Mortality associated with Anaesthesia

J. N. LUNN
MD, FFARCS
Senior Lecturer, Department of Anaesthetics.

W. W. MUSHIN, CBE
MA, MB, BS, FRCS, FFARCS
Emeritus Professor of Anaesthetics,
Welsh National School of Medicine,
Cardiff.

Association of Anaesthetists of
Great Britain and Ireland

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Contents

Foreword

The Trustees have for some considerable time taken an interest in the question of quality of medical care as a subject certain to be of continuing and developing concern to a public increasingly becoming more sophisticated and critical about matters affecting their health and the treatment of illness.

Some of its major publications during the last few years on the general issue have been: *A Question of Quality* (1976), *Intimations of Quality* (1977), *Reviewing Practice in Medical Care* (1981).

In 1977 in pursuit of its policy in the general area of quality assurance a grant was made to the Association of Anaesthetists of Great Britain and Ireland for the design and development over three years for a confidential enquiry into deaths associated with anaesthesia. This was modelled on the Maternal Deaths Enquiry carried out on a permanent basis by the DHSS on foundations laid by leading obstetricians and the steady support of the Royal College of Obstetricians and Gynaecologists.

This book is the report of the enquiry and is published not only as a contribution to the literature of medical action on the subject of quality assurance but as an indication of an acceptance of public responsibility and what can be done by a specialty which is set on improving practice for the advantage of patients.

G. McL.

3 Prince Albert Road,
London NW1 7SP

Acknowledgments

The development of the project is described in the text of this report but it is appropriate to record here the authors' sincere gratitude first to the Council of the Association of Anaesthetists of Great Britain and Ireland for initiating this study and in particular to Dr. Michael Rosen, its Treasurer, for his personal interest. Secondly, to the Nuffield Provincial Hospitals Trust who readily provided substantial financial support, and in particular, Mr. Gordon McLachlan CBE, the Trust's administrator, who personally advised us during this study. Thirdly, the Regional Assessors (whose names appear below) and their local correspondents (listed on pages 103–4), whose considerable personal effort and general co-operation made the project possible. We are also grateful to Professor M. D. Vickers, who read and commented on the manuscript. Lastly, but by no means least, we are particularly grateful for the valuable advice of Professor A. Cochrane CBE to both the Committee and to ourselves as authors.

Computer services were sanctioned by the Welsh Office through the interest of Dr. M. George, and provided by the Welsh Health Technical Services Organization through Mr. Tony Sharpe. The authors are particularly in the latter's debt and that of his staff at the Regional Computer Centre at Velindre Hospital, Cardiff. Finally, it is a pleasure to record our thanks to Miss D. G. Forbes and Mr. S. R. Morgan for patient and skilful secretarial help in preparing this report.

REGIONAL ASSESSORS

Dr. P. J. Tomlin (West Midlands)
Professor A. R. Hunter (North Western)
Professor J. A. Thornton and Dr. T. E. Healy (Trent)
Dr. J. N. Lunn (Wales)
Dr. D. B. Scott (Scotland)

1 Introduction

The fact that anaesthesia may be associated with, and sometimes even be, the cause of death during and after surgery has never been questioned. The many events associated with anaesthesia that may lead directly or indirectly to death are now well known. They include among others the interaction between the toxic nature of all anaesthetics and pre-existing disease, aspiration of vomit, gross clinical mismanagement in the form of such things as overdose of drugs, failure to maintain a clear airway, failure to maintain fluid balance, inability to intubate the trachea, ineffective lung ventilation, and insufficient or inept care in the post-operative period. Several recent studies have re-documented these clearly (*vide infra*).

The skill of the anaesthetist and the range of drugs and techniques available to him have steadily expanded and this has enabled the range of surgery to follow suit. Indeed the two specialties are interdependent. These developments have gradually led to the administration of the great majority of anaesthetics in this country being in the hands of specially trained doctors who have reached or hope to reach the standards laid down by the Faculty of Anaesthetists of the Royal College of Surgeons. It might have been expected therefore that fatalities due to the more obvious gross causes would have by now disappeared. There is a widespread impression, which this study supports, that this is not so.

Death certificates are a poor guide to the real train of events connected with anaesthesia which led to death. The certificate is often completed by a comparatively junior doctor unfamiliar with the technicalities of anaesthesia and of the factors that might have been involved. Opinions based on postmortem examination and those expressed at Coroners' inquests are also of limited value for similar reasons.[1]

The Association of Anaesthetists of Great Britain and Ireland

considered that the time had come to investigate this matter once again. Such an investigation might clarify in present day circumstances, not only the extent of the association, if any, between anaesthesia and death, but possibly to ascertain the frequency and the nature of the factors involved, so that if the deaths were considered to be avoidable, the publication of the results of the investigation might bring about an improvement in the standard of anaesthesia with a consequent reduction in mortality.

The Nuffield Provincial Hospitals Trust with its current interest in defining and improving the standards of care in the National Health Service, readily agreed to provide the financial support. The preparatory work for the study, which was to last for many months, began in 1978.

HISTORY

The Association of Anaesthetists showed its first public interest in this subject in 1949 when it commissioned a study of deaths associated with anaesthesia, by means of volunteer reports from its members. An editorial in its journal *Anaesthesia*[2] commented that a study of anaesthetic 'incidents' culled from the literature of Anaesthetic Societies on three continents revealed that the majority of deaths happened amongst 'fit patients undergoing routine operations of no particular severity'. The editorial concluded by commending the Association's plan 'to the earnest attention of our readers as the first step in the reduction of *avoidable* (our italics) anaesthetic mortality'.

As a result of this endeavour one thousand cases were collected over five years.[3] This report emphasized that only clinical data were assembled and that statistical inferences could not and should not be drawn. They listed a variety of incidents (very similar to those found in the following pages of this report) and made a number of recommendations of which many are still not universally followed. The authors' main conclusion has since then often been repeated: 'in the great majority of the reports (i.e. from anaesthetists) there were departures from accepted practice. This fact, and its implications, should receive the attention of those responsible for the teaching of anaesthesia'. Their report included 100 cases of aspiration of vomit (i.e. 10 per cent of the deaths). In 17·4 per cent of the deaths the patients were in 'good' pre-operative condition, 28·8 per cent were 'fair', 46·3 per cent were 'poor', and 15·5 per cent were 'very poor'.

Eight years later in 1964 a further 600 cases were reported to the

Association.[4] The position had changed by this date. Whereas the earlier study had revealed that aspiration of vomit was the single most important cause of death, this report emphasized the adverse effect of hypovolaemia from whatever cause, as the major factor.

Since the time of these two British reports, there have been many advances in surgical and anaesthetic practice, to say nothing of an improvement in the general health of the whole population. The connexion between anaesthesia and surgery is so close that in most cases of death it is virtually impossible to separate the part played by anaesthetic and by surgical factors. Ideally, any study of mortality ought to be a combined anaesthetic and surgical one. Although this ideal appeared to have been achieved by Beecher and Todd[5] (1948–52) who carried out a co-operative study between surgeons and anaesthetists, this was not possible in Britain in 1979–80 for a variety of reasons. We too, would have preferred such a combined effort, but the opportunity was lost. Our request for support and co-operation with the surgical specialties was met with some suspicion and only a limited agreement to help was made—conditional on the exclusion of, or comment on, possible surgical factors. Thus, this study had perforce to limit its aims to the identification and the quantification of those features within the whole practice of anaesthesia in the hospital environment of the National Health Service (NHS) which may influence the incidence of death.

The population and the total number of operations in each of the Regions is known. The overall hospital surgical mortality is known and the deaths within six days (*vide infra*) are known independently as well as from this study. Thus, estimates can be made of the relative importance of anaesthesia as a cause of death and a more accurate assessment made of the part played by the various factors involved. The ability to quantify both the deaths and the factors marks a major difference between this study and its predecessors.

In contrast to the two previously published surveys in this country we are able to present numerical data upon which to base our conclusions. The data itself, although incomplete in many respects, appears to be of reliable quality.

Needless to say, concern about mortality in association with anaesthesia is not limited to this country. The U.S.A., Canada, South Africa, Australia, Scandinavia, Finland, and France have all reported surveys with a variety of methodologies, of anaesthetic practice in relation to mortality. The social environment, the

standards of training in both anaesthesia and surgery, the organization of medical care, and the standard of assessment of the factors involved in these deaths are all so different from those in Britain, that their conclusions, though valuable, are on the whole inapplicable here and close comparisons with our own results are not possible.

2 Objectives

GENERAL PURPOSE OF STUDY

The main purpose of this study was to examine mortality after surgery and anaesthesia in in-patients so that the clinical practice of anaesthesia might be improved. Comparative figures between Regions might possibly facilitate this latter process. A second and an equally important aim of the study was to establish an index of contemporary standards of care[6] within the specialty, for comparison with similar studies in the future.

Clinical, environmental, and organizational factors are well known to be closely linked in the determination of the general standard of medical care in hospital practice. This is no less the case in anaesthetic practice. There are many occasions in this report when reference is made to matters which essentially reflect local politics, planning, and bureaucracy. These aspects include both the provision of proper modern facilities for the practice of anaesthesia and of manpower to carry it out, and we make reference to them where that is appropriate.

DESIGN OF STUDY

The Association of Anaesthetists of Great Britain and Ireland appointed a *Central Committee* to oversee the study in a general way. This committee under the Chairmanship of Professor William W. Mushin was broadly based containing representatives of the Association of Anaesthetists of Great Britain, the Royal College of Surgeons of England, the Faculty of Anaesthetists of the Royal College of Surgeons, the Department of Health and Social Security, the Office of Population and Census Studies, the Faculty of Community Medicine, and the Chairman of the Regional Assessors.

The Committee agreed, on the advice of Professor A. L. Cochrane, to limit the enquiry in the first instance to about one-third of the hospitals, represented by five Regions (three in England, Wales, and

Scotland) as a pilot investigation. The Committee appointed one or two Assessors for each Region, each of whom was a senior anaesthetist with long experience of clinical anaesthesia and of the hospital management problems involved in this specialty. The Assessors were thus qualified to make an assessment of the part anaesthesia played when presented with the full clinical account of death. They were also responsible for the detailed organization of the study within their own Regions. The Regions selected were the North Western, West Midlands, and Trent Regions of England, Wales, and Scotland.

The Committee was set up in 1978 and nearly a year was spent in preparation. The organization was completed and after a trial run of a few months data collection for this study began in March 1979. The data in this report represent a complete year's collection. A long time-lag followed before all the completed records were collected so that the analysis of the data could not start until late in 1980.

There are two additional features about this project which make it different from those which have preceded it.

COMPARISON WITH DATA FROM OTHER SOURCES

The first feature is the ability to compare its data with figures collected independently by another agency. This was achieved by the use of the DHSS's Hospital Activity Analysis (HAA). Permission to have access to this data was granted readily by the Chief Medical Officers for England, Wales, and Scotland.

QUANTITATION

The second feature of this study is that it has concentrated not only upon qualitative descriptions of the deaths and all the circumstances surrounding them, but also upon the enumeration of the incidence of various events. The combination of these two features makes comparisons between Regions a realistic possibility and enables anaesthetic mortality to be displayed in proper perspective as a part of Public Health and in relation to death from other causes.

CONFIDENTIALITY

The requirement that confidentiality and anonymity of both doctors and patients be maintained is paramount in studies of this sort. The detailed arrangements which were made in order to achieve this desirable state of affairs did not reduce efficient data collection.

The co-operation of both surgeons and anaesthetists at the hospital

level was purely *voluntary* and was sought and given without any coercion. Thus as always with this type of study the success rate of return of information reflects both the local and personal interests which this study aroused. The identities of the patient, the patient's surgeon, and anaesthetist were known solely by means of a code number. The key to this code number was destroyed as soon as the Regional Assessor had all the information which was required. Thus, the facts alone were retained for analysis. The three Medical Defence Societies scrutinized these arrangements and expressed their unanimous opinion that the safeguards for confidentiality were satisfactory.

OBJECTIVE

It is important to emphasize that there is no judicial element in this study. The purpose is not to allocate blame to any one but to establish the extent to which current anaesthetic practice affects fatal outcome.

At the outset, in order to deal with the day-to-day conduct of the study, an Executive Committee of Assessors was established under the Chairmanship of Dr. J. N. Lunn which consisted of the Regional Assessors and the Chairman of the Central Committee.

This Executive Committee of Assessors listed a number of questions which it was hoped might be answered:

(1). In what proportion of those patients who die within six days of operation does anaesthesia play a part?

(2). What are the causes of death in these patients?

(3). Have these causes of death changed since 1956 when they were investigated by a Committee of the Association of Anaesthetists?

(4). Are there avoidable factors associated with anaesthesia which contribute to this mortality?

(5). Are there Regional differences in mortality?

(6). Is the experience of the anaesthetist a factor related to a fatal outcome?

(7). Does the quality of the supporting help to the anaesthetist affect anaesthetic mortality?

(8). Does the equipment available to the anaesthetist, or the lack of it, make any contribution to mortality during or after operation?

3 Method

In each Hospital District, the Regional Assessor selected one or more Local Correspondents with whom he would communicate. These doctors formed the lynchpin of the investigation and upon them much of the success or failure rested. They were chosen by their Regional Assessors in consultation with the anaesthetic staffs of local hospital departments as colleagues whom their peers would trust. The duty of a Local Correspondent was to arrange some appropriate system which would ensure that notification was made to him of every in-patient who died within six days of surgery. The Local Correspondent would then identify the patient's anaesthetist and the surgeon and send them a very brief letter and questionnaire (see Appendix A).

The recipient of each of these letters was given a pre-paid envelope for his reply which was sent direct to the Regional Assessor. If either the surgeon or the anaesthetist thought that anaesthesia had played some part in a patient's subsequent death, the Regional Assessor then sent, via the Local Correspondent, either a detailed questionnaire (see Appendix B) to the anaesthetist or if the surgeon's positive opinion was different from that of the anaesthetist a request for the reason for his opinion.

In the latter case, on receipt of the reply from the surgeon, the Regional Assessor made a decision about the need to follow up with a further questionnaire for the anaesthetist concerned. At the inception of the study we feared that this might be a source of irritation since it might appear to the anaesthetist that the surgeon with whom he worked was criticizing his work. In the event, apart from sporadic instances, anaesthetists did not seem to mind this and indeed it was clear that most surgeons were interested only in trying to help this study. Of course the Assessors' opinion might be different from that of the surgeon or anaesthetist. If both surgeon and

anaesthetist agreed that anaesthesia had played no part in the death, no further action was taken.

On receipt of the completed questionnaire, the Regional Assessor completed his assessment sheet (see Appendix C). The entire questionnaire was then sent to a second Regional Assessor for his opinion. In the early stages of the study it was intended that this second assessment be made in ignorance of the first, but this was found to be inconvenient from a practical point of view, and it was then decided that the two Regional Assessors should reach an agreed opinion. In the event of this being impossible the Chairman of the Central Committee, acting as arbitrator, was asked to adjudicate between the two opinions. If the Regional Assessor needed further information, this was acquired via the Local Correspondent without the Assessor having any direct contact with the anaesthetist concerned, who remained anonymous.

CO-OPERATION

It is fortunate for the success of this study that most of the anaesthetists co-operated in an excellent manner but there were a few bad spots. On the page of the questionnaire designed to discover facts about the anaesthetist himself relevant to the death without revealing his identity, we were roundly criticized by a few anaesthetists.

One example from the run-up period before the study started will suffice. This anaesthetist regarded this part of the enquiry as impertinent: 'my professional ability would be called into account'. Another statement made was, 'I do not give anaesthetics (or do anything else) to elective cases when incapable of doing so, whether that is due to inadequate help, fatigue, hypoglycaemia, drink or drugs. Nor do I divulge my personal habits with regard to sleep, food, or anything else'. These comments were made on the same report which recorded the following facts. The patient, aged 65 with jaundice, had a history of myocardial infarction six months previously, and diabetes. Nevertheless, the anaesthetist refused to answer the question about what pre-operative examination of the patient was performed or treatment given! The patient was clearly a poor anaesthetic risk. The only treatment during operation was 300 ml dextrose-saline. The patient was sent back to the ward to die 36 hours later, with the additional comment that 'it is well known that operations upon patients with jaundice carry an inevitably high

mortality'. Thus the Assessors could discern something not only about the anaesthetist but also about the quality of anaesthetic care given to this particular patient.

We also draw attention to a few instances in which the staffs, anaesthetic as well as surgical, of hospital areas, or of large individual hospitals, refused or were for various reasons unable to take part in this study. Explanation and reassurance to local medical committees about the confidentiality and the scientific intent were unavailing. Perhaps it is inevitable in a voluntary study and in the current climate of suspicion that in any review of clinical practice, which might appear—quite unjustifiably—to involve an element of blame such instances of lack of co-operation occur. It is for this reason that sophisticated statistical treatment of our data has on the whole been avoided. We should perhaps also mention once again that the initial suspicious reaction by the surgical colleges was only allayed by a promise to avoid consideration of any factors exclusively concerned with surgical management. Since anaesthesia and surgery are inextricably linked where mortality is concerned, it is often difficult to apportion responsibility between the two activities. To that extent this report is seriously deficient, and this particular hiatus must somehow be closed in future studies.

NOTES ON THE INTERPRETATION OF THIS REPORT*

The term *anaesthesia* in this report means all those activities for which the anaesthetist is generally held to be responsible and includes not only the actual administration of anaesthesia, but also the pre- and post-operative care relevant to anaesthesia, and those organizational and administrative aspects for which the anaesthetist is generally regarded as being responsible and upon which he is dependent.

Obstetric cases were specifically excluded, since the DHSS publishes its own report on *Maternal Mortality* every three years.

Some deaths were classified by the Assessors as '*total*' (group T)

* The authors take full responsibility for the compilation of the report and for such opinions expressed in addition to those of the Assessors. Both the Central Committee and the Executive committee of Assessors agreed that, since the report deals with detailed clinical and anaesthetic matters about which there is bound to be a wide spectrum of opinion even amongst experienced anaesthetists, it is preferable for it to be written by two individuals rather than to embark on the inevitably lengthy process of preparation of a report from a committee with, almost certainly, a number of minority reports.

meaning that anaesthesia contributed to the death in such a significant way as to have been totally responsible for the death, and that there were deficiencies in one or more of the above factors which, if they had not been present or had been corrected, the death would almost certainly not have happened at that time.

Other deaths were classified by the Assessors as '*some*' (group S) meaning that anaesthesia partially contributed to the death and that there was some deficiency in one or more of the above factors, although the deficiency was not sufficiently gross to have been the sole cause of death. To the extent that anaesthesia was contributory, the avoidance or correction of these deficiencies might have improved the chances of survival.

In the remaining deaths anaesthesia was judged by the assessors to have played no part at all notwithstanding the fact that one or more clinicians involved with the care of the patient had thought that anaesthesia contributed (otherwise no detailed report would have been forthcoming). These deaths were classified as '*nil*' (group N).

INTERVAL BETWEEN ANAESTHESIA AND DEATH

The deaths considered in this study occurred in in-patients within six days of operation. This interval was chosen because of a previous study of the survival of patients after operation.[7] This showed that in Cardiff of all deaths in hospital after surgery, half occurred within 6 days. However this was not the only basis for our choice of interval. It was also shown that the improvement in mortality after surgery which occurred over the years, took place during the first 5–6 days, whereas the incidence of death later on was virtually unchanged. Since most of the advances of modern surgery and anaesthesia concerned such things as pre- and post-operative care, choice of anaesthesia, skill of the anaesthetist and surgeon, antibiotics, and the general organization and facilities in the operating room, this 6 days would be an appropriate interval of time during which anaesthesia might be expected to play an important role.

4 Results
All data

Numbers

VALIDITY

The numbers of in-patient operations in the five Regions as recorded by the HAA are shown in table 4.1.

Region 1 is the West Midlands, Region 2 is Scotland, Region 3 is Trent, Region 4 is the North Western, and Region 5 is Wales.

Our study is therefore based on over one million operations in the five Regions, with 6,060 patients dying in hospital, according to the HAA, within six days. The table also shows this mortality rate by Region. The agreement between the Regions gives considerable ground for confidence in the HAA figures. The study retrieved 3,736 (61·6 per cent) of these deaths, though some Regions were much more successful than others in their retrieval.*

The reasons for these differences in retrieval rate are not fully known. The main source of difficulty seems to lie in the size of hospital: large hospitals (with more deaths) experience greater difficulty in retrieval than smaller ones. A few deaths in small hospitals are easier to identify and the numbers of staff involved are both smaller and more readily available. This may be the explanation for the greater success rate in Wales. Another reason is that trainees, both in anaesthesia and in surgery, are constantly on the move and several gaps in the survey occurred because the staff involved had moved from the hospital and could not be easily traced.

A third reason for the apparent discrepancy lies in the definition of the term 'operation' as recorded by HAA staff (see page 13).

* Our critics will point to the small numbers of patients in the various groups or subgroups and to our use of percentages. There are disadvantages of giving results in percentages, but they are the only practical way of comparing groups whose denominators vary widely. In addition it provides one more safeguard of confidentiality.

There is a fairly uniform percentage of six day deaths in the HAA figures, but the rate of 0·5 per cent varies considerably from the figure which we have come to expect in Cardiff where it is about 1 per cent; this may be partly because of the complexity of the surgery but may also arise from the difference in definition of the word operation. In Cardiff this applies to a surgical operation requiring an anaesthetic performed on a patient who has been in hospital at least one night.[7] The definition in compiling the HAA is the same as that used in the Hospital Inpatient Enquiry (HIPE) although almost certainly not fully implemented, which includes such procedures as urethral or venous catheterization or passage of a stomach tube. (We have found one large hospital where this discrepancy occurred.)

We are also concerned about the mechanism by which the clinical information reaches the HAA forms. This is usually by transfer from hospital notes by clerical staff rather than by the doctors concerned. This allows even more uncertainty about the definition of an operation. It is almost certain therefore that the HAA figures for deaths in table 4.1 underestimate considerably the percentage incidence of mortality, because the number of operations may be overstated.

Although we have described how both the number of operations and the number of deaths may be overstated in the HAA figures, we think on balance, that overstatement of the number of operations is the greater with apparent reduction of the mortality rate. We have come to this conclusion because a trivial procedure like urethral catheterization by itself is unlikely to be followed by death within a few days. Indeed such procedures are performed on patients in many parts of a hospital unconnected with surgical treatment.

In spite of the reservations which we have expressed, we feel compelled to make use of the HAA figures for deaths since they derive from an official source, and there are no others.

RETRIEVAL

In table 4.2 the return of reports-in-detail resulting from the initial notification by the local clinicians to the Assessors is shown. Slightly fewer than 10 per cent of the original 6 day deaths notified were considered either by the anaesthetist or the surgeon concerned to have been influenced by anaesthesia. There was fairly good agreement between the Regions.

It is possible to estimate the number of reports-in-detail (table 4.3)

that would have been submitted had the initial identification of deaths by the local correspondents been the same as the HAA data.

For example, in the West Midlands (table 4.1) there were 717 initial reports and 1,316 HAA-deaths. If the number of reports-in-detail in this Region is increased by the factor $1{,}316/717 = 1{\cdot}835$, then 128 reports-in-detail might have been received instead of 70. If this crude correction is applied to each Region, a total of 599 reports-in-detail is obtained—0·05 per cent of all surgical operations instead of 365 (0·03 per cent).

It is worth noting also that more questionnaires-in-detail were sent out than were returned, for reasons which are unknown. Some may have been lost: in some cases there might have been a change of the anaesthetist's mind. Resentment (that the form had been sent to the anaesthetist because of a reply from the surgeon that anaesthesia had played some part) might have been demonstrated by refusal to complete the questionnaire.

A 61 per cent retrieval rate is not satisfactory, but the totals in table 4.3 represent the *minimum* number of deaths attributable in whole or part to anaesthesia and there were almost certainly many more.

The population

The breakdown of the deaths by age is shown in table 4.4. As might be expected, the extremes of age are both represented, although 70 per cent of the patients were over 60 years (for further discussion see p. 40).

The high proportion of children under 10 years is disturbing. An analysis of the clinical details given in chapter 6 shows no evidence that specialized operations having a high surgical mortality were involved. 54·5 per cent of the patients were male.

Figure 4.1 shows the distribution of age in both the general and the surgical populations in England and Wales. The two populations follow the same pattern.

Figure 4.2 shows that the male surgical population is different from the general male population. In the surgical population there are fewer males under 45 years and more over 65 years. This also partly accounts for the male preponderance which has already been indicated.

Figure 4.3 shows the cumulative percentage of deaths in the study.

It shows clearly that more than 50 per cent of the deaths occurred in the population aged 70 years or more. Comparison between figure 4.1 and 4.3 is not possible in a precise manner. Patients aged over 75 comprise only about 5 per cent of both the surgical and the general populations. However amongst those who die within six days of surgery, this proportion is increased ten times.

The general pre-operative state of the patient was graded by the anaesthetist as good, moderate, poor or moribund (table 4.5). The preponderance (72·3 per cent) of poor and moribund grades is not surprising and corresponds closely to the figures in the earlier report.[3] The relatively low number of good risk patients may possibly be ascribed to the understandable reluctance on the part of the reporting anaesthetists to grade retrospectively a patient who had subsequently died, as 'good'! There was some evidence of this bias because the authors of this report took the opportunity, during the coding process, to reach their own independent opinion on the basis of the recorded information. In 9·3 per cent of cases we formed the opinion that the pre-operative state of the patient was rather better than that indicated by the anaesthetist. The following examples illustrate this point.

One patient aged 81 years was described as 'moribund' by a registrar anaesthetist with one year's experience of anaesthesia. No details of clinical examination, or of X-ray or laboratory tests were presented which led him to this opinion. The patient was suffering from carcinoma of the oesophagus and was to have a Celestin tube inserted. The anaesthetic itself (no ECG monitoring, no anaesthetic record) was hardly exemplary. The patient stopped breathing in the recovery room, and appeared to have aspirated stomach contents. Since no evidence was presented that she was moribund pre-operatively (and if she were, why did the young registrar anaesthetize her without further consultation?) one is driven to the conclusion that the description of 'moribund' might well have been made restrospectively!

A 62-year-old woman who, apart from some degree of muscle weakness (labelled as 'functional' by a consultant physician), was considered to be fit for an operation for the removal of a thyroid adenoma. She was described however as a 'poor risk' by the anaesthetist but this assessment had no apparent influence on his management of the patient. When the patient died 3 days later, her death was said to be the result of a pulmonary embolus at the

autopsy, but later there was histological evidence of myotonic dystrophy. The histological report was known to the anaesthetist before he completed the questionnaire and thus probably influenced his retrospective record of his pre-operative assessment of risk.

Table 4.6 shows the incidence of elective compared to emergency cases. The deaths occurred within these groups with similar frequency. However the records in Cardiff show that the mortality following emergency surgery in a general hospital is usually two or three times higher than that following elective surgery.

Half the operations were emergencies and half were elective procedures. This appears to rebut the argument that is often made that a particular type of anaesthetic (perhaps later held to be unsuitable) was administered because there was an 'emergency' and that there was thus insufficient time for proper planning and care. This is then used as an excuse that a subsequent disaster is acceptable. That half of these deaths occurred after elective surgery when all the clinical arrangements, organization and facilities should have been at their best emphasizes the invalidity of the common excuse. In 10 cases the surgery was abandoned after anaesthesia had commenced and no operation was performed. There was 1 death in a 'day case' patient.

The deaths

Table 4.7 shows 37·5 per cent of patients died on the same day as their operation. These results follow our own experience that most post-operative deaths occur within the first few days.[7]

Half of the deaths occurred in the ward on the day of operation (table 4.8). The explanation for this must be either that there is a shortage of recovery rooms or that the selection of patients for recovery room care is poor, or that they were sent to the ward from the recovery room too soon, or that staff is not available for the appropriate periods and that recovery rooms are rendered 'unavailable' or that death was unanticipated. A few patients died on the same day in the intensive therapy unit. Only 20 per cent of the deaths took place in the operating theatres or recovery rooms (table 4.8).

Region 4 (North Western) had the largest number of deaths in the operating theatre, and Region 5 (Wales) had a higher proportion of deaths in the recovery room than any other Region. Region 3 (Trent) had a higher proportion of deaths in the ITU.

One hundred and fifty-three (41·9 per cent) autopsies were performed (table 4.9). There is a wide variation in the use of an autopsy to confirm diagnoses (35–60 per cent) although this is irrelevant to this study.

In the great majority of the instances in which an autopsy report was available, the pathological findings gave little or no clue as to why the patient died at that particular time, although the clinical account of the events which preceded death provides clear evidence to an experienced anaesthetist as to what went wrong.

There were two cases of undiagnosed phaeochromocytoma demonstrated at autopsy. Although the patients were hypertensive, they had been untreated, and their deaths were unexpected and at the time inexplicable. Here the autopsy provided the answer.

The variety of pathologists' opinions about the causes of death as determined in 153 autopsies are shown in table 4.10. (There are more 'causes' than autopsies because it was possible to record more than one diagnosis.) There is a wide spectrum of disease processes. Apart from two cases which were classified as acute poisoning, i.e. overdose of sedation, the relationship between the autopsy findings and the clinical causes of death connected with anaesthesia in most cases is not clear (cf table 4.23).

In 39 per cent of autopsies ischaemic heart disease was mentioned as a cause of death. This reinforces our concern in relation to the use of instrumental monitoring (table 4.16). Nevertheless the finding of ischaemic heart disease at autopsy is not helpful, since ischaemic heart disease is common while deaths associated with anaesthesia are not. The question is, 'Why did these particular patients die?' There was little indication in the records of what, if any, precautions were taken or what special treatment was given to patients before operation who were known to have ischaemic heart disease or previous infarction.

The anaesthetist

The age and sex of each anaesthetist were recorded: 40 per cent of the anaesthetists were aged less than 35 years and 10·1 per cent were more than 55 years old.

77·4 per cent of all anaesthetists in England and Wales (DHSS; 1979) are men.[8] This is very close to the percentage (77·8 per cent)

of male anaesthetists who were involved with the patients in this study.

Table 4.11 shows the *country of graduation*: unfortunately, 12·8 per cent of anaesthetists failed to give this information. The high proportion of foreign medical graduates in Region 4 (North Western) and their virtual absence from Region 2 (Scotland) is noticeable.

Table 4.12 shows the *grade of the anaesthetist* involved compared with the distribution of the grades in the whole of England and Wales. In this study 59·5 per cent of the patients were anaesthetized by senior registrars and consultants, compared with 51·8 per cent in England and Wales.

In Region 2 (Scotland) nearly 15 per cent of the anaesthetics in the study were administered by doctors not in a training grade and not holding a consultant post. This explains why only 24 per cent of patients were anaesthetized by doctors in the registrar and SHO grades in that Region. Region 3 (Trent) is also a little different from the other Regions. Fewer of their cases were anaesthetized by doctors in the registrar and SHO grades, senior registrars playing a larger part.

The influence of the non-consultant non-training grades is best seen by comparing the distribution of these grades in the Study with that in the whole of England and Wales[8] because 10·1 per cent of the deaths in our study occurred in connexion with anaesthesia administered by these grades. This is probably in excess of their general distribution, but it is impossible to be certain because precisely comparable figures are not available for clinical assistants and general practitioners who are engaged in the practice of anaesthesia.

There is also some suggestion in this comparison that the more senior grades (consultant and senior registrar) administered slightly more of the anaesthetics than the training grades. The implication is that anaesthetists-in-training summoned assistance for poor risk cases, whereas it may be that those in the non-consultant non-training grades did not. There is evidence from inspection of individual reports that medical assistants, clinical assistants, general practitioners and other anaesthetists outside the training grades either do not feel at liberty to call for consultant help or are disinclined to do so because of their own assessment of their competence. (See also table 6.8).

Table 4.13 shows the *duration of experience* of the anaesthetists involved. Region 3 (Trent) and Region 5 (Wales) stand out. The first

because of the relatively small number of cases (12 per cent) anaesthetized by doctors with less than two years in the specialty compared with all other Regions and the second for the other extreme in which nearly 24 per cent of cases were anaesthetized by doctors with little experience. Overall only 15 per cent of the 365 cases were anaesthetized by doctors with less than 2 years' experience. However, in a Region in which a high proportion of the major surgery is in a University or large Hospital where much postgraduate instruction is carried out, it is probable that a higher proportion of anaesthetics are administered by junior doctors under supervision than in Regions where the reverse obtains. Nevertheless it is a matter for concern that in Region 5 (Wales) such a high proportion of the deaths occurred after anaesthesia given by an anaesthetist of less than 2 years' experience; indeed 9·5 per cent of the anaesthetics were given by doctors with less than 6 months' experience.

Table 4.14 shows a combination of the previous two tables and demonstrates that 3 per cent of patients in this study were anaesthetized by SHOs of less than six months' experience. A cumulative percentage of 9·3 per cent of patients were anaesthetized by registrars or SHOs with less than one year's experience; a cumulative percentage of 15·3 per cent were given by SHOs or registrars with less than 2 years' experience and finally no fewer than 30 per cent of patients were anaesthetized by senior registrars, registrars, or SHOs none of whom had more than 5 years' experience. This table excludes medical assistants.

Of the 12·8 per cent of patients anaesthetized by SHOs, 3·3 per cent (i.e. a quarter) were anaesthetized by SHOs with less than 6 months' experience.

About 60 per cent of all the anaesthetists possessed the FFARCS diploma and another 7 per cent had passed the primary FFARCS examination.

The anaesthetic

ASSISTANCE FOR THE ANAESTHETIST

Table 4.15 lists the total staff available to help anaesthetists. This help came either from anaesthetists or other doctors, or from nurses, technicians, operating department assistants (ODA), or orderlies (ODO). Help was either stated to be absent or was not specified in

3·3 per cent of cases. On the average, therefore, there seems to have been an adequate number of people to help for each case and this ranged between 1·5 and 2·0 people in addition to the anaesthetist. It is probable that more than one extra skilled person assisting an anaesthetist is unnecessary in the great majority of cases. If this were accepted, particularly in large busy hospitals, the assistance available might be spread more evenly assuming that all assistants are equally skilful.

In 47 per cent of cases, there were two or more anaesthetists present. In 45 per cent there was a nurse present and in 69 per cent there was a technician or ODA present. Orderlies (ODOS) or other unspecified and similarly unskilled personnel were the only help in 13 per cent of cases.

MONITORING

There was no instrumental monitoring at all in 4·4 per cent of all cases reported in this study (table 4.16). This is somewhat surprising in view of the fact that 72 per cent of the patients were regarded by their anaesthetists as 'poor' or 'moribund' pre-operatively. In 84·4 per cent of the patients *indirect blood pressure* measurements were made and in 57 per cent an *electrocardiograph* was also in use.

Pulmonary *ventilation* was stated to have been measured in only a fifth (21 per cent) of the patients; and in a similar proportion the *inflation pressure at the mouth* was recorded.

The relatively infrequent use of such potentially valuable forms of monitoring does not seem to us to be entirely satisfactory, and there do seem to be a few differences between the Regions, which may be worth looking into.

Although table 4.17 is labelled 'standard of practice', there were of course many other indicators. The ones listed were simply the most readily extracted from the questionnaires and are intended to give a general impression of the standard of clinical practice.

A *pre-operative examination/assessment* was omitted in 8·8 per cent of patients. Region 3 (Trent) had a higher percentage of omission than the other Regions.

In 17·8 per cent of cases the *anaesthetic machine* was not *tested* before use: Regions 2 and 3 (Scotland and Trent) were the highest in this respect. The urgency for operation must indeed be great for both the omission of a formal pre-operative assessment or of a functional test of the anaesthetic machine to be excused.

Twenty-eight per cent of patients were not *pre-oxygenated* prior to the induction of anaesthesia but we think that this may be an underestimate of the position since, although the question was clearly worded in the questionnaire, it is possible that it may have been misunderstood.

Most anaesthetists stated that they had *confirmed the correct placement* of a tracheal tube. However in five deaths in this series, the Assessors gave their opinion that there was a substantial probability that the tracheal tube had been placed in the oesophagus without the anaesthetist being aware of this misplacement.

The difficulty of maintaining contemporaneous *records* of blood pressure during difficult, worrying, or emergency cases is well known, but it is disappointing that no records were made at all in 12 per cent of cases.

In only 14 per cent of cases were copies of these records sent to us despite an invitation to do so. The very poor response must represent an indication of their poor quality, or throw doubt on the veracity of the claim that records had been made in 88 per cent of cases!

RECOVERY ROOM

The provision of recovery rooms varies widely across the country (table 4.18). Some hospitals reported that there was no recovery room but that they used, for particular patients, an intensive therapy unit for the same purpose. The availability of a recovery room to patients included in this study varied from 100 per cent down to 73 per cent. This is in accord with a DHSS[9] estimate that approximately 80 per cent of acute hospitals in England have recovery rooms. It is however a matter for concern that in 17·5 per cent of our series of deaths, the hospital had no recovery facilities at all. Indeed in one Region the figure is 27 per cent. Part of the explanation for this high figure is that there is one particularly large hospital in that Region (undertaking all sorts of surgery) which does not have a recovery room. This deficiency is naturally noted by the anaesthetists for each death in that hospital. (The rows in this table do not summate correctly because this section of the questionnaire was not fully completed for many cases particularly when the patient had died in the operating room).

Perhaps the most disturbing figure included in this table is that 18 per cent of patients were not admitted to a recovery room at all, although that facility existed. The reason for this failure can only be

a matter of conjecture, but as a result of this and of the absence of a recovery room, no fewer than a third of the patients were not admitted to a recovery room, and presumably spent this hazardous period in a relatively less well-equipped and serviced place.

ASSESSORS' OPINIONS 1

The deaths were classified into three groups according to the contribution of anaesthesia (table 4.19).

The Assessors classified 137 (37·6 per cent) of deaths in group N as having nothing whatever to do with the administration of the anaesthetic. However, it is important to remember at this stage that *someone* had thought that anaesthesia had played some part in *all* the 365 deaths. The clinician who expressed that opinion was personally involved either as anaesthetist or surgeon in the management of the patient who subsequently died, and it is right that some credence should be placed upon this opinion in addition to that of the Assessors. A close study of the reports has convinced us that, in general, the surgeons were anxious to be helpful when they expressed their opinion as 'some' or 'nil', and that they had sufficient knowledge of anaesthesia for their opinion to be noted. It is for these reasons that in constructing this report, we have used all the 365 deaths in much of our analysis.

The apparent differences between the assessments of deaths (particularly of the 'nil' group) in Region 2 (Scotland) and Region 5 (Wales) and those in the other Regions is statistically highly significant. This is probably due to the fact that the pairing of Assessors did not change during the period of the study. The other possibility that the distribution of particularly 'bad' features of patients, staff, equipment, etc., was confined to Wales and Scotland is not confirmed by other figures in the study. Thus, we are left with the conclusion that the two paired Assessors for these Regions were more stringent in their opinions than the other three Assessors.

The 169 patients (46·4 per cent) put into group S indicated that there was some deficiency in their anaesthetic management, in addition to other non-clinical factors. These deaths were not totally due to anaesthesia.

Finally, in 58 patients (15·9 per cent) who died, the Assessors' opinion was that anaesthesia was totally responsible, and they were placed in group T. This group of 58 patients will be the subject of a more detailed analysis later in the report (chapter 6).

ASSESSORS' OPINIONS 2

The Assessors attempted the very difficult task of deciding whether the partial or total contribution of anaesthesia to the death was either clinical or organizational. However in many individual patients both clinical and organizational factors were detected. The results of this process are shown in table 4.20.

Clinical failure includes all aspects of care which are directly under the control and responsibility of the anaesthetist. If a patient were, for example, to have died from aspiration of vomit and the anaesthetist had made no attempt to empty the stomach, tilt the table, perform cricoid pressure or otherwise to protect the airway, then this would have been classified as a clinical failure. In 42·5 per cent of the cases there was some element of clinical failure.

Organizational failure refers to such matters as the absence of suitable recovery facilities, the failure of a consultant to support his trainee adequately, or the failure to allocate adequately trained staff to problem cases, 35·3 per cent of the cases included some of these factors. Poor organization, as defined, was more frequently noted in Region 2 (Scotland) and Region 4 (North West).

ASSESSORS' OPINIONS 3

The Assessors made another judgement about each case report which was on a different basis from the above. This one was concerned with the *avoidability* of the death although it should be clear that even if clinical or organizational deficiencies might be revealed by inspection of the report, the subsequent death might indeed have been unavoidable.

It is important to emphasize that the question of 'avoidability' referred to the overall management of anaesthesia as defined above.

Table 4.21 shows clearly that there are differences between the Regions: Region 3 (Trent) and Region 4 (the North West) stand out (highly statistically significantly) in this matter.

Table 4.22 is a further breakdown of the data in table 4.19.

There were 169 patients in group S, in whose deaths the Assessors considered anaesthesia played 'some' part, and 77 (45·5 per cent) of these were avoidable. However, of those deaths in which they considered anaesthesia to be 'totally' responsible (group T) 48 (82·7 per cent) were deemed to be avoidable.

The table shows the Regional differences in avoidability amongst

groups S and T. There were 125 avoidable deaths, 77 in group S, and 48 in group T.

In our opinion there can be very few occasions when death is totally due to anaesthesia and yet be unavoidable: the ten cases are listed on pp. 34–5.

The Assessors identified events as partly responsible for death which, had they not been present, then the death might not have occurred (table 4.23). In some of these cases death did not take place immediately; had it done so, the assessment might have been that anaesthesia was totally responsible rather than only partially so.

The table lists these various causative events and naturally there were often more than one in individual patients.

ASSESSORS' OPINIONS 4

After the above processes had been carried out by the Assessors they summarized their overall view of the case report and indicated by means of seven categories the avoidable features which had in their opinion contributed to the death. These are listed for all the avoidable deaths (groups S and T) in table 4.24.

Lack of experience and of assistance have already been dealt with (tables 4.13 to 4.15).

Errors of judgement are related to matters of diagnosis, assessment of the degree of difficulty, assessment of the risk or estimation of prognosis.

Clinical errors are those in relation to the choice of method, the decision to use particular drugs, methods or monitoring or to the management of the post-operative phase.

Technical errors are those in relation to the accomplishment of the above, i.e. technique.

Twice as many errors of judgement were reported by the Assessors than any other. It is probable that this is because they assumed that a judgement error preceded the clinical decision or technical performance and therefore both tended to be recorded.

Equipment, either because of its failure or of its absence, does not appear to be an important item in the causation of death although these features were mentioned in 12 per cent of cases. Lack of assistance for the anaesthetist (medical or technical) was mentioned in 10 per cent of cases.

5 Results
The anaesthetic agents used

The following tables analyse the drugs used although the choice of a particular agent, (in contrast to the choice of a particular method), did not appear to have great significance. There are exceptions but in general the skill, expertise and experience of the anaesthetist seem to be of greater importance in determining a satisfactory outcome than the use of particular drugs.

PRE-OPERATIVE INTERCURRENT DRUGS (table 5.1.)

This lists drugs which the patient was receiving at the time of operation for some intercurrent illness not necessarily relevant to the operation. These drugs would normally have been prescribed by the patient's physician, although occasionally, when general disease was discovered after admission to hospital (e.g. hypertension, diabetes) they might be prescribed by the anaesthetist. The table is broadly consistent and provides further evidence that the populations at risk in the five Regions were substantially the same. It is assumed, of course, that all the drugs used in a particular patient were recorded and in individual cases there may have been some omissions. The table therefore underestimates rather than overestimates the extent of medication. Only about a quarter of the patients were not in receipt of any therapy.

TYPES OF ANAESTHETIC

In 91·7 per cent of these cases a general anaesthetic was used and in 7·9 per cent a regional (i.e. spinal or epidural) anaesthetic to which attention will be drawn later.

PREMEDICATION (tables 5.2 and 5.3)

42·5 per cent of patients had no premedication at all. 32 per cent had an antisialogogue (atropine or hyoscine) and 25·5 per cent had a sedative, an analgesic, or an anxiolytic. Many of these were combined.

There were some Regional variations in this part of anaesthetic practice which have some interest, but they do not appear to be related to the purpose of this study. The range of drugs used for premedication is very wide and probably reflects local anaesthetic practice and we cannot determine from the information supplied on what basis a choice was made. Of the common sedative drugs, Regions 1 and 5 (West Midlands and Wales) favoured diazepam, Region 2 (Scotland) used morphine, Region 3 (Trent) used papaveretum, and Region 4 (North Western) used pethidine most frequently.

The role of premedication in a study of mortality is somewhat speculative, but in several instances the Assessors commented that anaesthetists tolerated in their patients a combination of a high arterial blood pressure and a rapid heart rate (that is to say, a high rate-pressure product), in patients with known ischaemic heart disease. The strain on the myocardium from this cause is well known and it may well be that a return to the use of more traditional premedication might contribute to the avoidance of this effect. A noteworthy number of patients with this observation were stated to have 'died from myocardial infarction', or to have been found dead in bed within a brief interval of their operation. This was particularly the case with old patients.

INHALATION AGENTS (table 5.4)

The predominant use of nitrous oxide in all patients who received a general anaesthetic (apart from one) is expected. Diethyl ether and methoxyflurane were not used at all and only one patient received cyclopropane. 40·8 per cent of the cases who received general anaesthesia received halothane at some stage.

MUSCLE RELAXANTS

Non-depolarizing relaxants (tubocurare, pancuronium, alcuronium, gallamine) were received by 71 per cent of patients and 58 per cent received suxamethonium. Clearly many patients had both.

There are marked Regional differences in the usage of some non-depolarizing relaxants. There is no evidence from the data that the

choice of relaxant played any part in the deaths, although the wide variations might justify investigation in another context.

INTRAVENOUS DRUGS (table 5.5)

Again it is not possible from table 5.5 to deduce on what basis the selection of drugs such as diazepam, droperidol, ketamine, or phenothiazine was made. It is unlikely that methohexitone, propanidid, Althesin, or thiopentone would have been used for any other purpose than to induce unconsciousness prior to general anaesthesia (although a few patients may have received these drugs as a supplement to a regional anaesthetic procedure). There is general agreement between all Regions except Region 2 (Scotland), and in some details Region 4 (North Western).

The use of analgesic drugs (e.g. fentanyl, morphine, pethidine, phenoperidine) seems to be inversely related to the use of intravenous induction agents (thiopentone, methohexitone, Althesin, propanidid).

OTHER DRUGS (DURING AND AFTER ANAESTHESIA) (table 5.6)

This table lists the class of drugs used by the anaesthetists during the operation or as part of resuscitation from cardiac arrest. Forty-five per cent of patients received no such supplementary drug therapy, probably due to the fact that, since only 37 per cent died on the same day as the anaesthetic, the particular anaesthetist was unlikely to be involved in more than a minor part of the resuscitation procedures. Inotropic drugs such as dopamine were used more commonly in Region 3 (Trent) and Region 5 (Wales) and (excluding electrolytes, i.e. sodium bicarbonate, calcium chloride etc.) overall these are the commonest type of drugs used.

Steroid drugs, are the next most frequent supportive measure and there is a fairly wide scatter of usage through the country of these drugs. Vagolytic drugs rank third, although Region 3 (Trent) recorded their use on only one occasion. The figure for anticoagulants is also remarkably high in Region 3 (Trent) compared with the others and this is probably due to the fact that there happened to be a few cases in the study which involved cardiopulmonary bypass. This also accounts for the high usage of inotropes there.

6 Results

Deaths totally attributable to anaesthesia

There now follows a detailed consideration of the group of deaths (Group T) (58) for which the Assessors believed anaesthesia was *totally* responsible. The definition of this classification is given on page 11.

In the following tables the 58 'Total' deaths (Group T) are compared with the remaining deaths (Groups S and N).

The population

There were fewer deaths totally attributable to anaesthesia in the group of patients aged over 70 than in the other two groups (table 6.1). The distribution of ages is shifted towards the younger ages in the Group T. If the figures for successive pairs of decades are combined a highly significant difference between the three populations can be demonstrated.

In figure 6.1 the cumulative percentage of deaths within the study in relation to the end of each decade of life is shown. It is clear that the deaths in group T tended to occur at an earlier age than those amongst groups N and S. This difference is statistically highly significant. There are more deaths in the younger age groups which the Assessors thought to be totally attributable to anaesthesia than appear in the remainder of the study. This is a particularly disturbing result, but in this chapter the numbers are too small to make Regional comparisons.

In table 6.2 three patients (5·2 per cent) in group T were of African or Asian origin. There was one Asian in group N. Two of these three patients in group T died on the same day as the operation; one in the recovery room and the other in the theatre.

It was unfortunate that in 33 (9·0 per cent) of the 365 deaths the ethnic group was not reported. If all these 33 patients were African

or Asian the importance of colour is diminished. If, on the other hand, the failure to report the ethnic group is either ignored or the data included on the assumption that all these patients were white then the likelihood that colour played an important contributory part in the death, is increased. There are very few patients on which to base firm conclusions and we do not know the population at risk (that is, the numbers of non whites who have operations).

The site and nature of the operations in group T is shown in table 6.3. There are many instances in which the nature of the operation by itself is not ordinarily associated with early mortality, such as appendicectomy, laparoscopy, removal of cataracts, laryngoscopy, or bronchoscopy and incision of an axillary abscess.

It is highly likely that there is a link between serious intercurrent medical disease and death in association with anaesthesia (table 6.4). The pre-existing condition is not necessarily the final causative factor in death but it must contribute overall to the risks and thus make survival less likely. In the case of the diseases listed, every one, with the possible exception of mental deficiency, has in the past been incriminated as a major contributing factor in the association of death with surgery and anaesthesia. When table 6.4 is compared with table 6.12 (see pages 33 and 84) it is easy to see that the effects of the causative factors might be much worse in the presence of the serious intercurrent diseases listed here.

Table 6.5 compares the assessments by the anaesthetists pre-operatively. In 8·6 per cent of cases in group T, the pre-operative condition of the patient was recorded by the anaesthetist as 'Good'! It is also noteworthy that there were many fewer patients described as 'moribund' in group T than in the other groups. The figures for the 'moderate' and 'poor' assessments were very similar in all groups. Statistically there is a significant difference between the assessments in the three groups and there is a suggestion that the assessments in group S and T are different from those in group N.

Half these deaths followed elective procedures. Elective procedures are assumed to take place when any adverse risk factors have been identified and to an extent corrected or minimized.

The deaths

Table 6.6 and figure 6.2 (see also table 4.7). More patients in group T died on the day of operation. The graph of cumulative percentage

of deaths shows clearly that in groups S and N, the patients tended to live longer than in group T although ultimately they were to die. Most of these 58 patients died on a day close to their operation, indeed 56·2 per cent died on the same day. There are statistically significant differences between the three groups but these are largely due to the differences between group N and group T. There was a much greater tendency for the deaths in group N to be later than the deaths in group T. (There was no demonstrable difference between group N and group S nor between group S and group T.)

LOCATION AT DEATH (table 6.7)

The difference between group T and the other two groups is very marked. Forty per cent of the deaths in group T took place in the theatre or recovery area, whereas only 17 per cent occurred in these locations in groups S and N. The fact that 26·6 per cent of deaths of group S took place in the ITU, whereas only 7 per cent of group T did so indicates a major difference between the two groups of patients. A similar percentage died in the ward in all groups. Table 6.6 has already demonstrated that patients in group T died earlier than those in group S, which confirms that group T patients died from a different sequence of events.

The anaesthetist

Table 6.8 shows the NHS grades of the anaesthetists concerned. The distribution of grades of anaesthetists in all groups is very similar although slightly different from that of the distribution by grade of anaesthetists in England and Wales[8] but this is partly because of the exclusion of the figures for non-training sub-consultant grades. If the groups of registrars and SHOs are combined it can be seen that in all the study groupings they are fewer than in England and Wales whereas this combined group appears more commonly in group T deaths, although still less frequently than in England and Wales.

Fewer anaesthetists with more than 10 years' experience were involved with group T patients than in groups N or S (table 6.9). In group N fewer anaesthetists had less than two years' experience than in the other two groups. It seems that in forming their opinion of whether a death was attributable to anaesthesia the Assessors took into account the degree of anaesthetic difficulty for a case, and

matched this against the experience and qualifications of the anaesthetist.

There were ten patients in group T who were anaesthetized by senior house officers or registrars with less than two years' experience in anaesthesia and six of these patients were aged 65 years or more. Ten per cent of the deaths in group T were at the hands of anaesthetists of less than 1 year's experience, and 65 per cent in those of less than ten years' experience.

We would not like to give the impression that experience can be quantified only on the basis of the number of years in the specialty or of the grade of the anaesthetist. Nevertheless, most experienced anaesthetists would accept that an anaesthetist with less than two years' experience should have close supervision so that the process of anaesthesia would be impeccable even though the final outcome may prove to be inevitably fatal.

Two examples from group T illustrate this point.

1. An SHO with nine months' experience undertook anaesthesia of a 73-year-old woman who was to undergo an emergency operation for perforated colon. She suffered from chronic bronchitis and obesity and was described as being 'very ill'. The stomach was not emptied effectively. The patient inhaled vomit immediately post-operatively and died the following day.

2. An SHO with less than two years' experience undertook to anaesthetize a 49-year-old man for an emergency saddle embolectomy of the aorta. The patient was described as being 'moribund' and suffered from chronic pyelonephritis and angina and he was receiving steroid therapy. The registrar who helped his junior was called away to an emergency obstetric case, and the consultant on call was more than ten miles distant and did not come in.

Clearly reliance is being placed on junior and relatively inexperienced anaesthetists for both emergency and elective cases in which there is a considerable element of risk.

The anaesthetic

ASSISTANCE FOR THE ANAESTHETIST

At the inception of this study it was thought that we would reveal many occasions of inadequate help for the anaesthetist. In the event table 4.15 has shown that this was not the case. However SHO's and registrars are rarely provided with technical or nursing help in times

of shortage of staff. Help tends to go to the senior staff. In these circumstances the inexperienced trainee is ill-equipped to cope with the many things that may go wrong during anaesthesia.

In one case, from group T, an SHO with three years' experience in anaesthesia, working single handedly, anaesthetized a 79-year-old patient with a strangulated inguinal hernia. Although the manner of completion of the questionnaire leaves room for doubt about the reliability of some of the information, the Assessors formed the opinion that this anaesthetist was far too inexperienced to be allowed to anaesthetize the particular patient on his own. In this case the anaesthetic itself passed off satisfactorily, but within 15 to 20 minutes after the patient returned to the ward, cardiac arrest occurred, possibly (although this was not proven) following aspiration of stomach contents or following untreated recurarization.

This case relates not only to the lack of experience of the anaesthetist but perhaps more to a lack of proper organization within the hospital so that the important requirements of an adequate standard of supervision and nursing care both in the operating theatre and afterwards are provided.

Another case, although from group S, points more clearly to the effect of the lack of technical assistance on the provision of expert anaesthetic care. A consultant of considerable experience anaesthetized an elderly lady who was to have a prosthesis inserted into her femur. Cardiac arrest occurred shortly after the insertion of cement. The arrest was managed as best they could by the doctors present—but the consultant anaesthetist had no help whatever. There is no evidence in this case report to suggest that this affected the fatal outcome but correct and expeditious management of such serious complications is less likely to be achieved in these difficult circumstances by a single-handed anaesthetist.

There is less instrumental monitoring in this group than in groups S or N (table 6.10, see also table 4.16). The absence of even minimal monitoring for a 'good' or 'moderate' risk patient is one factor amongst others more directly linked to the death, which might have led Assessors to suggest that anaesthesia was totally responsible. Fewer patients in group T had their arterial blood pressure measured than in group S and also fewer had their ECG monitored.

In table 6.11 15·5 per cent of cases in group T received a spinal

or epidural anaesthetic either alone or one combined with a general anaesthetic. This incidence can be shown to be statistically different from the use of spinal or epidural anaesthesia in groups S and N.

Assessors' opinions

Table 6.12 lists examples of events noted by the Assessors as clinically causative in group T. None of them is surprising and the list includes most of the traditionally recognized hazards of anaesthesia. It is hardly a new observation that aspiration of stomach contents and that unintentional hypotension are frequent[3,4] but that these two accidents should still account, at least in part, for a third of the deaths is a matter for concern.

There are obvious similarities between the events listed for group T and those in group S (table 4.23). There is less variety here and it must be assumed that the degree of effect of each of these occurrences was, in the Assessors' judgement, greater.

Nine of the eleven events connected with spinal or epidural anaesthesia occurred in separate patients in group T, whereas twenty deaths occurred with these methods in groups S and N.

The relative infrequency of equipment-related factors is encouraging.

AVOIDABILITY

The Assessors categorized, as before, the events for convenience into seven groups (table 6.13). (See also table 4.24.) This classification is arbitrary and more than one category was ascribed in many cases. The difference between the two groups S and T is not surprising and since the nature and distribution of the factors is much the same, both the number of factors and the degree of effect of them in each death appears to be determinants of the allocation of a case to group S or to group T. Errors of judgement predominate in both groups with errors of a clinical nature ranking second and lack of experience and technical errors third.

Within this group of 58 deaths, there were ten deaths which were regarded by the Assessors as being unavoidable, despite the fact that they were totally attributable to anaesthesia.

Although these ten deaths were judged as unavoidable, it does not mean that there were not features of their management which might

have been improved: these are noted in the list below since, although they may appear irrelevant to the particular death, they are believed to have influenced the Assessors who placed them in group T. Verbatim statements made by the Assessors or the anaesthetist concerned are in quotation marks.

Case 1 was a 78-year-old man for an elective prostatectomy. He had ischaemic heart disease and was in atrial fibrillation. He suffered from gout, obesity, and chronic bronchitis. Nevertheless he was regarded as a 'moderate risk' by the anaesthetist. Pre-oxygenation was not performed. An epidural was administered, and sedation was provided with Althesin. He breathed atmospheric air spontaneously. Profound hypotension occurred and the operation was abandoned. He died five days later. There was no recovery room in the hospital.

Case 2 was a 65-year-old man for an amputation performed electively for peripheral vascular disease. He was described as a 'poor risk' and was very ill prior to surgery, having diabetes, ankylosing spondylitis, chronic renal and cardiac failure, and 'panhypopituitarism'. He died in the ward on the same day as the operation.

Case 3 was a 32-year-old woman for a biopsy of the uterus for suspected carcinoma. She was anaemic and had an upper respiratory tract infection. She was sent to the ward where she aspirated vomit and died there the same day. Autopsy showed widespread neoplastic disease.

Case 4 was a 79-year-old woman for an elective extraction of bilateral cataracts. She had well-controlled diabetes. Pre-operatively, she was given both droperidol (5 mg) and nitrazepam (5 mg). Pre-oxygenation was not performed. She was given 175 mg of thiopentone and 50 mg of suxamethonium and her lungs were inflated with oxygen. A tracheal tube was passed. Spontaneous ventilation returned 'following reversal from suxamethonium'. Cardiac arrest occurred 15 minutes later. 'The tube might have been in the oesophagus' or the patient might have been suffering from 'autonomic neuropathy'. She died two days later.

Case 5 was an 80-year-old woman for an emergency laparotomy for faecal peritonitis. She was dehydrated, hypotensive, and toxic at the time of operation. She had been receiving digoxin. She died in the ward eight hours later. Diamorphine had been liberally prescribed as a post-operative analgesic.

Case 6 was a 59-year-old man for an emergency repair of a ruptured

aortic aneurysm. He suffered from ischaemic heart disease and died in the intensive therapy unit one hour post-operatively, 'the diagnosis of malignant hyperpyrexia must be accepted'.

Case 7 was a 76-year-old man for an emergency amputation of leg. He suffered from ischaemic heart disease, was frail and confused, and was receiving treatment with digoxin and diuretics. The patient was 'inadequately prepared', since he was noted to be dehydrated. Inadequate notice was given to the anaesthetist concerned (a registrar with the D.A. whose senior colleague was 20 miles away). No ECG was used during the anaesthetic and the patient died in the recovery room.

Case 8 was a 29-year-old woman for an elective bilateral adrenalectomy suffering from Cushing's syndrome. She was grossly obese, and suffered from diabetes and hypertension. She was anaesthetized with trichloroethylene. She died in the intensive therapy unit on the same day with the diagnosis of malignant hyperpyrexia.

Case 9 was a 25-year-old man for an elective biopsy of a lymph node. He was in a poor state of health from metastatic carcinomatosis and was 'riddled with cancer'. He was anaemic and hypoxic from lung dysfunction: a secondary pneumothorax was present. He was given 'an excessive premedication' and was not adequately assessed pre-operatively by the anaesthetist who was a clinical assistant. He died in the operating room.

Case 10 was a 63-year-old man for an elective hemicolectomy. He was described as having a 'fair exercise tolerance', but the pre-operative assessment seemed 'inadequate'. He died two days after surgery from an undiagnosed carcinoma of the lung with multiple metastases.

Most of these patients suffered from irretrievable pathological conditions and the fatalities were clearly inevitable. Nevertheless many of the deaths seem to have occurred earlier than the state of the patient or the pathology itself would appear to have dictated. The quality of anaesthetic care in these 10 cases was sufficiently poor for anaesthesia to be held by the Assessors to have been *totally* responsible for the death *at that time*. There is little doubt that each of these patients had an extremely grave prognosis, but equally little doubt that their death may well have been hastened by inept anaesthetic management. It is possible that with more skilled anaesthetic care these patients might have survived to die of their disease in more appropriate surroundings. Although the

deaths are considered here in an anaesthetic context, the decision to operate on gravely ill (often terminally ill) patients should ideally be taken only after consultation by both anaesthetist and surgeon with long experience and with close attention to all those factors which only can give hope of survival.

7 Discussion

OTHER RECENT STUDIES

The most recent attempt to analyse in some way surgical deaths in respect of causes related to anaesthesia was by Adelstein and Loy.[10] They were in the main concerned that adverse effects of drugs and other treatments including anaesthesia should be properly noted on death certificates as well as the main disease or circumstance which killed the patient. They came to the conclusion that Coroners' and other certificates rarely mentioned adverse effects of drugs and in particular, anaesthesia, because of the belief that adverse effects would be reported separately to the DHSS. However *inter alia*, they go into some detail about the numbers of deaths in which anaesthesia is mentioned as one of the causal factors on the death certificate issued by doctor or coroner. Unfortunately, their analysis is based almost entirely on Coroners' reports and in addition to this limitation they exclude, among others, cases where 'death followed surgical operation—but was not closely connected with it, and cases where death was due to what were regarded as ordinary post-operative complications such as cardiac failure, pneumonia, or pulmonary embolism' unless the operation was of a minor nature. The report does not utilize the clinical opinion of experienced anaesthetists, and the severe limitations and exclusions make the figures given of little if any relevance to this present study.

We have already indicated our regret that this report is not a combined anaesthetic and surgical one. Gough, *et al.*[11] presented a report of clinical audit on the work and performance of a surgical firm without even mentioning anaesthesia or anaesthetics. Our omission of surgical matters is no less blameworthy; but we at least tried! However, they make one useful observation which is relevant to this study—that there was good correlation between their diag-

nostic codes and those of the HAA, although the latter system did fail in one small omission.

We found that the clinical information which can be retrieved from the HAA is somewhat limited both in quantity and in quality for reasons which we have indicated elsewhere in this report. Doctors require detailed information about clinical events and there is a strong case for a Clinical Activity Analysis similar to that of the HAA to be set up centrally in order to answer some of the unanswered questions which arise in epidemiological studies such as this.

Cameron, *et al.*[12] in comparing clinical diagnosis in life and that at autopsy reported that 15 per cent of main diagnoses and 42 per cent of causes of death were not confirmed by autopsy. We have already commented on the fact that the pathologist's diagnosis of the disease responsible for death is not very relevant or helpful in a study such as ours and that it is the sequence of events which triggers death which is more valuable.

The main current means of determining the cause of death after anaesthesia and surgery is by means of an autopsy. Often this is requested by a Coroner and may be followed by an inquest. This study supports the view that greater reliance than at present should be placed on the views of clinical anaesthetists in elucidating the events leading to the death. The value of a pathologist's opinion based on an autopsy is often limited when deaths associated with anaesthesia are concerned. It might be more useful if independent and expert advice was sought more often from anaesthetists by Coroners, and others, in addition to that of a pathologist.

NUMBERS

If this report is to have an influence on practice in the UK, it is important to appreciate that all the figures are likely to be underestimates. About 600 reports-in-detail might have been gathered had the ideal return rate been achieved in the five Regions. This would mean about 1,800 detailed reports from the whole country and thus 280 deaths per year (approximately 1 in 10,000 anaesthetics) might have been assessed as totally due to anaesthesia.

The occurrence of 1,800 deaths related to, but not caused definitively by, anaesthesia is a very large number, although the incidence (approximately one in 2,000) appears to be very small amongst three million anaesthetics. There is probably a rate below which even superhuman efforts will not achieve improvements, but

it would be difficult or impossible to estimate what that rate is. There is sufficient evidence in this report to suggest that the death rate involving anaesthesia has not yet fallen to this low level and indeed we have the impression that we are still far above it.

That death is often related in time to surgery is obvious, but the recurrent question in our minds has been, need this death have occurred when it did? On many occasions the Assessors have been forced to the conclusion that even when death was inevitable at some time after surgery, it had taken place when it did almost solely because of a sub-standard level of anaesthetic care. We think we detected the influence of shortcomings in surgical practice but we cannot draw attention to them for the reasons already outlined (page 10). It needs also to be understood that in saying that anaesthesia was responsible in a particular case we cannot pretend that surgery itself had no influence. If there had been no surgery there would have been no anaesthesia. Without surgery some of these patients might not have died at the time that they did. Furthermore, our study could not examine the death rate in surgical patients who did not have operations.

The Confidential Enquiry into Maternal Deaths reports every three years. Avoidable factors are identified and, on average, ten deaths per year are claimed to be associated with mishaps in anaesthesia. These patients are young, usually free from intercurrent disease and are at risk from identifiable hazards (emergency surgery, full stomach, haemorrhage). The understandable and emotional response to a maternal death has meant that this important Enquiry has influenced the professional practice of obstetric anaesthesia to a considerable extent. The emergence of a sub-specialty, obstetric anaesthesia, and the demand that proper assistance, equipment, and training be provided have all been accelerated as a result of public awareness of the facts about avoidable anaesthetic mortality in obstetrics.

Even on our own minimum figures the estimated mortality of about 280 deaths per *year* in the UK *totally* due to anaesthesia in general surgery as distinct from obstetrics should have the same effect. Even were we to be correct in our assessments in merely half of the occasions the mortality exposed by this study is still over ten times the maternal mortality and is by any standard too great.

ACCURACY OF ASSESSMENTS

One of the weaknesses of this type of study is that opinions are expressed by an independent Assessor retrospectively about data either recorded at the time of operation or in answer to the questionnaire. The possibility of bias of some sort is always present. The understandable desire on the part of the Assessors not to blame anaesthesia unjustifiably cannot be ignored. (There are indeed a few cases where the authors disagree with the assessments.) We have included a number of illustrative case reports and these should be sufficient to support our opinion that there is still substantial room for improvement in the practice of anaesthesia.

Questionnaires of the type which were used in this study—however carefully they are designed—can never reveal the whole picture. There may be a number of deficiencies in this questionnaire (see Appendix B), and the full details of the circumstances surrounding the death are not always revealed. However we must reiterate once again that the occasional harsh judgements which have been passed by the Assessors are based on the information with which they were provided by the anaesthetists.

AGE OF PATIENT AT DEATH

Our group N patients were, on the whole, much older than those in the other two groups. We have the impression that anaesthetists regard old age as a factor in determining death which cannot be minimized by them. The allocation of a case report to group T by the Assessors seems to have been more likely if the patient were young rather than old. Group S contains a number of cases in which, were it not for the patients' age, the allocation might have been to group T. These observations should be borne in mind when differences in age between the groups are considered.

The clearest contrast appears when the ages of the patients in group T are examined: the skewness to the older age groups is still marked but there are statistically significant ($p<0{\cdot}005$) differences in the three populations (table 6.1). Just over one-fifth of the patients in group T were less than 50 years old at the time of their death, and thus in the whole country there would probably be about 50 deaths each year in this age group.

Age is sometimes used to excuse a death. When the death is the result of a less than ideal anaesthetic management, and is considered to be avoidable, it remains avoidable despite the undeniable fact of

the patient's age. If there are features which are, to any extent, undesirable and contributory to the death and which could have been avoided, then it does not really matter how old the patient happened to be. The important point is that these features should not have been present.

INTERVAL BETWEEN OPERATION AND DEATH

Most anaesthetists would agree that the longer this interval the more remote is the influence of anaesthesia likely to be. However with modern intensive therapy, patients are frequently kept alive for considerable periods even though ultimately they perish. The primary and precipitating event which occurred during anaesthesia may then be overlooked. Indeed we have received only one detailed report of such an occasion (death after six days post-operatively from a process started during anaesthesia) despite an open invitation to report such cases. The extent to which this type of sequence of events occurs therefore remains unknown.

We have already suggested (page 11) that improvements in anaesthesia are likely to lower figures for *early* mortality and it was for this reason, amongst others (see page 11) that the interval of six days was chosen. Table 6.6 shows the difference between groups T and S in this respect, but the important difference is between groups N and T. The pattern (see fig. 6.2) is already set by the events on the day of operation, but by the fourth day the cumulative percentage in the three groups is almost the same and 95 per cent of deaths had already occurred. There is thus no justification for the continuing myth that anaesthesia as a cause of death is only important in the first 24 hours. It is clear that factors related to anaesthetic practice exert their effect for much longer.

LOCATION AT DEATH

Detailed statistical analysis of table 6.7 shows that the significant differences which exist between the three groups (N, S, and T) in relation to the different places where the patients died are due entirely to the differences in group T between the numbers who died in the operating room and those few who died in the intensive therapy unit. It has already been pointed out that this indicates that these patients were dying a different sort of death—that is to say, one from a more acute process.

By way of contrast, in group N, although the Assessors had

exonerated the influence of anaesthesia, a much larger percentage of patients died in the ITU. It is probable that death in the operating theatre was more likely to be assessed as totally due to anaesthesia than death in the ITU where management of clinical problems tends to be shared and therefore in the terms of this study, difficult to apportion responsibility for deficiencies.

Practices with regard to the extent of the anaesthetists' responsibilities in the ITU do vary from hospital to hospital. It might be unduly harsh to apportion to anaesthetists responsibility in the ITU, which they did not usually accept at that hospital in contrast to another hospital, where that responsibility was accepted. Death in the ITU after failure to recover consciousness after surgery, other than neurosurgery, would probably be held to be due to anaesthesia in some way, whereas death due to hypovolaemia, renal failure, or cardiac failure, for example, might not.

AUTOPSY

The information in this study demonstrates that postmortem diagnoses of death are seldom of value in relation to the identification of those aspects of anaesthesia which led to death. All too frequently either irrelevant findings are reported (bronchitis, 'mild' bronchopneumonia) which contribute very little to the solution of the puzzle, or generalities (widespread cerebral softening following hypoxia) which, though important in themselves, apart from being self-evident in the case of a patient who died after cardiac arrest, are also unhelpful. Unfortunately, these findings are often included on death certificates.

AVOIDABILITY

The allocation of a case report to group N, S, or T was entirely dependent on the judgement of the Assessor, and much of the value of this report depends on the credibility of the assessments and no more so than when the question of avoidability is considered. A trainee may not have the experience to cope with a series of events which lead to a patient's death, and in the circumstances it would be reasonable that the death be labelled 'avoidable'. However the same circumstances in the case of a very experienced anaesthetist would indicate that with his assumed abilities and judgement, the best and most appropriate treatment was applied and the death labelled 'unavoidable'. Needless to say this is an idealized example and in the

study many instances occurred of experienced anaesthetists making what seemed to be obvious errors of clinical expertise and judgement.

Thus, the issue of avoidability is judged after consideration of as many of the facts as possible, bearing in mind the best possible current practice of anaesthesia.

The fact that in this study there were 125 deaths with avoidable features (many with more than one) cannot be ignored. If the same argument that has been used on page 14 and in table 4.3 is applied, then amongst the 1,800 deaths in which anaesthesia might have played some part, 600 would have avoidable features, in the whole UK each year. (The estimate of 600 deaths is derived from the Assessors' opinions reached after their study of the clinical reports. The figure of 1,800 deaths is an estimate based on the original opinions of the anaesthetist and/or the surgeon concerned that anaesthesia had played some part in the 365 deaths.) A higher standard of anaesthesia might not of itself have prevented these deaths but there is a high probability that many of the deaths would not have occurred and the overall hospital death rate following anaesthesia and surgery might well have been reduced.

The avoidable features have been identified in this study in relation to mortality: we do not know to what extent these factors are involved in the causation of morbidity following anaesthesia, but it is likely that they are considerable. It is important to appreciate in this context that we have no information about the occurrence of 'near misses'—that is to say, events such as have been recorded in this study, but which did not prove fatal. The results of the study set up by the Association of Anaesthetists into anaesthetic morbidity are awaited and should illuminate these particular matters.

MANPOWER

There is sufficient evidence in the cases reported here that anaesthetists-in-training, young in age and experience, are either accepting, or being forced to accept, responsibility out of proportion to their skills. The present arrangements in the UK as a whole lead to elective anaesthetic work being performed by consultants and anaesthesia for emergency surgery particularly at night being delegated to trainees. It is not a new observation to state that this is illogical. Many senior registrars and consultants do in fact often undertake supervision of trainees at night. However, these anaesthetists, in contrast to the trainee who is often freed from duty the next

day, have to undertake their regular work which makes no allowance for intermittent calls from trainees during the night. It is no solution to suggest that consultant anaesthetists alone should do the work at night because trainees would then not obtain the necessary experience. This problem is not peculiar to anaesthesia, but it is a complex one and this is not the place to discuss it further, except to emphasize that it is clear that a greater number of expert anaesthetists need to be present in hospital for a greater proportion of the 24 hours. Anaesthesia carries more risk in the hands of inexperienced doctors than any other branch of medicine.

EXPERIENCE AND GRADE

An expansion in the numbers of consultants in all specialties is probably inevitable to bring the career and training grades into balance. In addition a sufficient increase in the numbers of consultant anaesthetists will enable a more direct teaching relationship between consultant and trainee. In the case of major anaesthetics or of seriously ill patients, no trainee of limited experience should act alone. Even in apparently less serious cases the trainee needs support. To some extent, these remarks might also apply to the non-consultant career grades of anaesthetist. There is evidence from a study of individual case reports that consideration needs to be given to the problem of the continuing education of non-consultant specialists who may have had no opportunity for this since their first apprenticeship. It may also be necessary, in some parts of the country, to formalize arrangements so that these doctors become full members of Divisions of Anaesthesia.

Clinical skill

ASSESSMENT OF PATIENT

Pre-operative assessment by the patient's anaesthetist is an integral part of the practice of anaesthesia: omission of this in nearly 10 per cent of the cases suggests a defect in attitude and organization. If the cases in our study are representative of practice throughout the UK 300,000 patients are anaesthetized each year without meeting their anaesthetist!

The classification by anaesthetists of the 'risk' of anaesthesia to a particular patient depends on that anaesthetist's clinical acumen and

experience. It is not something absolute in itself. What is a 'poor risk' for a registrar with one year's experience, may not be so for a consultant with fifteen. The trainee with his limited experience might consider a patient as a 'good' risk, whereas a consultant with his greater understanding might view the matter differently and classify the patient as a 'poor' risk and take the appropriate precautions. There are other aspects too. An anaesthetic for major surgery to a patient with ischaemic heart disease and left bundle branch block in a hospital without facilities for cardiac pacing, is a much greater risk than if that patient were to be transferred to a unit with that facility. The patient's condition has not changed, but the risk has.

ETHNIC GROUP

Difficulties in the detection of cyanosis in patients with dark skins should by now be well known. In the Confidential Enquiry into Maternal Deaths a similarly increased incidence of avoidable death was noted in this group of patients.[13] Our evidence is not conclusive but suggests that it is still not sufficiently appreciated that increased vigilance is required in the care of patients with pigmented skin.

DECISION TO OPERATE

There were not many cases in which the Assessors commented upon the possibility that the operation might have been mistimed, although there were some. We ourselves note that a considerable number of patients appeared from the records to have been operated on by surgical registrars who might possibly have been at the limit of their experience. We have no evidence to judge the extent to which anaesthetist and surgeon consulted together pre-operatively.

ELECTIVE OPERATIONS

The traditional differentiation of surgical cases into elective and emergency ones is gradually being replaced by elective, urgent, and emergency. Few, if any, of the cases in the study were 'emergencies' according to this latter categorization. The excuse of 'life-saving' cannot therefore be made in respect of any reported deficiencies. The omission to test the anaesthetic apparatus before use in 18 per cent of cases cannot be excused on the grounds that all these cases were 'emergencies'.

CHOICE OF ANAESTHETIC TECHNIQUE

We have already expressed our opinion (page 25) that the quality of the anaesthetist is more important in terms of outcome than the drugs or techniques he chooses to use. However, we draw attention to the frequency with which spinal or epidural techniques were mismanaged to an extent which suggests that their disadvantages were not fully realized.

The responsibility for the choice and administration of spinal or epidural anaesthesia for particular patients or operations ultimately rests on the anaesthetist. Other specialists, whose opinions are valuable and should be taken into consideration, should nevertheless avoid putting pressure on the anaesthetist, especially junior ones. This may have an unfortunate influence upon an inexperienced trainee and may even affect a consultant anaesthetist. There is no evidence that a method which abolishes autonomic and sensory response to surgery is particularly beneficial to the poor risk or moribund patient in, or on the verge of, cardiorespiratory failure. Indeed simple logic suggests that this would be a poor choice in these circumstances.

If, because of partial failure of the spinal or epidural injection, it becomes necessary to induce general anaesthesia as well, the scene is set for disaster. It is by such events that spinal or epidural gains an undeservedly poor reputation.

PRE-OPERATIVE PREPARATION OF THE PATIENT

There were many occasions when the Assessors thought that pre-operative preparation had been inadequate or had been mismanaged. It is a matter for concern that the simple measurement of central venous pressure is not carried out as a routine whenever pre-operative intravenous therapy is used aggressively. Several patients were over-transfused with fluids and cardiac failure ensued. Others were not given adequate fluids before operation and suffered hypotension on induction of anaesthesia.

INTERCURRENT DISEASE

The presence of intercurrent disease indicated that many of the patients were already at risk before surgery. Many of the conditions noted are common and without (so far as is known) particular significance in relation to modern anaesthesia. Nevertheless, some are known to introduce grave risks and yet do not always seem to

have been viewed very seriously by the anaesthetist. For example, the prevalence of ischaemic heart disease in this study is very obvious and the adverse influence of anaesthesia demonstrated frequently. Nevertheless there is little evidence that ischaemic heart disease was always regarded as sufficiently important to justify special precautions.

FACILITIES

It seems from this study that major surgery of a specialized nature is still being carried out in hospitals without proper facilities for post-operative care. While the surgical and anaesthetic skills for the operation itself are not in question the facilities for post-operative care do not always match the skills of the doctors. Communications in the UK are sufficiently good except in the remotest parts, to ensure that transport can be arranged for such patients to be moved to appropriate centres, where full facilities are available.

RECORDS

One of the major advantages claimed of a centrally funded Health Service such as the NHS is that Regional standards of medical care would be the same throughout the whole country. In order for this ideal to be reached, there must be a continuous process of information retrieval so that clinical and the related administrative decisions may be properly based on factual data. The HAA system is the cornerstone of this process in the UK and it is vital that it should be properly funded, particularly at the hospital level so that its credibility is undeniable and its accuracy cannot be doubted. Neither of these two latter desiderata seem to be fully met at the moment. The staff of hospital record departments have, in a number of cases, been unable or unwilling to co-operate in the way necessary to the success of this study and have claimed shortage of staff and equipment as their excuse. It seems to us a short-sighted policy indeed that inhibits the records system of a hospital from achieving its full potential as an essential part of the infrastructure of clinical practice.

The apparent unwillingness on the part of anaesthetists to photocopy the anaesthetic record card for our inspection with full regard to confidentiality is also disturbing. Perhaps no record was made? If so, this is a particularly serious matter since neglect to maintain a contemporaneous record has many implications of which the clinical one is the gravest and of which the legal one is by no means the least.

MONITORING

The place of physiological monitoring by instruments (in contrast to the observation by the anaesthetist of physical signs) is still debated. Strong hospital Divisions of Anaesthesia usually acquire sufficient funds to equip the operating rooms for which they are responsible with a range of monitoring instruments. Weaker ones may fail to do so.

We realize that instruments such as the ECG, which we assume to be routine aids in the practice of safe anaesthesia, are not so regarded by all anaesthetists. We take the view that there should be a blood pressure cuff and an ECG applied to every patient under anaesthesia. In addition patients, in particular those whose lungs are being artificially ventilated, should have some device within the breathing system so that the volume of ventilation can be measured. These are, as far as we are concerned, the *minimum* acceptable standards of instrumental monitoring, although we recognize that not all anaesthetists would accept even this view.

Some take a more extreme position and believe that the concentrations of the components of the inspired and expired gases should always be measured, that neuromuscular tone and body temperature should be monitored and urine volume recorded. Many anaesthetists in the USA would regard pulmonary artery catheterization as essential during major surgery. Each of these are no doubt valuable in certain circumstances and perhaps essential in a few, but we do not consider them yet to be the minimum.

Since monitoring instruments may contribute to safety, it is reasonable that they should be available in all operating and recovery rooms. It is however clear that there is a wide variation of opinion about this and consequently in the provision of this equipment.

REGIONAL COMPARISONS

There are no great differences between Regions. They all maintain high standards of anaesthesia, but there are some small differences. The overall state of anaesthetic practice in the UK is satisfactory, but there are still serious deficiencies, and individual Divisions of Anaesthesia will see from the information in this Report and the case examples how their own facilities and organization might be improved.

CONCLUSION

This report has shown that it is possible to conduct an enquiry of this nature. The data we have collected is informative but the process is expensive of both time and money. Time alone will show if this study has been effective in the improvement of anaesthetic services, but we believe that it is important that further studies at regular intervals are undertaken in the future.

8 Summary

1. The overwhelming message of this report is that the process of anaesthesia is remarkably safe. Although one in 166 (0·6 per cent) patients die within six days of a surgical operation, only one in 10,000 dies *totally* as a result of anaesthesia.*

2. This extremely low incidence should not obscure the unpleasant observation which follows. The actual *number* of deaths totally attributable to anaesthesia is in the region of 280 per year and the majority of these are probably avoidable.*

3. In a much larger number, 1,800 deaths (one in 1,700, or 0·06 per cent), anaesthesia may have played *some* part and this too could, in large measure, be avoided.*

4. The events which caused these deaths have not changed much over the past thirty years.

5. The mistakes which occur do so in the hands of all grades of anaesthetist. Trainee anaesthetists are all too often left unsupported by consultant anaesthetists for supervision, and by other staff for assistance.

6. The provision of essential monitoring instruments is inadequate; where they are available they are not always used.

7. Clinical anaesthetic records are not always kept. In so far as the HAA records are concerned a careful reappraisal of such definitions as 'operation' is indicated.

8. There appears to be insufficient consultation between surgeon and anaesthetist concerning various aspects of the operation including timing, pre- and post-operative care and prognosis.

9. A high proportion of patients suffer from intercurrent disease

* These figures are based on the ones in this report and calculated for the whole of the UK on the basis of the annual HAA returns.

unrelated to surgery. This undoubtedly increases the risk, but the implications for the anaesthetist are often ignored.

10. There are still hospitals where proper recovery facilities are not available.

11. There is little evidence that fatigue of the anaesthetist plays much part in these deaths.

12. Such differences as do occur between the Regions are probably unimportant.

13. It has become clear that anaesthesia may be a contributory factor in deaths which occur more than twenty-four hours after its administration.

14. Autopsy reports alone are of limited value in explaining deaths associated with anaesthesia.

15. The difficulty of assigning causative factors in post-operative deaths to anaesthesia or to surgery makes it important that future epidemiological studies should be combined ones between anaesthetists and surgeons.

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Tables

TABLE 4.1

Total number of operations and six-day deaths

Region	Number of operations (HAA)	6 day deaths	
		HAA (% operations)	Study (% HAA deaths)
1	265.274	1316 (0.49)	717 (54.5)
2	269,993	1379 (0.51)	894 (64.8)
3	167,274	1008 (0.60)	750 (74.4)
4	340,306	1818 (0.53)	886 (48.7)
5	104,515	539 (0.51)	489 (90.7)
	1,147,362	6060 (0.53)	3736 (61.6)

TABLE 4.2

Numbers of initial reports to assessors and reports-in-detail from anaesthetists

Region	Initial Reports	Reports-in-detail	
		(% of initial)	
1	717	70	(9.8)
2	894	108	(12.1)
3	750	55	(7.3)
4	886	90	(10.2)
5	489	42	(8.6)
	3736	365	(9.77)

TABLE 4.3

Actual and estimated reports-in-detail

Region	Initial reports	Reports-in-detail	Factor*	Estimated Reports-in-detail
1	717	70	1.835	128
2	894	108	1.542	167
3	750	55	1.344	74
4	886	90	2.05	184
5	489	42	1.102	46
		365	1.64	599

* 6-day death rate (HAA) divided by study return rate.

TABLE 4.4

Percentage distribution of the age of patients who died

Years	Per cent	
<10	3.3	
10 +	0.5	
20 +	0.8	
30 +	1.4	
40 +	3.8	
50 +	14.8	
60 +	23.3	
70 +	32.0	51.1
80 +	14.2	
90 +	4.9	
Not specified	0.8	

TABLE 4.5

Anaesthetist's assessment of the pre-operative state of the patient

(Percentage by Region)

Region	Good	Moderate	Poor	Moribund
1	1.4	24.3	62.9	11.4
2	4.6	28.7	56.5	10.2
3	3.6	20.0	61.8	14.5
4	2.2	20.0	60.0	17.8
5	2.4	30.9	57.1	9.5
Total (365)	3.0	24.7	59.4	12.9

TABLE 4.6

Urgency of operation

(Numbers by Region)

Region	Elective	Emergency
1	36*	31
2	52	54
3	33	20
4	38	50
5	20	21
	179 (50.3%)	176

* Includes 1 Day Case

10 Cases were abandoned

TABLE 4.7

Day of death

(Percentage of total)

	Same	1	2	3	4	5	6
Total (365)	37.5	27.1	13.4	6.8	9.3	3.8	1.9

TABLE 4.8

Location of patient at death

(Percentage by Region)

Region	Theatre	Recovery	ITU	Ward
1	11.4	1.4	32.8	54.3
2	14.8	4.6	20.3	60.2
3	12.7	3.6	40.0	43.6
4	23.3	4.4	24.4	47.8
5	16.7	11.9	21.4	50.0
Total (365)	16.1	4.6	26.8	52.3

TABLE 4.9

Autopsy rate

(Percentage by Region)

Region	
1	48.6
2	35.2
3	36.4
4	40.0
5	59.5
Total (365)	41.9

TABLE 4.10

Pathologists' opinions about the causes of death in 153 autopsies

Acute myocardial infarction	20
Chronic ischaemic heart disease	40
Cardiac failure	13
Cardiomyopathy	2
Congenital heart disease	3
Other cardiovascular	6
Bronchopneumonia	26
Other respiratory	18
Pulmonary embolus	8
Neoplastic disease	14
Disease of adrenal gland	2
Cerebral pathology	16
Miscellaneous	19

TABLE 4.11

Country of graduation of anaesthetist

(Percentage by Region)

Region	Not known	UK	Non UK
1	15.7	65.7	18.6
2	8.3	88.9	2.8
3	9.1	74.5	16.4
4	17.8	54.4	27.8
5	7.1	76.2	16.7
Total (365)	12.8	72.3	15.6

TABLE 4.12

Grade of anaesthetist

(Percentage by Region)

Region	Consultant	Senior Registrar	Registrar	Senior House Officer	Medical Assistant	Clinical Assistant	General Practitioner	Other
1	45.7	14.3	17.1	14.3	5.7	2.8	0.0	-
2	51.8	8.3	18.5	5.5	5.5	0.9	5.5	2.8
3	54.5	14.5	14.5	12.7	0.0	3.6	0.0	-
4	42.2	10.0	18.9	17.8	5.5	5.5	0.0	-
5	52.4	7.1	16.7	19.0	4.8	0.0	0.0	-
Total (365)	48.8	10.7	17.5	12.9	4.7	2.7	1.6	1.1
England and Wales	42.9	8.9	22.3	22.1	3.5	-	-	-

TABLE 4.13

Duration of experience of anaesthetist

(Percentage by Region)

Region	>10 yrs	<10 yrs	<5 yrs	<2 yrs	<1 yr	<6/12	Not Specified
1	41.4	20.0	20.0 (34.2)*	7.1 (14.2)	4.3	2.8	4.3
2	50.0	17.6	16.6 (31.3)	7.4 (14.7)	4.6	2.7	0.9
3	36.4	40.0	9.1 (20.9)	1.8 (11.8)	7.2	3.6	1.8
4	40.0	20.0	20.0 (36.5)	5.5 (16.5)	7.7	3.3	3.3
5	50.0	14.3	11.9 (35.6)	7.1 (23.7)	7.1	9.5	0.0
Total (365)	43.8	21.6	16.4	6.0 (15.8)	6.0	3.8	2.2

* Cumulative percentages in brackets

TABLE 4.14

Grade of anaesthetist and total years of experience in the specialty

(Percentage of Total)

	>10 yrs	<10 yrs	<5 yrs	<2 yrs	<1 yr	<6 months	Totals
SHO	-	-	0.8	3.0	5.7	3.3	12.8
Registrar	-	3.0	10.1	3.0	0.3	-	16.4
Senior Registrar	0.3	5.7	4.4	-	-	-	10.4
Consultant	36.4	12.0	-	-	-	-	48.4

SHOs and Registrars <1 year - 9.3%
" " <2 years - 15.3%

N.B. This table excludes medical and clinical assistants, general practitioners and one doctor of each grade who failed to record the duration of his experience

TABLE 4.15

Assistance for the anaesthetist

(Percentage by Region)

Region	None or Not Specified	Doctor or Anaesthetist	Nurse SEN, SRN	Tech ODA	ODO Other
1	4.3	51.4	28.6	75.7	7.1
2	4.6	41.7	43.5	43.5	21.2
3	0	58.2	30.9	92.7	7.3
4	3.3	40.0	66.7	67.8	13.3
5	2.4	52.4	45.2	85.7	7.1
Total (365)	3.3	46.8	44.7	69.3	12.9

TABLE 4.16

Instrumental monitoring

(Percentage by Region)

Region	None	BP	ECG	CVP	Other Vascular	Volume of Ventilation	Pressure at Mouth	Other respiratory	Temperature	Not Specified
1	2.8	88.6	57.0	12.9	10.0	12.9	8.6	1.4	1.4	1.4
2	3.7	85.2	64.8	15.7	9.3	25.9	19.4	2.8	3.7	0.0
3	1.8	78.2	41.8	30.9	30.9	23.6	32.7	7.3	9.1	1.8
4	5.5	85.5	52.2	14.4	7.8	14.4	15.5	1.1	1.1	3.3
5	9.5	80.9	66.7	33.3	19.0	33.3	26.2	4.8	7.1	0.0
Total (365)	4.4	84.4	57.0	19.2	13.4	21.1	19.2	3.0	3.8	1.4

TABLE 4.17

Standards of practice

(Percentage by Region)

Region	No Preoperative Examination	No test of Machine	No Pre-oxygenation	No Confirmation of placement of Tracheal Tube	No BP Record made	Record sent to us
1	7.1	14.3	18.6	10.0	10.0	10.0
2	8.3	23.1	37.0	9.2	8.3	13.9
3	12.7	21.8	25.4	3.6	7.2	23.6
4	8.9	17.8	25.5	8.8	20.0	10.0
5	7.1	4.8	26.2	2.4	14.3	19.0
Total (365)	8.8	17.8	27.7	7.7	12.0	14.2

TABLE 4.18

Availability of recovery room

(Percentage by Region)

Region	Incomplete Forms*	No Recovery Room	Yes. Admitted	Yes. Not Admitted
1	11.4	11.4	57.1	20.0
2	10.2	26.9	51.8	11.1
3	10.9	20.0	47.3	20.0
4	13.3	17.8	47.7	22.2
5	9.5	-	69.0	21.4
% (365)		17.5	53.1	18.1

* Patient died in theatre and remainder of form ignored; does not mean that there were no facilities available

TABLE 4.19

Assessors' opinions on contribution of anaesthesia

(Percentage by Region)

Region	Nil	Some	Total
1	41.4	30.0	28.6
2	22.2	64.8	13.0
3	45.4	36.4	18.2
4*	53.9	38.2	7.9
5	26.2	57.1	16.6
Total (364*)	37.6 (137°)	46.4 (169)	15.9 (58)

* 1 case not assessed

Numbers of deaths in brackets

TABLE 4.20

Assessors' opinions: Classification of deficiencies

(Percentage by Region)

Region	Clinical Failure	Oganisational Failure
1	40.0	28.6
2	50.9	41.7
3	29.1	23.6
4*	31.1	44.4
5	50.0	26.2
Total (364)	42.5	35.3

* 1 case not assessed

TABLE 4.21

Assessors' opinions on avoidable deaths

(Percentage by Region)

Region	Avoidable Deaths
1	41.4
2	46.3
3	14.5
4*	22.2
5	47.6
Total (364)	34.3

*. 1 case not assessed

TABLE 4.22

Assessors' opinions: Contribution of anaesthesia to avoidable deaths

(Percentage of Group in Region)

Region	Avoidable (125 Deaths)	
	Group S	Group T
1	57.0	85.0
2	53.4	92.8
3	10.0	50.0
4	38.2	85.7
5	54.2	100.0
Total	45.5 (77 deaths)	82.7 (48 deaths)

TABLE 4.23

Events quoted by the assessors in group S

Inexperience/too junior/wrong anaesthetist for case	16
No recovery room	11
Overdose (drugs)	9
Fluid overload	6
Dehydration	5
No ECG monitor	6
No CVP monitoring	5
No consultant cover	4
No/insufficient blood tranfusion/fluids	4
Preoperative electrolyte imbalance and insufficient corrective treatment	4
No ITU	5
Inadequate warning	4
Bad postoperative management	3
No postoperative IPPV	3
No preoxygenation	2
No blood pressure measurement	2
Inadquate monitoring	2
Accidental hypotension	3
Uncontrolled diabetes	2
Bizarre mixture of drugs/wrong choice	2
No records	2
Pneumothorax	2
Shortage of staff	2
Too 'light' general anaesthesia	2

Inappropriate induced hypotension	2
Inadequate preparation	2
Cardiac arrest during general anaesthesia	2
No colloids when indicated	1
No stomach emptying	1
Spontaneous ventilation in a patient with congestive cardiac failure	1
Epidural followed by general anaesthesia	1
Spinal followed by general anaesthesia	1
Accidental extubation	1
Aspiration of vomit	1
No bronchial toilet	1
Epidural? paravertebral	1
Premature discharge from recovery room	1
Wrong choice of spinal	1
Althesin and ischaemic heart disease	1
Premature extubation after cardiac arrest	1
No postoperative oxygen	1
No diuretics in jaundiced patient	1
Respiratory obstruction treated with narcotics	1
Fatigue	1
Inadequate help	1
Inadequate facilities for general anaethesia	1
Bronchospasm	1
Pulmonary embolus during operation	1
Cardiac arrest on induction	1
No pacemaker	1
Inadequate reversal of narcotics	1
Inappropriate use of naloxone	1
No preoperative visit by consultant	1

TABLE 4.24

Assessors' opinions: Summary of factors in 125 avoidable deaths

	Per Cent
Lack of experience	29.6
Lack of assistance	10.4
Error of judgment	70.4
Error of clinical expertise	36.0
Error of technical expertise	24.0
Lack of equipment	7.2
Equipment failure	4.8

TABLE 5.1

Intercurrent drugs

(Percentage by Region)

Region	Nil	Analgesic	Antibiotic	Anticholinesterase	Anticoagulant	Anticonvulsant	Antidepressant	Antidiabetic	Antidysrhythmic	Antihypertensive	Cardiacglycoside	Diuretic	Monamine oxidase inhibitor	Phenothiazine	Steroid	Bronchodilator	Other
1	32.9	12.9	14.3	0.0	2.9	1.4	2.9	4.3	5.7	2.9	15.7	28.6	0.0	1.4	14.3	2.9	25.7
2	26.8	22.2	10.2	0.0	0.0	0.9	1.8	2.8	2.8	6.3	10.2	21.3	0.0	5.5	6.5	8.3	24.1
3	21.8	14.5	14.5	0.0	0.0	1.8	0.0	3.6	9.1	7.3	21.8	20.0	0.0	5.4	9.1	7.3	36.4
4	26.7	17.8	14.4	0.0	4.4	0.0	0.0	5.5	5.5	2.2	17.8	21.1	0.0	3.3	10.0	6.6	22.2
5	21.4	14.3	21.4	0.0	0.0	0.0	0.0	9.5	9.5	4.8	11.9	30.9	0.0	2.4	16.7	11.9	28.6
Total (365)																	
	26.6	17.3	14.0	0.0	1.6	0.8	1.1	4.6	5.2	4.1	15.1	23.6	0.0	3.8	10.4	8.2	26.3

TABLE 5.2

Premedication

(Percentage by Region)

Region	Nil	Antisialogogue	Anxiolytic sedative/ Analgesic
1	48.6	12.9	41.4
2	42.6	37.0	30.4
3	30.9	38.2	43.5
4	45.5	33.3	30.8
5	40.5	40.5	38.1
Total	42.5	32.0	25.5

TABLE 5.3

Drugs used in premedication

(Percentage by Region)

Region	Nil	Atropine	Diazepam	Droperidol	Hyoscine	Lorazepam	Morphine	Barbiturate	Papaveretum	Pethidine	Phenoperidine	Phenothiazine	Other
1	48.6	10.0	18.6	0.0	2.8	7.1	0.0	0.0	5.7	5.7	0.0	0.0	4.3
2	42.6	32.4	4.6	0.9	4.6	0.9	9.2	0.0	7.4	2.8	0.0	0.0	4.6
3	30.9	20.0	5.4	10.9	18.2	0.0	0.0	0.0	14.5	9.1	0.0	0.0	3.6
4	45.5	30.0	1.1	4.4	3.3	2.2	4.4	0.0	5.5	7.7	0.0	1.1	4.4
5	40.5	33.3	11.9	0.0	7.1	0.0	7.1	0.0	4.8	0.0	0.0	2.4	4.8
Total (365)	42.4	25.7	7.4	3.0	6.3	2.2	4.6	0.0	7.4	4.4	0.0	0.5	4.9

TABLE 5.4

Anaesthetic agents and relaxants

INHALATIONAL AGENTS

(Percentage of total)

Nil	Trichloroethylene	Cyclopropane	Enflurane	Halothane	N_2O	O_2 alone
6.0	3.0	0.3	1.7	40.8	84.4	4.4

MUSCLE RELAXANTS

(Percentage of total)

Nil	Alcuronium	Gallamine	Pancuronium	Saxamethonium	Tubocuranine	Other
9.3	16.2	3.6	43.2	58.1	8.2	0.8

NON DEPOLARIZING RELAXANTS

(Percentage by Region)

Region	Alcuronium	Pancuronium	Tubocurarine
1	25.7	31.4	10.0
2	16.6	32.4	8.3
3	18.2	52.7	10.9
4	8.8	57.8	4.4
5	11.9	47.6	9.5

TABLE 5.5

Intravenous drugs

(Percentage by Region)

Region	Nil	Diazepam	Droperidol	Ketamine	Methohexitone	Propanidid	Althesin	Thiopentone	Fentanyl	Morphine	Pethidine	Phenoperidine	Phenothiazine	Other
1	18.6	4.3	15.7	1.4	4.3	0.0	5.7	31.4	44.1	10.0	2.9	1.4	2.8	18.6
2	9.2	2.8	12.0	0.9	1.8	1.8	12.0	60.2	25.0	10.2	2.8	5.5	1.8	9.2
3	12.7	3.6	9.1	5.4	3.6	0.0	7.3	27.3	32.7	12.7	3.6	1.8	3.6	23.6
4	15.5	3.3	13.3	1.1	4.4	2.2	10.0	27.8	43.3	1.1	4.4	3.3	0.0	4.4
5	11.9	2.4	7.1	2.4	2.4	0.0	4.8	38.0	35.7	11.9	0.0	4.8	0.0	4.8
Total (365)	13.4	3.3	12.5	1.9	3.3	1.1	8.8	39.2	35.6	6.8	2.7	6.0	1.4	9.0

TABLE 5.6

Other drug therapy

(Percentage by Region)

Region	Nil	Analeptic	Antidysrhythmic	Anticoagulant	Diuretic	Electrolyte	Hypotensive	Inotropic	Narcotic antagonist	Oxytocic	Steroid	Vagolytic	Vasopressor	Antibiotic	Other
1	35.7	7.1	1.4	4.3	10.0	12.9	5.7	8.6	10.0	0.0	11.4	11.4	14.3	2.9	4.3
2	50.9	1.8	4.6	3.7	13.0	7.4	0.9	7.4	8.3	0.0	5.5	11.1	12.0	10.2	6.5
3	45.4	0.0	5.4	14.5	3.6	9.1	3.6	21.8	3.6	0.9	9.1	1.8	14.5	12.7	18.2
4	42.2	1.1	3.3	3.3	6.7	18.9	1.1	13.3	6.7	0.0	15.5	9.9	13.3	8.9	6.7
5	50.0	0.0	7.1	7.1	2.4	16.7	4.8	19.0	4.8	0.0	11.9	7.1	14.3	14.3	7.1
Total (365)	44.9	2.2	4.1	5.7	8.2	12.6	2.7	12.6	7.1	0.2	10.1	9.0	1.3	9.3	7.9

TABLE 6.1

Age at death

(Percentage by group)

Group	<10	10 +	20 +	30 +	40 +	50 +	60 +	70 +	80 +	Not Specified
N (138)	4.3	0.0	0.0	0.0	7.2	16.7	24.6	27.5	17.4	0.7
S (169)	1.8	1.2	0.0	0.0	1.2	13.0	21.3	37.9	23.1	0.6
T (58)	5.2	0.0	5.2	5.2	3.4	15.5	25.9	25.9	12.0	1.7

TABLE 6.2

Natural pigmentation of patient

(Percentage by group)

Group Region	Pigmented	Nonpigmented	Not Specified
N (138)	0.7	83.3	15.9
S (169)	0.0	95.3	4.7
T (58)	5.2	89.6	5.2
Total (365)	1.1	89.9	9.0

TABLE 6.3

Operations in group T

Abdominal (26)	
Laparotomy for intestinal obstruction	5
Laparotomy for perforated bowel	3
Laparotomy	2
Laparotomy for appendicectomy	3
Ruptured aortic aneurysm	2
Carcinoma of oesophagus	2
Cholecystectomy	1
Embolectomy	1
Laparoscopy	1
Colostomy	1
Adrenalectomy	1
Hemicolectomy	1
Ureterocolic anastomosis	1
Wound dehiscence	1
Inguinal hernia	1
Thoracic (3)	
for congenital heart disease	2
for fractured ribs	1
Head and Neck (9)	
Laryngoscopy/bronchoscopy	4
Bilateral cataracts	2
Fractured jaw	1
Tracheostomy	1
Dissection glands of neck	1
Orthopaedic (8)	
Fractured femur	4
Amputation of leg	4
Neurosurgery (2)	
Subarachnoid haemorrhage	1
Subdural haematoma	1
Urology (1)	
Prostatectomy	1
Gynaecology (5)	
Prolapse	1
Biopsies	3
Hysterectomy	1
Peripheral (4)	
Renal A-V fistula	1
Biopsy lymph node	1
Axillary abscess	1
Gluteal abscess	1

TABLE 6.4

Pre-existing medical diseases, diagnoses and treatments in group T

Chronic bronchitis and emphysema	12
Ischaemic heart disease	12
Obesity	9
Hypertension	8
Diabetes	6
'On digitalis and diuretics'	6
Anaemia	7
Dysrhythmias	5
Dehydration	4
Congestive cardiac failure	6
Acute on chronic respiratory failure	3
Bronchopneumonia	2
Previous cerebrovascular accident	2
'On steroids'	2
Asthma	1
Mentally defective	1
Gross distension	1
Mitral regurgitation	1
Poliomyelitis	1
Haemorrhage	1
Gout	1
Senility	1
Upper respiratory tract infection	1
Shock	1
Hypoproteinaemia	1

TABLE 6.5

The anaesthetist's assessment of the pre-operative state of the patient

(Percentage by group)

Group	Good	Moderate	Poor	Moribund
N (138)	1.4	26.8	49.3	22.4
S (169)	2.4	23.1	66.9	7.7
T (58)	8.6	24.1	62.1	5.2
Total (365)	3.0	24.7	59.4	12.9

50% elective

TABLE 6.6

Day of death

(Percentage by group)

Group	Same	1	2	3	4	5	6
N (138)	26.1	29.0	17.4	8.0	12.3	4.3	2.9
S (169)	40.2	28.4	11.8	7.1	7.7	3.5	1.2
T (58)	56.2	19.0	8.6	3.4	6.9	3.4	1.7
Total (365)	37.5	27.1	13.4	6.8	9.3	3.8	1.9

TABLE 6.7

Location of patient at death

(Percentage by group)

Group	Theatre	Recovery	ITU	Ward
N (138)	13.8	3.6	35.5	47.1
S (169)	12.4	4.7	26.6	56.2
T (58)	32.8	6.9	6.9	53.4
Total (365)	16.1	4.6	26.8	52.3

TABLE 6.8

Grade of anaesthetist (Percentage by group)

Group	Consultant	Senior Registrar	Registrar	Senior House Officer	Medical Assistant	Clinical Assistant	General Practitioner	Other
N (138)	51.4	10.9	18.8	11.6	3.6	2.9	0.7	0.0
S (169)	48.5	10.7	16.0	13.0	5.3	2.4	2.4	1.8
T (58)	43.3	10.3	19.0	15.5	5.2	3.4	1.7	1.7
Total (365)	48.8	10.7	17.5	12.9	4.7	2.7	1.6	1.1
England and Wales	42.9	8.9	22.3	22.1	3.5	-	-	-

TABLE 6.9

Duration of experience of anaesthetist (Percentage by group)

Group	>10 yrs	<10 yrs	<5 yrs	<2 yrs	<1 yr	<6/12	Not Specified
N (138)	44.2	21.0	18.1	2.9 (13.0)*	6.5	3.6	3.6
S (169)	46.7	18.9	15.4	8.3 (17.7)	5.3	4.1	1.2
T (58)	34.5	31.6	15.8	7.0 (17.5)	7.0	3.5	1.7
Total (365)	43.8	21.6	16.4	6.0 (15.8)	6.0	3.8	2.2

* Cumulative percentages in brackets

TABLE 6.10

Instrumental monitoring

(Percentage by group)

Group	BP	ECG	CVP	Other Vascular	Volume of Ventilation	Pressure at Mouth	Other respiratory	Temperature	Not Specified
N (138)	82.6	56.5	23.9	20.3	24.6	21.7	4.3	5.1	5.1
S (169)	88.2	59.2	18.3	10.6	21.9	20.1	2.4	3.5	4.1
T (58)	77.5	51.7	10.3	5.2	10.3	10.3	1.7	1.7	12.0
Total (365)	84.4	57.0	19.2	13.4	21.1	19.0	3.0	3.8	5.8

TABLE 6.11

Spinal or epidural alone, or in combination

(Percentage by group)

Group	
N (138)	8.0
S (169)	8.2
T (58)	15.2
Total (365)	7.9

TABLE 6.12

Examples of events quoted by assessors in group T

Inhaled vomit	11
Accidental hypotension	10
Errors in the management of spinal or epidural anaesthesia (barbotage by S.H.O. anaesthetist plus intravenous diazepam, no vasoconstrictor, failed spinal followed by excessive halothane, overdose on 3 occasions, obese patient breathing spontaneously in Trendelenberg position, spontaneous ventilation with air following epidural	11
No preoxygenation (in any patient in whom it was desirable, e.g. poor risk, or ischaemic heart disease)	6
Overdose of premedication	6
?Oesophageal intubation	3
Underventilation	3
Malignant hyperpyrexia	3
Recurarisation	2
Induced hypotension	2
Respiratory obstruction in recovery room	2
Overload of fluids	2
General anaesthesia induced before intubation in a case of respiratory obstruction	1
Failure of defibrillator	1
Pneumothorax	1
Displacement of pacemaker	1
Pulmonary embolus (PM)	1
Gas embolus	1
Failure or difficulty in intubation	1
Failure of ventilator	1

TABLE 6.13

Assessors' opinions: Summary of factors in 125 avoidable deaths

(Percentage by group)

Group	Lack of			Failure of Equipment	Error of		
	Experience	Assistance	Equipment		Judgement	Clinical	Technique
S	28.6	9.1	7.8	1.3	78.6	32.5	16.9
T	33.3	12.5	8.3	8.3	79.2	37.5	33.3

Figures

FIGURE 4.1

General and surgical populations

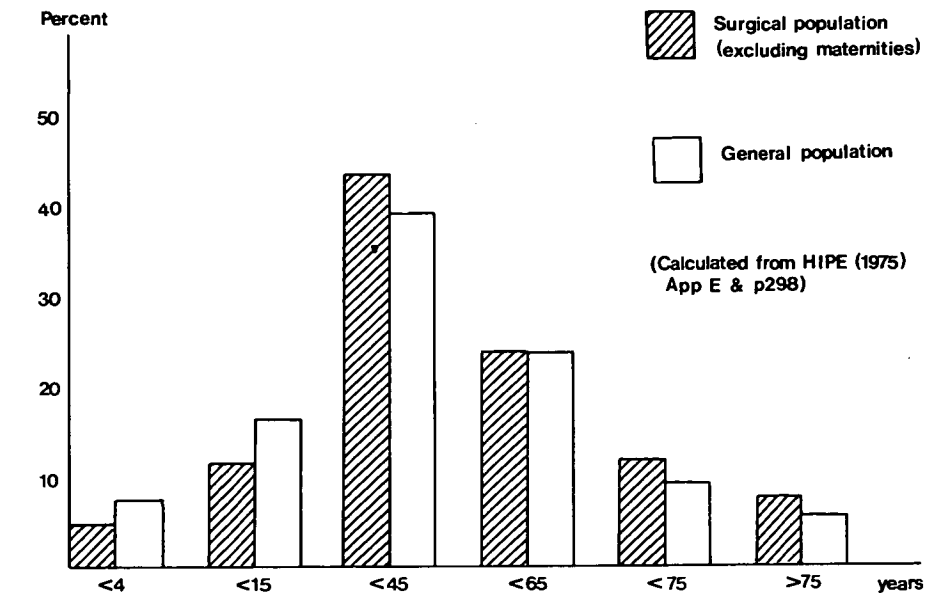


FIGURE 4.2

General and surgical male populations

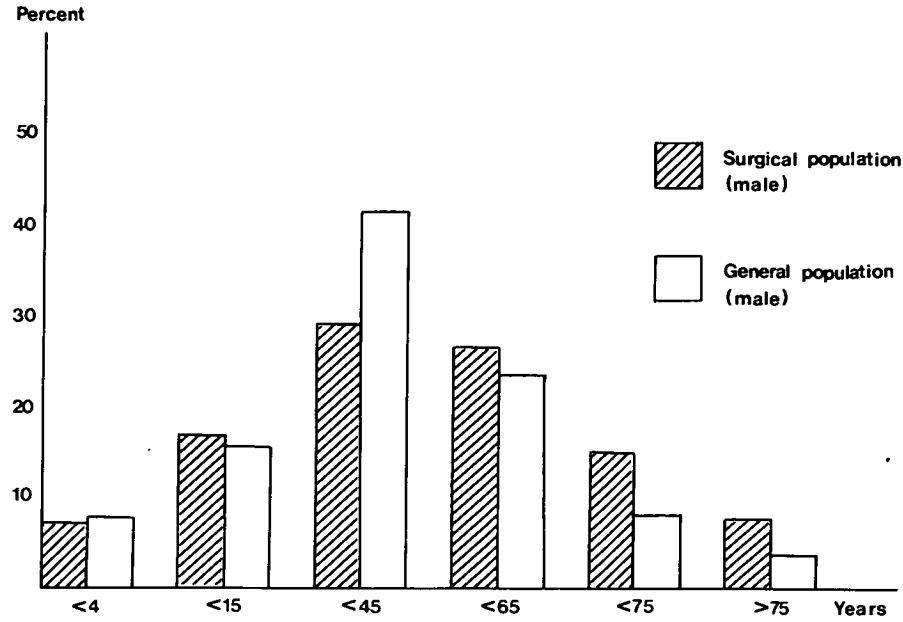


FIGURE 4.3

Cumulative percentage of deaths by age at death

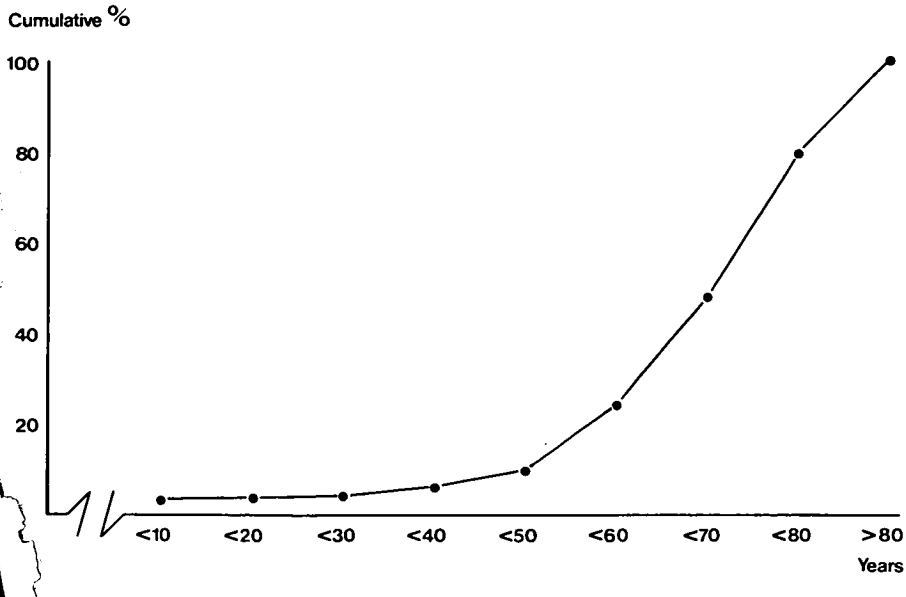


FIGURE 6.1

Age at death

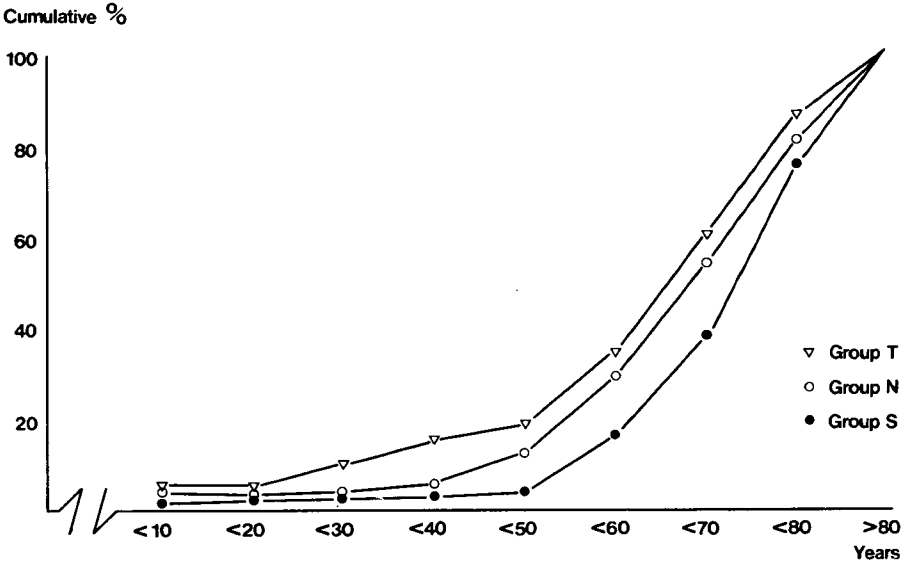
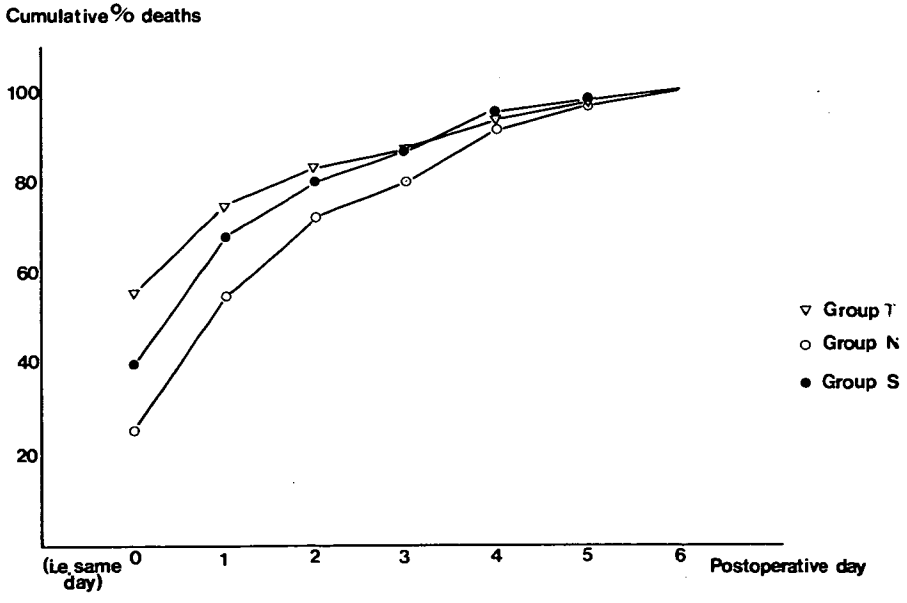


FIGURE 6.2

Day of death



Appendices

Documentation

Initial notification form

LOCAL CORRESPONDENT

Patient's name and address:

Date of death:

Anaesthetist:

Date of first letter sent:

Date of reminder:

Reply received by Regional Assessor:

Surgeon:

Date of first letter sent:

Date of reminder:

Reply received by Regional Assessor:

CODE № 51037

Date main questionnaire sent as requested by Assessor:

Date supplementary enquiry sent:

THIS STUB MUST BE DESTROYED WHEN, BUT NOT BEFORE, THE REGIONAL ASSESSOR ASKS YOU TO.

ANAESTHETIST

ASSOCIATION OF ANAESTHETISTS OF GREAT BRITAIN AND IRELAND

COMMITTEE ON ANAESTHETIC MORTALITY

CONFIDENTIAL

Dear Dr.

The Association of Anaesthetists of Great Britain and Ireland is undertaking a confidential study of mortality related to anaesthesia. It is essential that as many deaths as possible are reported to us and to this end we are asking for minimal data on all patients dying within six days of surgery. Unless either the surgeon or the anaesthetist considers that the anaesthetic may have contributed to the fatal outcome, no further information will be requested.

We would be grateful therefore if you would complete the questionnaire below regarding your patient:

.....

who died on.....

The confidentiality of this study is stressed. No data retained will be identifiable in regard to the patient, the hospital, or the medical attendants. In order to ensure your anonymity, will you please return the lower half of this sheet in the enclosed envelope addressed to the Regional Assessor.

Yours sincerely,

№ 51037

Local Correspondent.

TEAR HERE: the Regional Assessor will not then know your identity.

Details of patient who died within six days of surgery.

Date of operation:

Date of death: № 51037

Did the patient recover: Consciousness YES/NO
Protective reflexes YES/NO

Did any untoward event which could have contributed to fatal outcome occur during the course of anaesthesia or operation YES/NO

In your opinion was the contribution of anaesthesia to this patient's death:

Nil
(Ring one only) Some
Total

SURGEON

ASSOCIATION OF ANAESTHETISTS OF GREAT BRITAIN AND IRELAND

COMMITTEE ON ANAESTHETIC MORTALITY

CONFIDENTIAL

Dear Mr.

The Association of Anaesthetists of Great Britain and Ireland is undertaking a confidential study of mortality related to anaesthesia. It is essential for this study to be of any value that as many cases as possible are reported to us and to this end we are asking for some minimal data on all patients dying within six days of surgery. No further data will be requested unless either the surgeon or the anaesthetist considers that anaesthesia may have contributed to the fatal outcome.

We would be grateful therefore if you would complete the questionnaire below regarding your patient:

.....

who died on.....

The confidentiality of this study is stressed. No data retained will be identifiable in regard to the patient, the hospital or the medical attendants. In order to ensure your anonymity, will you please return the lower half of this sheet in the enclosed envelope addressed to the Regional Assessor.

Yours sincerely,

№ 51037

Local Correspondent.

TEAR HERE: the Regional Assessor will not then know your identity.

Details of patient who died within six days of surgery.

Date of operation:

Date of death: № 51037

Nature of operation:

In your opinion was the contribution of anaesthesia to this patient's death:

Nil
(Ring one only) Some
Total

If your answer to the above was 'some' or 'total' would you be willing to provide further information anonymously: YES/NO.

Association of Anaesthetists
Committee on Anaesthetic Mortality

Study on Anaesthetic Mortality

CONFIDENTIAL AND ANONYMOUS STUDY.

CODE NUMBER:

Notes

Many of the questions are of the yes/no type or there is a list from which a choice may be made. Please give you answer by circling the appropriate word(s), e.g. (Yes)/ No.

Please feel free to expand your answers in any way you believe might be helpful.

If you are a trainee you are advised to seek the help in filling up this form of the Consultant to whom you were responsible in your conduct of this case.

PLEASE RETURN, in the pre-paid envelope provided, to:—

PART A—THE PATIENT

1. Date of admission ..... day month year

2. Date of operation ..... day month year

3. Age.....years

4. Male/Female

5. Weight.....kg (1 stone=6·35 kg)

6. Ethnic group .....

7. What was the pre-operative surgical diagnosis? .....
.....

8. What was the proposed operation or procedure? .....

9. Was the operation elective? Yes / No
Was the operation emergency? Yes / No

10. Did the operation take place? Yes / No

11. If so where? (i.e., operating theatre, casualty department, x-ray, labour ward, etc.) .....

12. Was the operation on a day case? Yes / No

PART B—THE ANAESTHETIST

1. Age.....years
2. Male/Female
3. NHS grade .....
4. Years in specialty .....
5. Qualifications (state when and where obtained) .....
   .....
6. Who was present at the time to help you? (Specify by circling)
   Another anaesthetist, another doctor,

SRN	Technician	ODO
SEN	ODA	Other

7. If you are a trainee what cover was immediately available? .....
   .....
8. How long was it since you had a proper (sit-down) meal?
   .....hours
9. How many hours of sleep had you had in the previous 24 hours?
   .....
10. What warning did you have of this case? .....
11. What opportunity did you have to examine this patient? .....
    .....
12. If none, please state circumstances .....
    .....

PART C—PREOPERATIVE CONDITION OF PATIENT

1. List previous anaesthetics and operations giving approximate dates:
   .....
   .....
   .....
   .....
2. Was there any abnormal response to a previous anaesthetic or operation? Yes / No
   If yes, specify .....
3. What preoperative examination of the patient was performed relevant to:
   (*a*) surgery? .....
   .....
   (*b*) anaesthesia? .....
   .....
4. By whom? (Specify specialty and grade only: no names please):
   House Officer/another anaesthetist/surgeon/physician/self/other.
5. How long before the induction of anaesthesia? .....hours
6. What were the findings relevant to the conduct of anaesthesia?
   .....
   .....
   .....

7. Was the patient in good health apart from the surgical condition? Yes / No

8. What diagnoses of intercurrent medical disease were made?

.....

.....

9. What were the patient's smoking habits? (Specify consumption)

.....

10. What was his/her alcohol intake? (Specify consumption) .....

.....

11. Was there a history of allergy? (specify) .....

12. If haematological, radiological, biochemical or other special investigations were performed please enter relevant results below.

.....

.....

.....

.....

.....

.....

13. What drug or other therapy was the patient receiving (or had received) prior to surgery? (e.g. steroids, antihypertensives, etc.).

.....

14. What steps were taken to prepare the patient for anaesthesia? (e.g. transfusion, gastric emptying, antacids, chest physiotherapy,

etc.) .....

.....

15. How long before induction did the patient take by mouth

(*a*) liquids?.....hrs (*b*) solids?.....hrs

16. Was crossmatched blood available at the commencement of anaesthesia? Yes / No

17. Was the patient considered by you to be a
Good/moderate/poor anaesthetic risk, or moribund?

PART D — ANAESTHESIA

If you are prepared to send a copy of the anaesthetic record it will be welcomed but **please remove any evidence of identity of patient, anaesthetist and surgeon before sending it.**

1. Date of anaesthesia: ..... day month year

2. Time of induction: .....: 24 hr clock

3. Type of anaesthesia employed (e.g. general/basal/neuroleptic/local/regional/combination; please specify.

4. Was drug premedication given? Yes / No

5. If so what, when and by what route? .....

6. Was an intravenous infusion established before induction? Yes / No

   (specify fluid) .....

7. If not was an indwelling cannula or needle in place before induction? Yes / No

8. If not was either established after induction? .....

9. Were the working conditions satisfactory? (e.g. temperature, humidity, lighting; please specify) .....

10. Had the theatre effective air-conditioning at the time of the case? Yes / No

11. Name all drugs used except local anaesthetic (see Part E). Please state initial and subsequent doses:

    Inhalational .....

    .....

    Neuroleptic .....

    Analgesic .....

    Muscle relaxant(s) .....

    .....

    Anticholinesterase .....

    Narcotic antagonist .....

    Drugs for ancillary techniques (e.g. induced hypotension, etc.)

    .....

    .....

    Drugs for support of the patient (e.g. inotropic agents, vasodilators, diuretics, etc.) .....

    .....

    Other drugs (e.g. antibiotics, heparin, protamine, oxytocin, etc.)

    .....

    .....

12. Was preoxygenation performed? Yes / No

13. Duration of anaesthesia (Note: if cardiac arrest occurred during anaesthesia give duration before arrest). .....hrs .....mins

14. Posture and position of patient (if table was tilted, please give approximate angle of tilt, and for how long maintained) .....

.....

15. Was the patient intubated? Yes / No
If yes, please state:

(*a*) Were the lungs inflated before intubation? Yes / No

(*b*) Type of tube (i.e. Magill, Oxford, armoured, plastic, etc.)

.....

(*c*) Size .....

(*d*) Cuffed or plain .....

(*e*) Nasal or oral .....

(*f*) Difficulties experienced, if any (specify) .....

.....

(*g*) Was the placement of the tube in the trachea confirmed? Yes / No
If yes how? .....

(*h*) Was it necessary to change the tube for any reason? Yes / No
If yes, give reason .....

16. Whether intubated or not, was the patient's airway always satisfactory? Yes / No
If not, please add some details .....

.....

17. Did vomiting or regurgitation occur during induction? Yes / No

18. Did vomiting or regurgitation occur later? Yes / No

19. Were stomach contents obviously inhaled? Yes / No

20. Was there later evidence of aspiration? Yes / No

If yes, please add some details .....

.....

21. Were any other measures (than those mentioned in question number C14) taken to diminish the risk of aspiration, and if so, what were they? (e.g. cricoid pressure, head-up tilt, etc.) .....

.....

22. Please state:

(*a*) Type of anaesthetic apparatus .....

.....

(*b*) Gas supply (cylinder, pipeline) .....

(*c*) Was machine in working order? Yes / No.

(*d*) What tests were made on the apparatus? .....

.....

(*e*) What was not working properly? .....

.....

(*f*) What was the average flow rate of each gas used? (including oxygen, carbon dioxide, nitrous oxide, cyclopropane, etc.; specify) .....

.....

(*g*) What anaesthetic breathing system was used? (e.g. Magill, Bain, CO_2 absorption, T-piece, open mask, non-return, etc.; specify) .....

.....

(*h*) If a vaporiser(s) was used:

(i) What was its (their) position(s)? (i.e. inside or outside circle) .....

(ii) What agent(s) was (were) employed? .....

(iii) For how long? .....

(iv) What type of vaporiser? .....

(v) What were the vaporiser settings? .....

(vi) When was the vaporiser last serviced? .....

(*i*) If a CO_2 absorption system was used, was the soda lime inspected or changed during anaesthesia? Yes / No

(*j*) Did the patient breathe spontaneously or was ventilation controlled during anaesthesia? (If known state rate/tidal or minute volume) .....

23. If muscle relaxants were used, please state:

(*a*) Was ventilation controlled? Yes / No

(*b*) Was controlled ventilation manual or by machine? (or assisted) .....

(*c*) Which ventilator was used? .....

(*d*) Did you check it before use? Yes / No

(*e*) Was lung inflation always easy? Yes / No

(*f*) Did the ventilator function satisfactorily throughout? Yes / No

(*g*) To what extent did recovery from paralysis occur?

.....

(*h*) What were the criteria of assessment of this recovery?

.....

24. What apparatus was used for monitoring? B.P. (specify method), pulse monitor, ventilation meter, inflation pressures, C.V.P., temperature, others (specify) .....

25. Was the assistant(s) mentioned in B6 above available throughout the operation? Give details .....

.....

26. In the event of technical failure of apparatus (other than already mentioned) when was that apparatus last checked and by whom?

.....

27. Was any necessary piece of equipment defective or unavailable? Please specify .....

28. Were there any untoward reactions to drugs or intravenous fluids (anaphylaxis, sensitivity, etc.) .....

.....

PART E—REGIONAL/LOCAL ANAESTHESIA

(Please complete relevant parts of D as well)

1. What technique of local anaesthesia was used? (e.g. infiltration, topical, intravenous, regional, subarachnoid spinal, epidural (state route), plexus or nerve) .....

2. *In all cases* please state:
   (*a*) Drug(s) used including concentrations and baricity (hypo, hyper or isobaric) .....
   (*b*) Volume of injection .....
   (*c*) Total dose of local anaesthetic drug(s) .....
   (*d*) Whether a vasoconstrictor was used. Yes / No
   If yes, what was it? .....
   What was the concentration in the injected solution?
   .....
   (*e*) Whether an aspiration test was performed? Yes / No
   (*f*) Whether additional sedative/anaesthetic drugs were given. Yes / No
   If yes, for what reason? .....
   (*g*) The site of the injection .....
   (*h*) The area or segments blocked .....
   (*i*) The position of patient during and following injection
   .....
   (*j*) Pressor agents used if any, doses and route(s) of administration .....

3. If *epidural* anaesthesia was used please state:
   (*a*) How the epidural space was identified .....
   (*b*) The test dose used (state dose) .....
   (*c*) Whether an epidural catheter was used. Yes / No
   (*d*) Whether a filter was used. Yes / No
   (*e*) When and what volume of supplementary doses of local anaesthetic were required during the operation? .....
   .....

4. If *subarachnoid spinal* was used was the injection slow, quick or with barbotage? .....

5. Was there a pharmacological or technical complication? (e.g. convulsions, unusually high block accidental spinal) difficulty in identification of epidural space, pneumothorax) .....

PART F—THE OPERATION

1. What operation was performed? .....

2. N.H.S. grade of surgeon .....

3. Did the findings at operation confirm the preoperative diagnosis? Yes / No

4. What pathological conditions were found at operation? .....
.....

5. In your view did the operation or the surgical condition contribute to the patient's death? Yes / No

6. Were blood pressure and pulse rate recordings made during anaesthesia and surgery? Yes / No
If yes, please give some details (this is where your anaesthetic record would be particularly useful) .....
.....
.....
.....
.....
.....

7. Did the patient's condition give rise to concern during the operation? (e.g. cyanosis, pallor, tachycardia, hypotension, sweating, etc.; please specify) .....

8. Did the operation (posture, lighting, towels) interfere with the observation or management of the patient? Yes / No
If yes, please explain .....

9. What blood loss took place:
(*a*) Preoperatively?

(*b*) During the operation?

10. What volume of blood or other IV fluid (specify) was given during the operation? .....

11. If blood was transfused were blood filters used? Yes / No

12. Was the blood warmed before transfusion? Yes / No

13. Was calcium chloride or sodium bicarbonate also used? Yes / No
If yes, please specify .....

14. Was there any abnormal reaction to blood or volume expansion? Yes / No
If yes, please specify .....

15. Did any deterioration in the patient's condition take place? Yes / No

16. When did this occur? .....

17. Was this deterioration sudden? Yes / No

18. Was this deterioration gradual? Yes / No

19. Was cardiac massage then performed? Yes / No
If yes:
(*a*) By whom? (no names please—grade, etc., only .....
.....
(*b*) By the external or internal method? .....

(c) If internal, by the thoracic or abdominal route? .....

.....

(d) Was an effective artificial circulation produced? Yes / No (i.e. palpable carotid pulse, systolic pressure of at least 80 mmHg).

(e) Was simultaneous artificial respiration carried out, and if so, by what method? .....

(f) Was an apparatus capable of inflating the patient's lungs immediately at hand when the emergency arose? Yes / No

(g) If so, what was this apparatus? .....

(h) Was it used? Yes / No

(i) Did it work satisfactorily? Yes / No

20. When the circulation apparently ceased, was the heart in asystole or ventricular fibrillation, or was it not possible to tell? .....

.....

21. Did the heart subsequently fibrillate? Yes / No

22. Was a defibrillator available? Yes / No

23. Was it used? Yes / No

24. Did it work? Yes / No

25. What drugs were used? (calcium chloride, adrenaline, isoprenaline, bicarbonate, etc.) .....

26. For how long were attempts at resuscitation continued? .....

.....

PART G — IMMEDIATE POST-ANAESTHETIC PERIOD

1. Was there a recovery area? Yes / No
   State approximate distance from operating room ... .

2. Was the patient admitted to it? Yes / No
   If yes, when? .....

3. Was the patient conscious on admission? Yes / No

4. Were protective reflexes present on admission? Yes / No

5. Did the patient die in the recovery area? Yes / No

6. Give an account of the train of events which culminated in death.
   .....
   .....
   .....
   .....
   .....

7. Was the area fully equipped for resuscitation? Yes / No
   If not, specify deficiencies .....

8. Outline the treatment given .....
   .....
   .....
   .....

9. What grade of staff carried out the moment-to-moment care of the patient? (e.g. SRN, SEN, other?) .....

10. Were medical staff immediately available? Yes / No
State grade and specialty only .....

11. Were there any immediate complications? (Please specify in detail.)
.....
.....
.....
.....
.....

12. At what time was the patient discharged from recovery area?
.....hrs.

13. Describe the patient's condition on discharge .....
.....
.....

14. Who gave permission for the patient's discharge? (specify grade and specialty only) .....

PART H—FURTHER PROGRESS

To be filled out if patient died subsequently in the ward or intensive therapy unit.

Please give an account of the postoperative progress including details of complications (which and when), the mode of death and relevant autopsy findings if available. A copy of the post-mortem report with all identification removed) would be particularly valuable.

.....
.....
.....
.....
.....
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PART J — ANAESTHETIST'S OPINION

Would you please summarise the factors which in your opinion led to the death of this patient?

.....

.....

.....

.....

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.....

.....

.....

.....

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.....

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.....

.....

APPENDIX C

Assessors' form

Assessor's Code Number

For completion by the Regional Assessor or Central Arbitrator

1. In your opinion was the contribution of anaesthesia to this patient's death
   nil?
   some?
   total?

2. In your opinion was there any failure in the clinical management of this anaesthetic? Give details.

3. In your opinion were there any deficiencies in the administrative and organisational arrangements in relation to this case (e.g. staffing, equipment etc.)

SUMMARY

In your opinion was the cause of death in relation to anaesthesia in this patient:

1. unavoidable, on account of the patient's general (including age) or surgical condition

2. avoidable, because of:
   lack of experience
   lack of assistance
   lack of suitable equipment
   failure of equipment
   error of judgement
   error of technical or clinical expertise

Committee membership

Main Committee

Professor W. W. Mushin (*Chairman*)
Dr. D. B. Scott (*Secretary*)
Professor J. S. Robinson
Dr. J. F. Nunn (Dean of the Faculty of Anaesthetists)
Professor H. Ellis (Representing the Royal College of Surgeons)
Professor A. Cochrane (Representing the Faculty of Community Medicine)
Dr. M. Cloake (Representing the DHSS)
Dr. A. Fenton Lewis (Representing the DHSS)
Dr. J. Weatherall (Representing the Office of Population and Census Studies)
Mr. S. C. Stacey (Representing the Office of Population and Census Studies)
The President, Secretary and Treasurer of the Association of Anaesthetists (*ex officio*)
Dr. J. N. Lunn (Chairman of the Regional Assessors)

Regional Assessors

Dr. P. J. Tomlin (West Midlands)
Professor A. R. Hunter (North Western)
Professor J. A. Thornton and Dr. T. E. Healy (Trent)
Dr. J. N. Lunn (Wales)
Dr. D. B. Scott is responsible for the additionally funded and parallel study in Scotland.

Local Correspondents

The following doctors by Region acted as Local Correspondents. Their duties are explained on page 91, but it is important here to reiterate that without the services of each and every one mentioned this study would not have achieved the limited success that it has achieved. It is a pleasure for the authors to acknowledge the enormous amount of extra painstaking work which these individuals have undertaken for this study on behalf of the Association of Anaesthetists.

NORTH WESTERN
L. T. Scott (Lancaster)
S. M. Brownlie (Blackpool)
R. V. A. Consiglio (Preston)
D. B. Murray (Blackburn)
A. A. Khawaja (Burnley)

J. Crook (Wigan)
G. Phillips (Manchester)
G. Rees-Jones (Manchester)
I. M. Gow (Manchester)
J. Dowdall (Stockport)
J. Glass (Bolton)
H. Padmanabhan (Rochdale)
V. Brim (Ashton under Lyne)
F. N. Campbell (Oldham)
P. Morris (Salford)
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B. H. Doran (Manchester)
L. E. Mosscrop (Ormskirk)
A. J. Sims (Bury)

WEST MIDLANDS

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A. Singh (Rugby)
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J. F. Murray (Kidderminster)

TRENT

C. J. Levy (Sheffield)
D. E. Lee (Barnsley)
D. E. Harley (Chesterfield)
J. R. Bowers (Lincoln)
W. J. Colbeck (Doncaster)
M. J. Egginton (Nottingham)
B. A. Waldron (Nottingham)
K. M. Harrison (Sheffield)
N. A. Vincent (Rotherham)
G. J. Taylor (Derby)
W. R. Lamb (Boston, Lincs)
R. Vindlacheruvu (Sutton-in-Ashfield)
A. D. Jardine (Nottingham)
J. Wandless (Leicester)

WALES

P. M. Frost (St. Asaph)
D. L. Langley (Haverfordwest)
D. S. Jones (Swansea)
D. I. Fry (Abergavenny)
G. O. Davies (Merthyr Tydfil)
D. Wakeley (Cardiff)
J. Davies (Swansea)
T. J. B. Harris (Bangor)
I. P. Latto (Cardiff)
G. Arthurs (Wrexham)
G. W. Morris (Carmarthen)
R. Mucklow (Aberystwyth)
S. M. Laird (Newport)
T. Collis (Bridgend)
J. M. Lewis (Swansea)
P. W. Thompson (Cardiff)
R. S. Vaughan (Cardiff)
W. H. Morton (Cardiff)

SCOTLAND

J. McCulloch (Paisley)
J. Murray (Falkirk)
J. D. Muir (Inverness)
G. McNab (Kilmarnock)
H. W. Wishart (Glasgow)
O. Watt (Airdrie)
J. I. M. Lawson (Dundee)
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E. Pitt (Fife)
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D. A. N. Barran (Alexandria)
O. P. Maini (Greenock)
R. C. Taylor (Glasgow)
D. H. M. Robertson (Stirling)
R. Davidson-Lamb (Aberdeen)
R. Parikh (Glasgow)
J. McK. Mason (Dumfries)
T. Fraser (Carluke)
J. G. Millers (Perth)
J. R. Kyles (Kirkcaldy)
H. Turner (Midlothian)
J. Easton (Glasgow)
D. Brown (Glasgow)
J. W. Colins (Glasgow)