.4)
Halothane with adrenaline	3	(1.8)
Accidental pneumothorax	2	(1.2)
<i>Local Anaesthesia</i>		
Epidural	5	(3.0)
Total	163	

cases of death or cerebral damage (47 per cent) were due to faulty technique. An attempt at classification of these faults in technique is shown in Table V. Such a classification cannot, of course, be entirely consistent; thus error of tracheal intubation figures in the Table as an entity separate from hypoxia, despite the fact that the former will certainly result in the latter. Despite this sort of difficulty the classification, though far from perfect, seems to convey the essentials of the various problems.

The most common fault in technique was concerned with *tracheal intubation* and usually resulted in the tracheal tube being placed in the oesophagus. This sort of accident with tracheal tubes was responsible for 37 deaths and 13 cases of cerebral damage during the eight-year period under review. In most cases the tube was thought to be correctly placed when, in fact, it was not: movements of the reservoir bag and the chest can occur with the tube in the oesophagus. After pre-oxygenation especially, it may be a long time before the patient's colour changes, much less before cardiac arrest takes place. If there be the slightest doubt as to where the tracheal tube has been placed it should be removed immediately: "When in doubt take it out."

A second type of disaster occurs, but is less common: here the anaesthetist undertakes tracheal intubation with a technique inappropriate to the conditions as, for example, when thiopentone and suxamethonium are used in patients with gross respiratory obstruction due to Ludwig's angina. It is worth mentioning that, on occasion, prolonged and increasingly desperate

TABLE VI

ANALYSIS OF 19 CASES OF DEATH AND CEREBRAL DAMAGE DUE TO THE USE OF A PULMONARY VENTILATOR

	Deaths	Brain Damage
Excessive inflation pressure	2	3
Disconnection from gas flow	5	1
Disconnection from patient	4	1
Mechanical failure	2	
Unknown	1	
Totals	14	5

attempts are made to intubate the trachea in conditions where the indications for this technique are only marginal in the first place.

This sort of information raises important questions about the teaching of anaesthesia. Every teacher should surely ask himself if he gives sufficient emphasis to the problems involved in tracheal intubation and its hazards. It is a manoeuvre so commonly employed as to diminish both the respect it deserves and the care it demands. There is sometimes, perhaps, too great a tendency to teach about the esoteric and the rare at the expense of emphasizing the importance of scrupulous attention to technique.

Misuse of apparatus was the second most common cause of death and cerebral damage due to faulty techniques. Of the 40 cases of death or cerebral damage in this group 19 were due to accidents with lung ventilators. Table VI gives an analysis of these accidents. It can be seen that the main cause of death and cerebral damage attributed to pulmonary ventilation was not an abstruse form of mechanical failure. Over half of the catastrophes occurred for no more complicated a reason than that the ventilator became disconnected from the gas flow, or the patient from the ventilator.

It is possible to argue that any anaesthetist, however competent he may be, will eventually lose the life of a patient from *acid aspiration*, if he be unfortunate. No apology is needed for putting the 22 cases of acid aspiration in the group of faulty technique; however, since in each of these cases some reasonable precaution was omitted, for example, there was no adequate sucker available, pre-cricoid pressure was not employed, no pre-anaesthetic antacid was given.

Induced hypotension caused 16 of the cases of death and cerebral damage. Though safe in the hands of the expert, this technique is devastating in the hands of the inexperienced. In some of the cases in which induced hypotension caused death

TABLE VII

CASES OF DEATH AND OF CEREBRAL DAMAGE WHICH WERE THOUGHT TO BE DUE VIRTUALLY EXCLUSIVELY TO THE DISEASE PROCESS INVOLVED ANALYSED ACCORDING TO THE DISEASE PROCESS INVOLVED

	Deaths	Cerebral Damage
Cardio-respiratory disease	21	3
Renal disease	2	-
Infection	2	-
Postop. vomiting	1	-
Stab wound to neck	1	-
Head injury	1	-
Muscular dystrophy	1	-
Subarachnoid haemorrhage	1	-
Disseminated sclerosis	-	-
Intracranial tumour (coning)	1	-
Phaeochromocytoma (undiagnosed)	1	-
Ulcerative colitis	1	-
Drug addiction (methadone)	1	-
Totals	34	3

or cerebral damage no effort had ever been made to measure the arterial blood pressure.

Among the cases designated here as *hypoxia* (16 cases) were many in which the oxygen cylinder ran out. This has been distinguished from using *nitrous oxide instead of oxygen* (6 cases), *carbon dioxide instead of oxygen* (4 cases) and *airway obstruction* (4 cases). The use of halothane with adrenaline, the production of *accidental pneumothorax* by using apparatus in the wrong way and error in giving *epidural analgesia* complete the list of deaths and cerebral damage due to faulty techniques.

Co-existing disease

The second commonest cause of death and cerebral damage in this series (Table V) was due to the co-existing disease. These co-existing diseases are mentioned in Table VII. The overwhelming pre-eminence of cardio-respiratory disease in this group will come as no surprise.

Unknown causes

In a very considerable number of cases the cause of death was unknown. A brief look at Table VIII suggests that death without apparent reason is more common in the dental chair than elsewhere. This may possibly be true; it may be that some as yet undetermined factor may be at work in anaesthesia in the dental chair. It must be remembered, however, that a vast number of dental anaesthetics are given in the United Kingdom and that Table VIII may just reflect this fact.

TABLE VIII

CASES OF DEATH AND CEREBRAL DAMAGE FOR WHICH NO OBVIOUS CAUSE COULD BE FOUND BROKEN DOWN INTO THOSE OCCURRING IN THE DENTAL CHAIR AND THOSE OCCURRING ELSEWHERE

	Deaths	Cerebral Damage
Dental Chair	16	2
Other	13	5
Totals	29	7

TABLE IX

CAUSES OF DEATH AND CEREBRAL DAMAGE IN THE IMMEDIATE POSTOPERATIVE PERIOD

	Deaths	Cerebral Damage
Obstructed airway	18	3
Respiratory depression	7	1
Hypotension	3	—
Fall from table	—	1
Totals	28	5

Postoperative problems

The anaesthetist's responsibility does not end in the operating room, though he need not, perhaps, always take the blame for failure of postoperative care. Nevertheless the main cause of death and cerebral damage in the immediate postoperative period was obstruction of the airway (Table IX). After an operation the anaesthetist has to assure himself that the patient is able to look after his own airway or is put in the care of someone who is as able to look after the airway as the anaesthetist. It may be that the frequency of trouble postoperatively is due to failure to provide well-trained staff housed in adequate postoperative recovery rooms. Too often the anaesthetist hands over a patient who has not recovered completely to staff who are relatively untrained.

Others

Drug overdose is an obvious but avoidable cause of death and cerebral damage. Injudiciously large doses of intravenous induction agents, for example, are still given quite frequently.

Drug sensitivity, on the other hand, involves a grossly abnormal response to a normal dose of drug. This is not the place to stray into a discussion of the various merits or demerits of the intravenous induction agents; acute hypotension,

bronchospasm and cardiac arrest after propanidid is, however, represented in this group by more than one case, as is Althesin. Whether this is a genuinely high incidence of adverse reaction has yet to be decided.

Halothane hepatic failure is given a question mark for obvious reasons. Millions of words must have been written on this subject by now, and yet we seem little further towards the truth than we were. *Hyperthermia* again is a subject of controversy. Presumably a few years ago patients who died of malignant hyperpyrexia would have been classified in the group of unknown causes.

Failure of preoperative assessment involves situations in which the patient died or suffered cerebral damage because pre-existing conditions were missed. A male patient of 70 kg, for example, was subjected to elective gastrectomy but died some days after operation on a ventilator. It was not remembered that he had an FEV₁ of 800 ml; though the investigation had been done a month before it had been forgotten.

Blood loss accounted for six deaths only; though here, again, the incidence of reporting is probably low. Not infrequently there is a temptation to start an operation before blood is available, just because it is convenient.

Few can contemplate with equanimity the possibility of using the wrong drugs. Most of us must be frightened of doing so. One must feel great sympathy with the registrar who committed the error of giving a gram of potassium to a five-year-old child instead of atropine 1.2 mg and neostigmine 5.0 mg to reverse neuromuscular block; and with the several anaesthetists who have attempted to clear intravenous infusions with potassium, or used adrenaline instead of atropine. Nevertheless *drug error* of this sort is indefensible. It is so simple to check the ampoule and to have it double-checked.

Indefensible, too, is the situation which is here called *anaesthetist's failure*: the anaesthetist left the operating department to make a telephone call or even to have a cup of coffee and something went wrong with the patient. *Embolism* featured perhaps less commonly than might be expected, and *clot in a by-pass* is too specialized, and too uncommon, to require special mention.

MISADVENTURE

The title of this paper is "Human Misadventure in Anaesthesia". Excluding considerations of the law which deals with misadventure in a special way, "misadventure" is usually taken to

TABLE X
CAUSES OF DEATH AND CEREBRAL DAMAGE CLASSIFIED INTO THOSE APPARENTLY DUE TO MISADVENTURE AND THOSE APPARENTLY DUE TO ERROR

Mainly misadventure	%	Mainly error	%
Co-existing disease	10.6	Faulty technique	46.8
Unknown	10.3	Failure postop. care	9.5
Drug sensitivity	4.6	Drug overdose	5.2
Halothane hepatic failure (?)	3.4	Failure of preop. assessment	1.4
Hyperthermia	2.9	Drug error	1.4
Blood loss	1.7	Anaesthesiologist failure	1.4
Embolism	0.9		
Clot in by-pass	0.3		
Total	34.7	Total	65.7

be an unlucky chance or accident. In these terms being struck by lightning is the supreme misadventure: one is not able to protect oneself adequately against misadventure.

"Human misadventure in anaesthesia", however, though it undoubtedly occurs, does not feature as frequently in medico-legal work of this sort as does human failure. Table X divides the cases of death and cerebral damage already presented into two classes; those due mainly to misadventure and those due mainly to error. One may quarrel with some of the judgements made, but this need not obscure the basic fact that errors are about twice as common as are misadventures.

There are many causes of human failure; failure due to laziness and slackness (by omitting adequate preoperative assessment), failure due to pride (for example by omitting to take advice), failure due to boredom (when vigilance will fail). Most important of all, perhaps, is failure to teach the ordinary by concentrating too much on the esoteric.

SUMMARY

An account is given of the 602 anaesthetic accidents reported to the Medical Defence Union of the United Kingdom over the eight-year period 1970-1977: these were reported from a total membership of 2,000 anaesthetists. It is known that reporting of minor accidents, for example damage to teeth, is very incomplete, and that many deaths associated with surgery but due to disease processes rather than anaesthesia would not be reported either. It is thought, however, that the reporting by members of other accidents

involving death and cerebral damage is likely to be complete, or nearly so.

Cases of death and cerebral damage reported numbered 348 (60 per cent of the total) and the causes of these two major accidents were so closely similar that it was possible to deal with them together. This appears to be a suitable approach since cerebral damage can be as great, or greater, a catastrophe than death. In nearly half of this group of accidents there was discernibly faulty technique. Failure of postoperative care (10 per cent of the 348 cases) was another prominent and avoidable cause.

Analysis of the faulty anaesthetic techniques which led to these major accidents showed that factors involved in tracheal intubation were pre-eminent, and that misuse of apparatus was also conspicuous. Over all error was deemed to be twice as common a cause of death and cerebral damage as was misadventure.

RÉSUMÉ

Entre 1970 et 1977, 602 accidents anesthésiques ont été rapportés au Medical Defence Union qui représente environ 87,000 médecins et dentistes (dont 2,000 anesthésistes) dans les cas de poursuites liées à la pratique de leur profession.

Il est clair que ce total ne représente pas la totalité des accidents survenus. En effet, beaucoup d'accidents mineurs, comme les traumatismes dentaires, ne sont probablement pas rapportés. De même, on ne rapporte généralement pas les décès clairement liés à une pathologie pré-existante. Par ailleurs, il apparaît probable que la presque totalité des accidents suivis de décès ou de dommages cérébraux sont effectivement rapportés.

De tels accidents (suivis de décès ou de dommages cérébraux) représentaient 60 pour cent du total, soit 348 cas sur 602. Les causes de ces deux types d'accidents étaient si semblables que l'on a choisi de les considérer dans un même ensemble. Cette approche apparaît justifiée lorsque l'on considère qu'un cas de dommage cérébral peut être aussi catastrophique qu'un décès.

Dans près de la moitié de ces accidents graves, on a pu mettre en évidence une faute technique (tube trachéal dans l'œsophage ou incapacité d'intuber et de ventiler un malade obstrué après l'avoir endormi et curarisé, aspiration de contenu gastrique, respirateur ou tubes d'appareil d'anesthésie débranchés, cylindres d'oxygène épuisés, usage du protoxyde d'azote alors que

l'on croyait utiliser l'oxygène, etc). Dix pour cent des cas sont survenus en phase post-opératoire (surtout des problèmes d'obstruction des voies aériennes. Par comparaison aux situations peu prévisibles (hyperthermie maligne, hépatites à l'halothane) reliées à la pathologie préexistante, l'erreur humaine était en cause dans une proportion de deux pour un.

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