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THE VALUE OF THE AUTOPSY IN CLINICAL MEDICINE

A Dissertation Presented in

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by

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ABBREVIATIONS

AF	Asian Female
AM	Asian Male
BF	Black Female
BM	Black Male
Bx	Biopsy Histology
CF	Coloured Female
CM	Coloured Male
CNS	Central Nervous System
CVS	Cardiovascular System
CT	Computerized Axial Tomography
GIT	Gastrointestinal System
GSH	Groote Schuur Hospital
GUT	Genito-urinary System
ICU	Intensive Care Unit
NMRI	Nuclear Magnetic Resonance Imaging
O&G	Obstetrics and Gynaecology
SNOMED	Systematized Nomenclature Of Medicine
Std X-Ray	Standard Radiology
Sx	Surgery
WF	White Female
WM	White Male
US	Ultrasound scanning

INTRODUCTION

"A goodly number of classic time honored mistakes in diagnosis are familiar to all experienced physicians because we make them time and again. Some of these we can avoid; others are almost inevitable, but all should be borne in mind..." *R.C. Cabot*.

"Physicians who either performed many autopsies themselves or who regularly witnessed postmortem examinations, learnt at least to have their doubts. Those, however, who are not themselves dealing with the very often depressing findings of autopsy material are floating in the clouds of an uncontrolled optimism." *G.B.Morgagni*.

Autopsy (which means, literally, "seeing with ones own eyes") is one of the oldest methods of medical investigation. From the earliest human dissections practiced in Alexandria in about 400 BC to the fundamental work of Morgagni and his disciples in the eighteenth century, autopsy has contributed first to the evolution of anatomical knowledge and then to the understanding of the organic nature of diseases (52, 53).

Throughout the nineteenth century and the first half of this century autopsy demonstrations were a crucial part of medical undergraduate education in major medical centers in Europe. Organ demonstrations were a central part of life in medical schools. They provided pathophysiologic understanding of disease and enhanced medical education, with good attendance from both students and clinicians. However, the attitudes of many clinicians towards the autopsy have changed in the latter half of this century, associated with a marked fall in the rate of autopsies. The reasons for this trend are many and varied, with no simple answer.

The fallibility of doctors has long been appreciated. However, with increasingly sophisticated diagnostic aids, the degree of confidence in the accuracy of clinical diagnoses is increasing. Indeed, a widely held belief is that the value of the autopsy, which has traditionally been the "gold standard" in making a definitive diagnosis, is decreasing, and in clear cut cases may be of no value at all. This view is even more strongly held when there is histological confirmation of the clinical diagnosis. This view, however, presupposes that such "proof" is unchallengeable and that there is no point in obtaining any further information regarding the extent of the lesion, its spread, the presence of other lesions which may or may not be contributory to the patient's demise, or evidence of iatrogenic disease (46). Many studies have documented discrepancies between major clinical and autopsy diagnoses, with diagnostic errors occurring in between 10 and 39% of cases (24, 39). Although modern diagnostic aids are commonly thought to have reduced diagnostic errors and, therefore, the need for postmortem examination, a review of more than 50 000 autopsies found that the accuracy of clinical diagnoses of 11 specific diseases did not improve from 1930 to 1977 (8). Some of these discrepancies have been shown despite high levels of clinical confidence; 15% of such diagnoses in one study would have had an impact on patient management (47). This is even more significant in the elderly where multiple pathologies, atypical presentation of disease and frailty increase the number of diagnostic errors even more; only 47% of clinical major diagnoses were confirmed at autopsy in patients over 75 years of age (54).

Increased clinical commitments limit time available to doctors involved with the autopsied patient to attend the postmortem. This is even more so the case with senior clinicians, and the role model they provide to junior staff is one which places an ever decreasing emphasis on the role of the autopsy in clinical medicine. This removes a compulsion on junior staff, who are usually given the

task of securing consent for an autopsy, to arrange a post mortem on most cases. It has been suggested that any attempt to reverse the decline in autopsy rates should focus on changing the clinician's perception of the value of the modern autopsy (22).

Refusal of permission by relatives for an autopsy is another factor which plays an important role in the decreasing autopsy trend. In a major Melbourne teaching hospital permission was sought for an autopsy in 84% of cases, but obtained in only 22% (43). The hospital in that particular study often sought permission for the autopsy over the telephone, and this is probably not the most appropriate and satisfactory method for such a sensitive issue. In a multi-ethnic society the reasons for refusal for an autopsy are complex, and an awareness by the clinician of different perceptions of the value of the autopsy, and differing views about the fate of the soul after death in different cultures is of vital importance when requesting permission for a post mortem examination (35). In addition, many relatives in a multi ethnic society may not be fully conversant in English, and misconceptions may arise when they are not addressed in their mother tongue. It appears then, that procedures for requesting autopsy consent have to be reviewed.

Hospital autopsy rates have been decreasing world wide. A survey of 122 Departments of Pathology in the USA reveals current autopsy rates of 20-39% in over 50% of faculties, and a rate of less than 20% in 20% of faculties (18). Overall, the Heads of Department responding to this questionnaire favoured a doubling of their autopsy rate (to 64%). These current autopsy rates represent a significant decline in autopsy rates when compared with figures from only 20 to 30 years ago. A study of autopsies in 1960, 1970 and 1980 at the Peter Bent Brigham hospital in Boston revealed a decline in autopsy rate, being 75%, 71% and 38% in those respective eras (2). Autopsy rates in USA hospitals have

fallen from about 50% in the 1940s to 41% in 1964, 35% in 1972, 22% in 1975, and an estimated 10-15% in 1985 (5). This is part of a world wide trend (4, 5, 8, 14, 39).

In many countries laws have been revised in recent years, introducing more restrictive rules, with consent required of next of kin (Table 1). In some countries, introduction of legislation that shifted the power of decision from medical to lay persons resulted in a decline in the autopsy rate (55).

In the Eastern European countries of Poland and Hungary, autopsy is mandated by law on all patients dying in a hospital. Czechoslovakia and Rumania require consent from relatives, but in this region autopsy is regarded as desirable and routine and consequently the autopsy rate is high.

In contrast, Israel has restrictive rules because of orthodox religious objections. Written consent is required, and, in addition to near relatives, the form must be signed by the head of the department, and the chief medical officer of the hospital. If the relatives are not available, the autopsy may not be performed. Refusals are common. As a result, the autopsy rate is low. Similarly, all Muslim countries have virtually nonexistent autopsy rates because of religious reasons.

TABLE 1

LAWS & AUTOPSY RATES IN DIFFERENT COUNTRIES

COUNTRY	CONSENT	AUTOPSY RATE, %	
		HOSPITAL	FORENSIC
Australia (43)	Required	19	?
Austria (55)	No	34-100	100
Brazil (55)	Required	Low-80	?
Czechoslovakia (55)	Yes	High	100
Denmark (55)	May object	39	3
Finland (55)	Required	38	15
France (55)	May object	5-50	Variable
Greece(55)	Hospital autopsies not performed		100
Hungary (55)	No	90	50
Iceland (55)	May object	34	11
India (55)	Required	<1	?
Israel (55)	Required	<10	?
Italy (55)	No	15-20	?
Japan (55)	Required	4	?
Norway (55)	May object	22	7
Poland (55)	No	100	60
Rumania (55)	Yes	High	100
South Africa	No	7-21	100
Sweden (55)	Required	33	14
UK (51,55)	Required	20	30
USA (18,50,55)	Required	Variable. Low.	Variable

In Cape Town, with its significant Muslim population, special efforts are made to accommodate religious demands. These include performing limited autopsies, sometimes at short notice, before sunset on the day of death.

Greece, too, is a special case. No hospital autopsies are performed. Here autopsies are limited to forensic cases.

In the United States of America, consent is required on all non-forensic cases. Other legal factors influencing the autopsy rate there are fear of litigation and the abolition in 1973 of a minimum autopsy rate for accreditation of a hospital.

Section 28 of the "Human Tissue Act 1982" in Australia demands that permission for an autopsy be sought from the deceased's closest next of kin (43). This is often sought over the telephone. Before this act, autopsies could be performed on all patients who died in a public hospital unless an objection was raised by the relatives within six hours of the death. In other words, no consent had to be obtained from the next of kin.

The "Human Tissue Act" was introduced to South Africa in 1983. This greatly facilitated organ donation. However, as in the United States, the autopsy provisions of the act are not enforced on the relatives and at Groote Schuur Hospital consent of near relatives is usually requested if an autopsy is desired. The consent of relatives is not required in forensic cases in South Africa, and autopsies are performed on every unnatural death in this country.

In France, Denmark, Norway and Iceland no consent is required, but relatives may object. Clearly, it is vital to educate and inform the public about the benefits of the autopsy if the decision whether or not to perform an autopsy is to remain their responsibility. Knowledge and understanding are probably the

most powerful factors in overcoming public repugnance to the autopsy, and the responsibility for this falls back on the medical profession.

Additional factors that have contributed to the decline of the autopsy rate are fear of malpractice litigation arising from autopsy findings, the lack of financial incentives to perform autopsies, financing the costs of an autopsy and the general trend of research away from pathologic anatomy.

However the autopsy is of great value to the medical fraternity and to the community at large (11, 18, 55). It is interesting to note that in a list of 13 uses of the autopsy offered by Bowman (56) and a similar list by Anderson et al. (57), less than one third of the items are direct applications to medical uses; the rest are either societal or forensic benefits.

Perhaps the most important role of the autopsy in clinical medicine is in the quality assurance program for clinical diagnosis and treatment. It plays a crucial part in medical education at both undergraduate and postgraduate levels, and provides feedback about the accuracy and significance of the results of antemortem procedures, investigations and diagnoses (16, 51). It provides the ultimate clinical audit, and reveals missed major pathology in a significant number of cases (2, 5, 8, 9, 10, 12, 13, 14, 15, 17, 24, 27, 49, 50).

Autopsies are also useful for research (11, 51). Observations made at autopsy may prompt clinical research into a particular disease, for example research into atherosclerosis. Biochemical research may also be carried out, using tissue obtained at autopsy. Examination of autopsy- derived material provides insight into occult malignancy. Much research has been performed with regard to the risk factors for neoplastic diseases. Elucidation of the biologic, demographic and

historical determinants of the body to keep a malignancy at bay for years is a challenge for the future of the autopsy in cancer epidemiology (53).

Despite the autopsy's gruesome image in the public eye, it can, ironically, be a source of relief for the family when trying to cope with death. The lessons learnt from the autopsy may well benefit society at large, and some families are comforted by the altruistic feelings generated by their granting an autopsy on their next of kin.

"To lose one's offspring is hard, harder to lose a son, and hardest (to lose him) by a disease not yet fully understood by doctors. But for the sake of the other children, I think that to have seen his organs will be of the greatest utility."

These words of the father of the dead boy appear in an autopsy report submitted 500 years ago to a high official of Florence, by the fifteenth century physician Bernard Tornius (58).

Perhaps clinicians and pathologists could further the worth of such sentiments by reinforcing the value of the information gained from the autopsy to the relatives. Surprisingly little attention is given to informing the relatives of the outcome of an autopsy. The autopsy may also assuage the guilt associated with many deaths by providing clear-cut reasons for the deceased's death that could not have been prevented in any way by the bereaved.

The autopsy may also contribute to the practical issues of insurance, workmens' compensation and related benefits. Applications for compensation for work related deaths are much more likely to be successful if they are accompanied by autopsy-based proof of the pathology. Similarly, specific exclusion clauses in life assurance policies, or clauses for increased pay out due to accidental death, may be influenced by autopsy findings. Also, accurate data, such as may be gained from an autopsy, relating to the cause of death may influence the granting of life assurance policies to relatives.

Health issues have always had an influence on public policy. The Human Immunodeficiency Virus has had a profound effect on both health and general public policy, with, for example, increased awareness of safe sex practices and the distribution of condoms, the distribution of clean needles to drug addicts and the like. Similarly, tuberculosis is another disease with tremendous implications for both the medical fraternity and the country as a whole. Health statistics are essential for the monitoring of disease patterns in the population and the planning of appropriate action. One of the principal sources of these statistics is the data obtained from death certificates. These data are then used by the authorities to make policy decisions. However much of this data is inaccurate and therefore misleading. Cameron and McGoogan concluded, after their prospective study of 1152 hospital autopsies, that "statistics from death certificates are so inaccurate that they are unsuitable for use in research or planning" (47). There was major disagreement in diagnosis in 14,5% of cases, and a correct clinical diagnosis but inaccuracies in the death certificate in 4% of cases in one study involving five major Australian teaching hospitals (43). Comparable sentiments are expressed by authors of similar studies (39, 42, 50, 53). The inaccuracies present in death certificates, in conjunction with the greater sensitivity of autopsy information, indicate that the autopsy can, and should, be part of the data base of mortality statistics. Increasing the rate of autopsies, and using the autopsy diagnoses to complete the death certificate, would enormously increase the reliability of health statistics and improve the uses to which they are put. Unfortunately, individual death certificates, with few exceptions, do not contain autopsy information. In addition, death certificates are frequently not corrected once autopsy data becomes available. Clearly this problem needs to be addressed.

Autopsies are vital as a source of tissue for transplantation. Skin, bone, cartilage, dura mater, fascia, cornea and pituitary are tissues that can be removed routinely at autopsy. Other organs need specialized surgical removal. Many such tissues are removed at autopsy, but emotional issues on the behalf of relatives often hinder the optimal utilization of this facility.

The autopsy can also be of use in detecting "sentinel" lesions that may alert epidemiologists to possible hazards e.g. asbestos and mesothelioma, vinyl chloride and angiosarcoma of the liver, ionizing radiation and leukaemia, thalidomide and the associated congenital abnormalities, diethylstilbestrol and carcinoma of the uterus and cervix, cigarette smoking and lung cancer, the elucidation of Legionnaire's disease, and a host of other examples. This has allowed the institution of appropriate preventative and therapeutic measures.

Thus it is clear, from many studies, that the yield from autopsies remains high and that the autopsy continues to play an important role in clinical medicine (4).

The main purpose of this study was to assess the value of the autopsy in clinical medicine today. This has been achieved by analysing several variables. Clinical diagnostic accuracy was determined by assessing the concordance/discrepancy of clinical and autopsy diagnoses. In addition, several variables were assessed, namely whether or not the size of the hospital, type of ward, autopsy rate, age of the patient, and degree of confidence with which the clinical diagnosis was made had any bearing on the accuracy of the diagnosis. The impact of the newer diagnostic tests on clinical diagnosis was also assessed to confirm or refute the widely held opinion amongst clinicians that diagnostic advances have indeed reduced the need for autopsies. The attitudes of pathology registrars and consultants towards the autopsy were analysed, using a questionnaire (Table 2) proposed by Stubbs et al (59).

PATIENTS AND METHODS

The study was conducted at Groote Schuur Hospital, its satellite hospitals (Victoria, Valkenberg, Alexandra, Conradie, Princess Alice Orthopaedic and Brooklyn Chest Hospitals) and the University of Cape Town Medical School.

The study was divided into two, namely a 6 month prospective (July 1991 to December 1991) and a one year retrospective (June 1991 to July 1990) survey (ie. autopsies over an 18 month period).

PROSPECTIVE STUDY

In consultation with the pertinent clinician before each autopsy the following data was recorded:

1. The primary clinical diagnosis (ie. the immediate principal cause of death or the underlying disease that initially prompted the patient to seek medical attention).

2. The degree of clinical confidence with which this primary diagnosis was made (ie. "Certain", "Fairly certain", "Possible", or "Uncertain").

3. Other supplementary diagnoses, up to a maximum of five.

Autopsies were performed by pathology registrars who were supervised by consultant pathologists. Detailed macroscopical and histological reports were available on all subjects. Photographic records of significant pathology were also available for review.

The clinical diagnoses were then compared with the autopsy diagnoses, and categorized according to a modification of the scheme proposed by Goldman et al (2). (Table 3).

Diagnostic tests were divided into three broad categories, namely : endoscopies, biopsies and surgical explorations; standard radiographic procedures; and non standard radiographic procedures such as Nuclear Magnetic Resonance Imaging, Computerized Tomography scans and ultrasound scans. The result of a test or procedure was considered to be conclusive if it established or virtually established an autopsy diagnosis. A test was considered potentially helpful if it was neither misleading nor conclusive with respect to the autopsy diagnosis. The result of a test or procedure was considered misleading if it purported to establish a diagnosis that was not evident at autopsy, or if it provided no evidence of the pathology found at autopsy even though that test had been requested for the purpose of diagnosing that condition and that that test constituted a reasonable basis for making such a diagnosis.

All of the above categorizations were made as a result of direct discussions between the clinicians involved and myself.

The usual basic demographic data including patient age, sex and race were documented.

TABLE 2

QUESTIONNAIRE SAMPLE USED TO ASSESS ATTITUDES OF PATHOLOGISTS TOWARD THE AUTOPSY

1. I enjoy performing autopsies.
2. Autopsies are an important part of a pathologist's work.
3. Major advances in diagnostic techniques have diminished the need for autopsies.
4. Pathologists should be involved in requesting autopsies from patients' relatives.
5. Junior pathologists do not receive adequate supervision and training in autopsies.
6. Clinicians should attend autopsies that they have requested on their patients.
7. Performing autopsies does not further my own education in pathology.
8. I would prefer to spend my time on other duties instead of performing autopsies.
9. Autopsy demonstrations are worthwhile in the education of medical students.
10. Autopsies have a significant role in clinical audit.
11. The cost of autopsies may not be justified within a limited budget.
12. I would not give permission for an autopsy to be performed on a member of my family.

1 = Strongly agree; 2 = Agree a little; 3 = Neither agree nor disagree;
4 = Disagree a little; 5 = Strongly disagree.

TABLE 3

COMPARISONS OF PREMORTEM AND POSTMORTEM DIAGOSES

Class I: Missed primary diagnosis, with an adverse impact on the patient's survival. A class I discrepancy indicates that if the diagnosis had been made and appropriate therapy instituted, the patient would have been expected to live.

Class II: Missed major diagnosis, but with equivocal or no adverse impact on survival. A class II discrepancy indicates that no definitive treatment was available; or that the treatment was appropriate even though the condition was misdiagnosed.

Class III: Missed secondary diagnosis that should have been recognized by the patient's physician. A class III discrepancy indicates that the pathology was not related to the cause of death, but either was symptomatic and should have been treated or, would have effected the prognosis eventually, had the person lived.

Class IV: Missed secondary diagnosis that could not have been made from the information available before death.

Class V: No discrepancy between the primary clinical diagnosis and the autopsy findings.

Class VI: Metabolic/arrythmia related death not confirmed at autopsy.

Class VII: Inadequate autopsy.

RETROSPECTIVE STUDY

In the retrospective survey, patients' folders were withdrawn from medical records. The principal and secondary diagnoses were retrieved from the clinical notes. For obvious reasons, the degree of clinical confidence with which these diagnoses were made could not be accurately recorded. The autopsy records were consulted and the class of concordance or discrepancy of the clinical and autopsy diagnoses, and the value of the special investigations, as described above, were made by the author. In order to avoid making facile judgements on clinical investigations and management, such assessments were made with caution and conservatism.

All data were recorded in a data base.

RESULTS

Analysis of autopsy records at Groote Schuur Hospital (GSH) from 1972 to 1991 (Table 4) shows a steady decline in the number of autopsies performed. In 1972 450 autopsies were performed compared with 209 in 1991. Over these years there has been a general trend toward greater numbers of annual deaths as patient numbers have increased. This represents a decline in the autopsy rate (Figure 1). This is similar to a world wide trend. The marginal increase of 25 autopsies from 1990 to 1991 (which represents an approximately 1% increase in the autopsy rate) coincides with the beginning of this study and a drive on behalf of the Department of Anatomical Pathology to increase the autopsy rate.

During the study period there were 4152 deaths at GSH. A total of 272 non-forensic autopsies were done during the study period, of which 256 were from GSH and 16 were from the satellite hospitals. One hundred and eighty seven autopsies were performed during the 12 month retrospective study, and 85 autopsies were performed during the 6 month prospective study. The service distribution of GSH deaths and GSH autopsy referrals is shown in Table 5.

During the study period 59% of deaths occurred in the medical wards and 55% of the autopsies performed during this period were performed on medical patients. Fifteen percent of deaths occurred in the surgical wards and 21,5% of the autopsies performed during this period were performed on surgical patients. Ten and a half percent of deaths occurred in the Intensive Care Unit (ICU) wards and 5% of the autopsies performed during this period were performed on ICU patients. Eight percent of deaths occurred in the Neuro Surgery wards and

TABLE 4

AUTOPSY RATE AT GSH 1972-1991

YEAR	NO. OF DEATHS	NO. OF AUTOPSIES	AUTOPSY RATE (%)
1972	Records unavailable	450	-
1973	Records unavailable	453	-
1974	Records unavailable	427	-
1975	2010	407	20,3
1976	2103	346	16,5
1977	2176	335	15,4
1978	2266	314	13,9
1979	2242	307	13,7
1980	2319	303	13,1
1981	2264	313	13,8
1982	2298	282	12,3
1983	2297	273	11,9
1984	2228	292	13,1
1985	2400	277	11,5
1986	2389	274	11,5
1987	2386	294	12,3
1988	2448	243	9,9
1989	2691	195	7,2
1990	2575	184	7,2
1991	2608	209	8,0

GSH AUTOPSY RATE

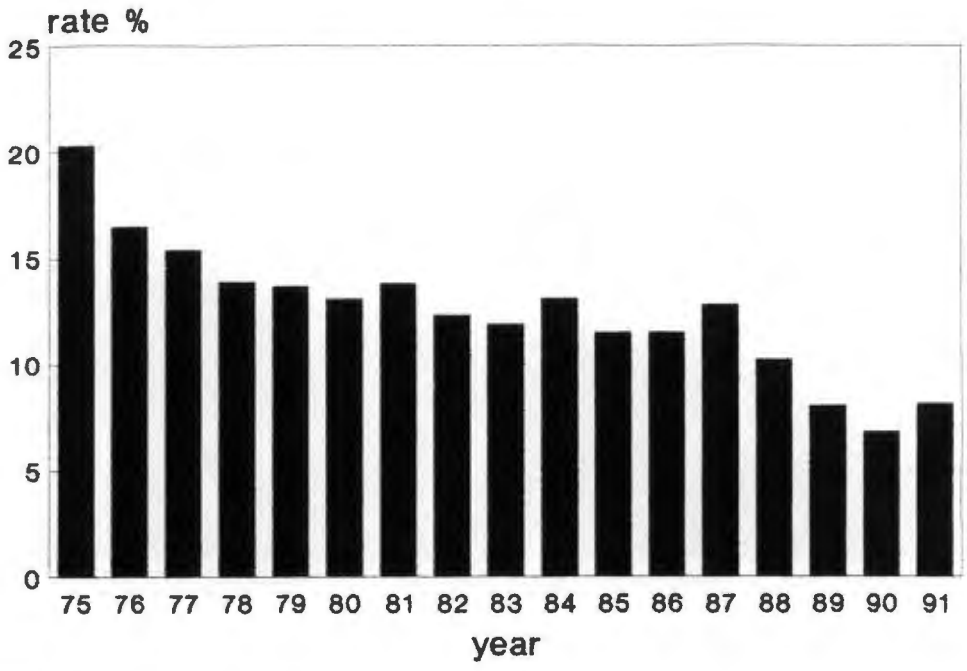

Figure 1

TABLE 5

DISTRIBUTION OF CASES

SERVICE	NUMBER OF DEATHS	NUMBER OF AUTOPSIES PERFORMED
Surgery	615	55
Medicine	2456	141
ICU	435	14
Cardiac Surgery	136	19
Neuro Surgery	311	6
Renal	53	4
O&G	56	4
Haematology	55	12
Neurology	35	1

2% of the autopsies performed during this period were performed on neurosurgery patients. Three percent of deaths occurred in the cardiac surgery wards and 7% of the autopsies performed during this period were performed on cardiac surgery patients. One percent of deaths occurred in the haematology wards and 5% of the autopsies performed during this period were performed on haematology patients. One percent of deaths occurred in the renal wards and 2% of the autopsies performed during this period were performed on renal patients. Less than one percent of deaths occurred in neurology wards and <1% of the autopsies performed during this period were performed on neurology patients. One percent of deaths occurred in the obstetrics and gynaecology wards and 2% of the autopsies performed during this period were performed on obstetric and gynaecology patients. (Figures 2a and 2b). Of the 16 autopsies requested from satellite hospitals, 13 came from medical wards, and 3 from surgical wards.

More males came to autopsy than did females (149 males, and 113 females) with a ratio of 1,32:1 (Figure 3). More males died in Groote Schuur hospital in the study period than did females (2286 males and 1866 females) with a ratio of 1,23:1. The overall autopsy rate amongst males was 6,55% and amongst females it was 6,68%. Most autopsies were conducted in the 50-59 year age group (59) (Figure 4), but most deaths occurred in the 60-69 age group (783). More males than females had autopsies in all age groups except the <10, 20-29, 60-69 and 90-99 age groups. More males than females died in all age groups except the 70-79 and 90-99 year age groups. In the 90-99 year age group, only one female, and no males, presented at autopsy. In this age group 13 out of 20 deaths were female patients. Seventy three percent of autopsies were performed on patients in the 40-79 age group, whereas only 58,5% of

DISTRIBUTION
% DEATHS

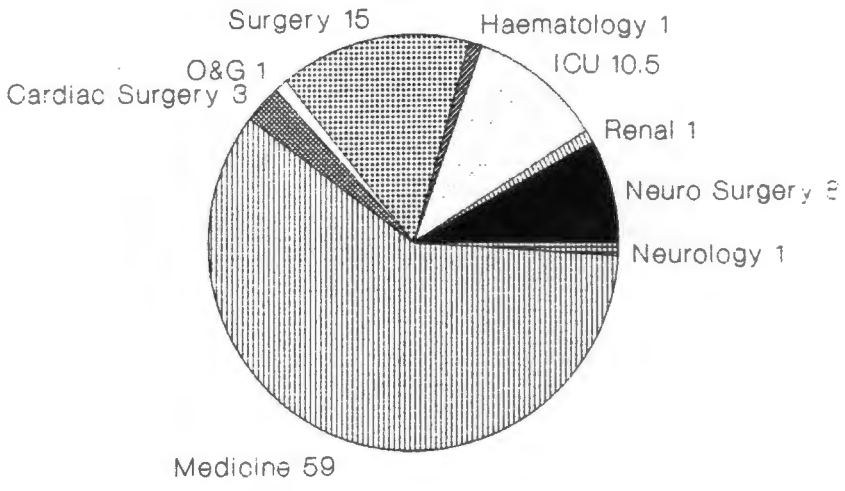

Figure 2a

DISTRIBUTION
% AUTOPSIES

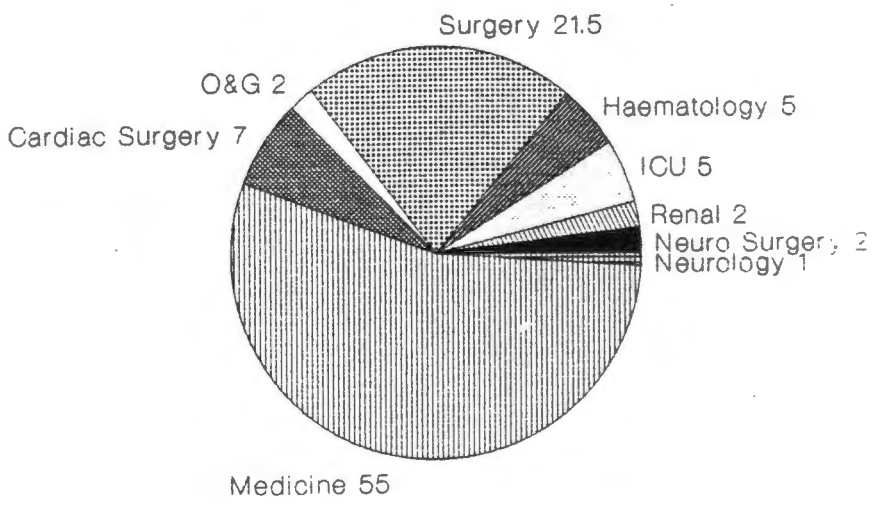

Figure 2b

SEX DISTRIBUTION AT AUTOPSY

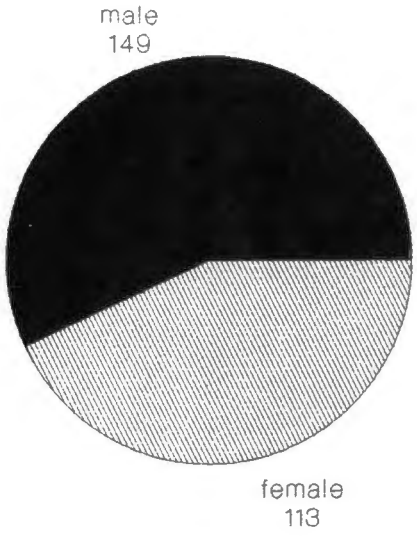

Figure 3

AGE DISTRIBUTION OF AUTOPSIES

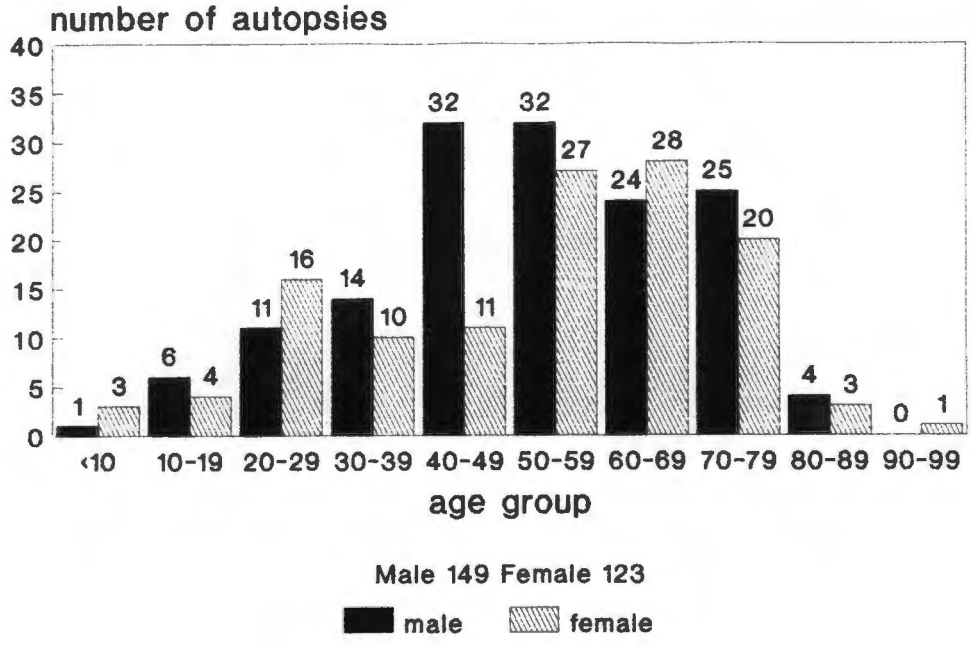

Figure 4

deaths occurred in this age group. The autopsy rate was greatest in the 40-49 year age group for males (14,5%), and greatest in the 20-29 year age group for females (23,5%), (Figure 5). Neonates were excluded from this study. The Coloured population represented the largest population group to die in GSH (55,5%). Of these, 29% were males and 26,5% were females. White males constituted 7,9% of hospital deaths, and White females constituted 5,8% of deaths, (Figure 6). Coloured patients represented the largest population group who came to autopsy (44%). (Figure 7). Almost twice as many White males (15,6%) came to autopsy than did White females (8,2%), (Figure 7).

Concordant clinical and autopsy (Class V) diagnoses represented 55% of cases in the Groote Schuur study, and 44% of the cases from its satellite hospitals. Major diagnostic discrepancies represent 20% of the Groote Schuur cases and 38% of cases from the satellite hospitals. These can be further sub-divided into discrepancies that were considered serious enough to have represented diagnostic errors that had an adverse impact on patients' survival (Class I) (8% at GSH and 25% at the satellite hospitals), and those discrepancies that did not significantly alter patient survival, but were nevertheless considered to be serious diagnostic errors or omissions (Class II) (12% at GSH and 13% at the satellite hospitals). Further valuable information, but which did not constitute missed major pathology, was found in 21% of GSH cases and 13% of cases from the satellite hospitals. This may be further sub-divided into cases with pathology that, although not major, was symptomatic and should have been treated, or would have become symptomatic eventually had the patient lived (Class III) (6% at GSH and 13% at the satellite hospitals), and those cases with non-major pathology that was revealed at autopsy, but that could not have reasonably been made by the clinician before death (Class IV) (GSH 15% and

AUTOPSY RATE
AGE DISTRIBUTION

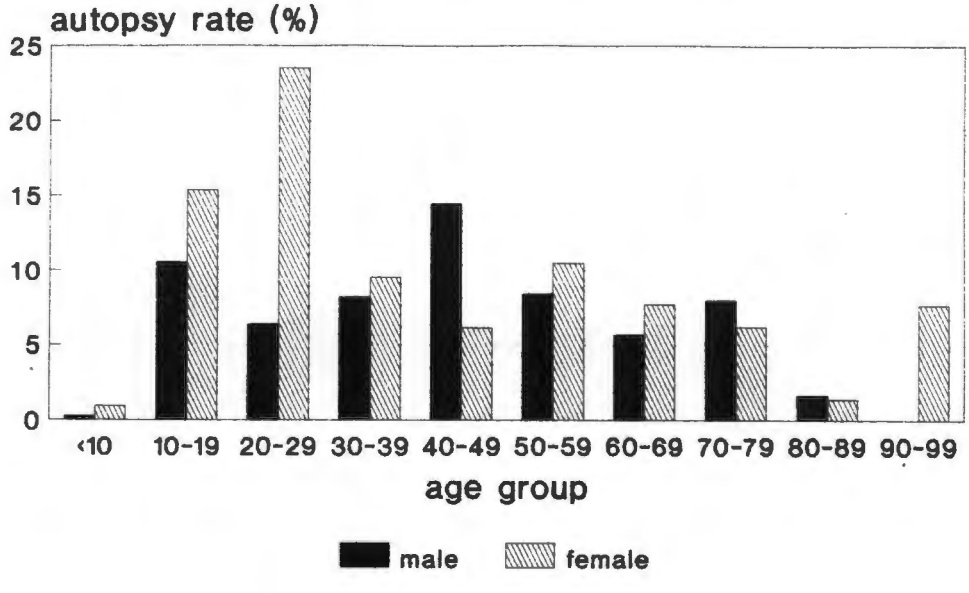

Figure 5

RACE & SEX DISTRIBUTION
% OF ALL GSH DEATHS

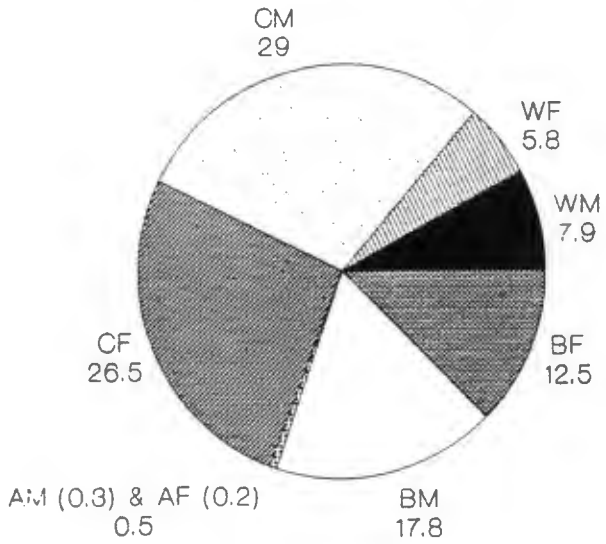

Figure 6

RACE & SEX DISTRIBUTION
OF GSH AUTOPSIES (%)

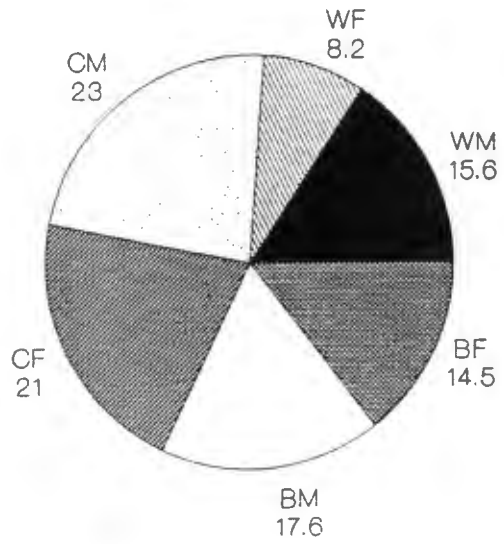

Figure 7

satellite hospitals 0%). Those cases in which no definite pathology could be found at autopsy and in which a metabolic or arrhythmia-related death were considered likely modes of death (Class VI) constituted 3% of GSH and 6% of satellite hospital cases. Of the 272 autopsies analyzed over the 18 month period, one was considered an inadequate autopsy (Class VII), this representing 0,4% of autopsies, (Figure 8).

Organ systems, as classified by the system into which the primary clinical diagnosis fell, with the greatest proportion of major missed diagnoses (classes I and II) were haematology (23,5%), gastrointestinal tract (22,2%), respiratory system (21,9%), and metabolic/endocrine system (20%). When the primary clinical diagnosis was of a central nervous system nature, the percentage of missed major diagnoses was the least (11,1%). (Table 6 and Figure 9).

The clinicians were certain of their clinical diagnosis in 35 of the prospective cases (43%), fairly certain in 27 cases (33%), considered the clinical diagnosis possible in 9 of the cases (11%), and were uncertain of their diagnosis in 11 cases (13%), (Figure 10). In three of the cases the clinicians could not be contacted before the autopsy to obtain their degree of clinical confidence. The greatest percentage of cases having no discrepant major diagnoses was when clinical confidence was the highest (29%), and lowest when the clinicians were uncertain of their clinical diagnosis (2%). Diagnostic accuracy was intermediate when the clinician was "fairly certain" or felt the diagnosis was "possible" (22% and 4% respectively). Such a predictable trend was not evident when the degree of clinical confidence was correlated with major diagnostic discrepancies. Most diagnostic errors occurred when the clinical confidence was stated as "fairly certain" (7%), and least when clinical confidence was

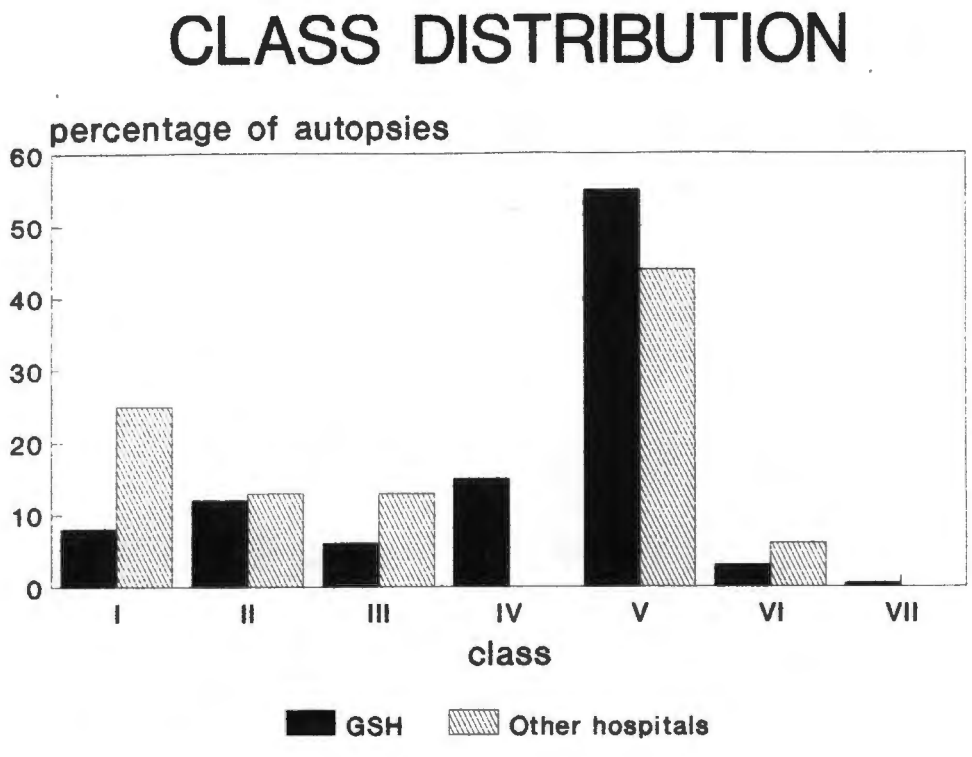
CLASS DISTRIBUTION
percentage of autopsies
60
50
40
30
20
10
0
I
II
III
IV
V
VI
VII
class
GSH
Other hospitals

Figure 8

TABLE 6

MAJOR MISSED DIAGNOSES IN 46 PATIENTS

SYSTEM	NUMBER OF PATIENTS
Genitourinary system	2 (out of 12 cases) (=16,7%)
Gastrointestinal system	12 (out of 54 cases) (=22,2%)
Respiratory system	14 (out of 64 cases) (=21,9%)
Cardiovascular system	11 (out of 65 cases) (=16,9%)
Central nervous system	2 (out of 18 cases) (=11,1%)
Haematological system	4 (out of 17 cases) (=23,5%)
Metabolic/Endocrine system	1 (out of 5 cases) (=20%)

ORGAN SYSTEMS ASSOCIATED WITH MAJOR DISCREPANCIES

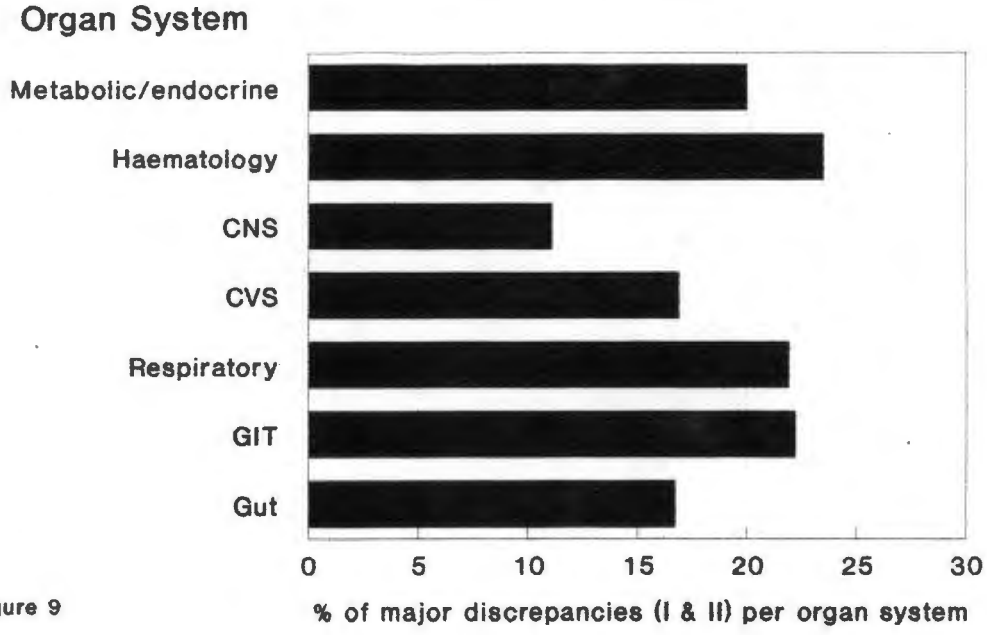

Figure 9

CLINICAL CONFIDENCE

%

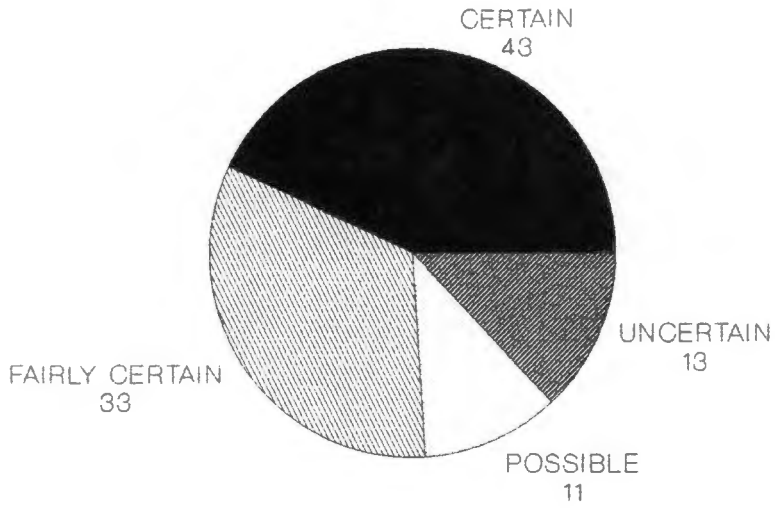

Figure 10

"possible" (2%). Four percent of autopsies revealed major diagnostic discrepancies when the clinical confidence was "certain", and 5% when "uncertain", (Figure 11).

As a general trend, major discrepant diagnoses (classes I and II) occurred with increasing frequency with increasing age (Figure 12). No major discrepancies were detected in the <10 year age group. In contrast, the 60-69 and 80-89 age groups had the highest incidence of major diagnostic errors, namely 29% of cases. The converse was true for concordant diagnoses (Figure 13). One hundred percent of cases under the age of 10 showed no discrepancy between the autopsy and clinical findings. As a general trend, the proportion of cases with concordant diagnoses dropped with increasing age, being lowest in the 80-89 year age group. In this age group, 29% of cases had concordant diagnoses.

Surgery (Sx), biopsy histology (Bx) and endoscopy provided the greatest percentage accuracy of all the investigations performed (82%) (Figure 14). Conversely, this group of special investigations recorded the lowest percentage of misleading results (2%). Standard radiology (Std X-Ray), which constituted the most frequently utilized investigation of those analyzed, had the greatest percentage of potentially useful results (39%), and the greatest percentage of misleading results (5%). Nuclear magnetic resonance imaging (NMRI), computerized axial tomography scanning (CT) and ultrasound scanning (US) provided correct results in 77% of instances, potentially helpful results in 20% of instances, and misleading results in 3% of instances; figures similar to those of the surgery/ biopsy/ endoscopy category of investigations.

CORRELATION OF CLINICAL CONFIDENCE AND DIAGNOSTIC ACCURACY

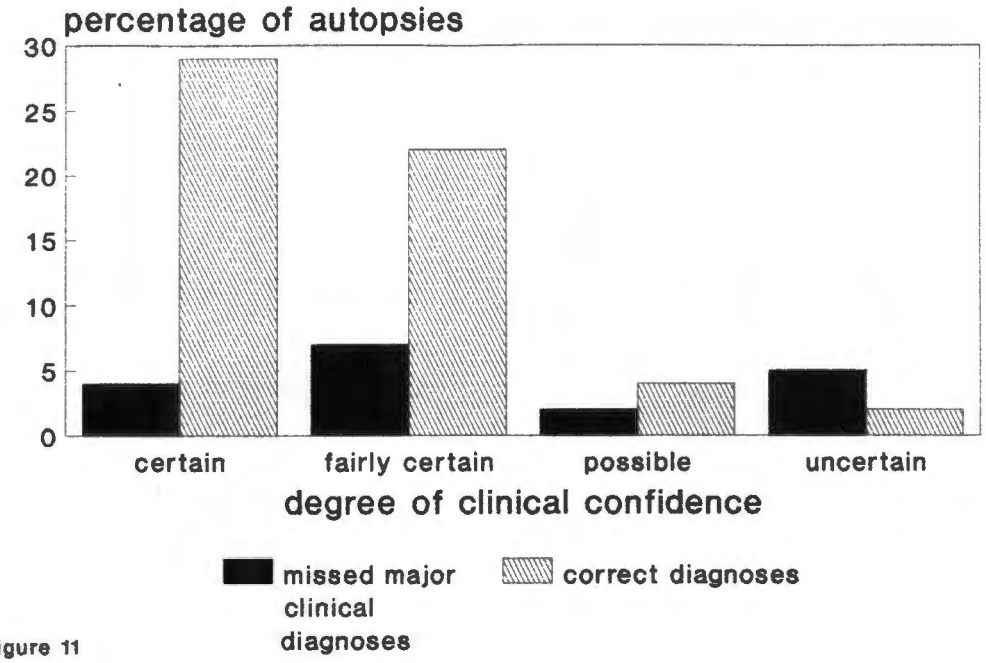

Figure 11

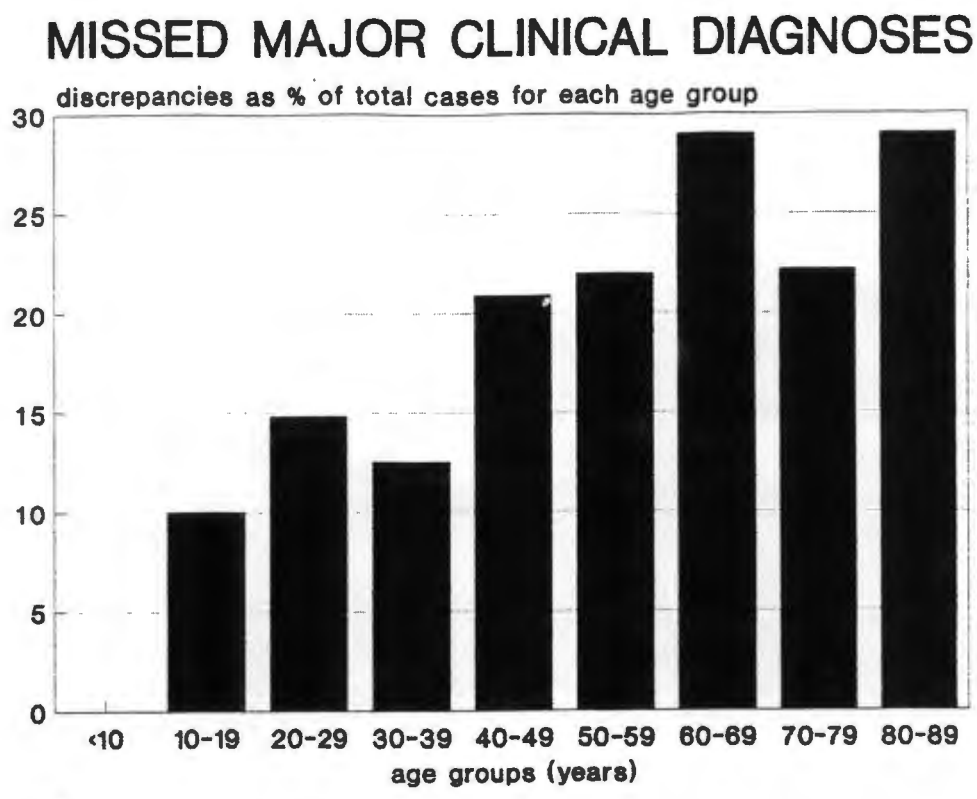

Figure 12

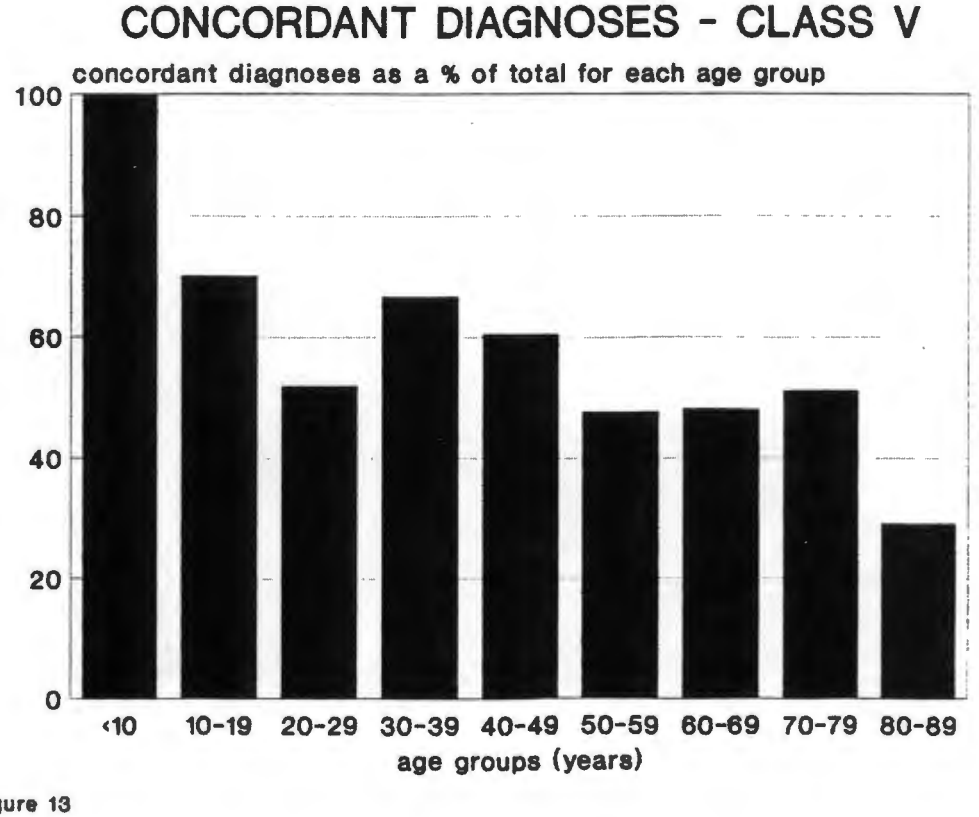

Figure 13

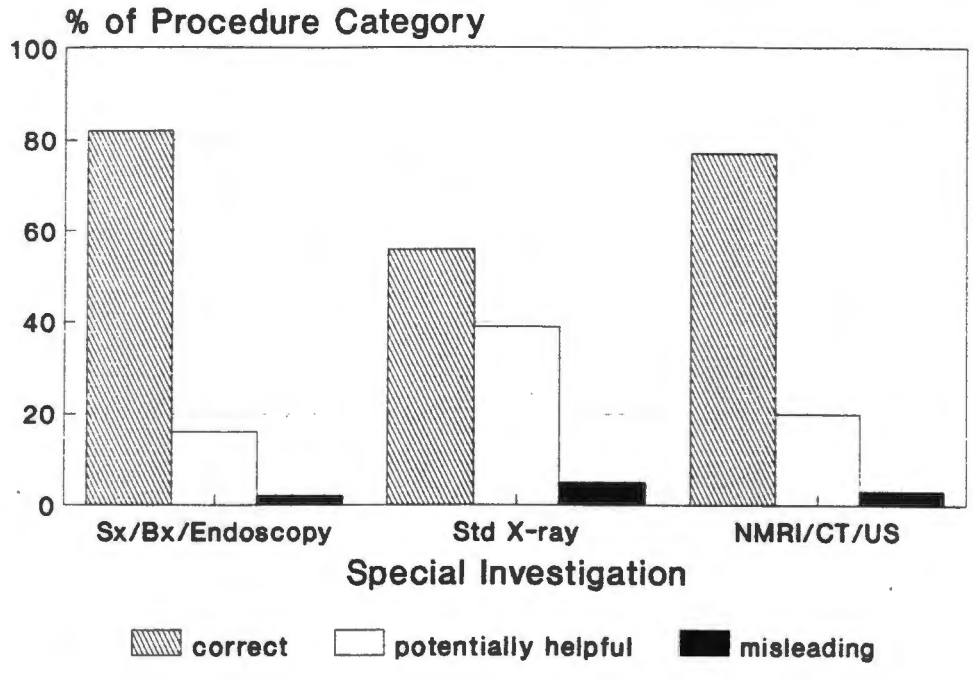
USEFULNESS OF DIAGNOSTIC TESTS
% of Procedure Category
100
80
60
40
20
0
Sx/Bx/Endoscopy
Std X-ray
NMRI/CT/US
Special Investigation
correct
potentially helpful
misleading

Figure 14

A total of 11 registrars and 11 consultants completed the questionnaire assessing attitudes of pathologists toward the autopsy. This represented an overall response rate of 96%. The average level of agreement for each question is indicated in Table 7.

All consultants felt that autopsies are an important part of a pathologist's work. All registrars felt that the clinicians should attend the autopsies that they had requested, and that the autopsy demonstrations are worthwhile in the education of medical students. There was strong disagreement amongst both registrars and consultants with the statement that performing autopsies does not benefit the education of the prosector. All registrars felt that pathologists should not be involved in requesting autopsies from patients' relatives. There was general agreement that autopsies have a significant role in the clinical audit.

TABLE 7

AVERAGE LEVEL OF AGREEMENT WITH EACH QUESTION FROM THE QUESTIONNAIRE

	STATEMENT	RESULT	
		CONSULTANT	REGISTRAR
1.	I enjoy performing autopsies	2,55	3,55
2.	Autopsies are an important part of a pathologist's work.	1,00	1,73
3.	Major advances in diagnostic techniques have diminished the need for autopsies.	3,18	3,36
4.	Pathologists should be involved in requesting autopsies from patients' relatives.	4,00	5,00
5.	Junior pathologists do not receive adequate supervision and training in autopsies.	1,64	1,27
6.	Clinicians should attend autopsies that they have requested on their patients.	1,45	1,00
7.	Performing autopsies does not further my own education in pathology.	4,36	4,91
8.	I would prefer to spend my time on other duties instead of performing autopsies.	2,33	2,64
9.	Autopsy demonstrations are worthwhile in the education of medical students.	1,45	1,00
10.	Autopsies have a significant role in clinical audit.	1,09	1,55
11.	The cost of autopsies may not be justified within a limited budget.	4,18	3,09
12.	I would not give permission for an autopsy to be performed on a member of my family.	4,09	3,45

COMMENT

The Perceived Value Of The Autopsy

The decline in the perceived value of the autopsy in clinical medicine is underscored by the significant drop in the autopsy rate at our institution. Whilst there used to be an autopsy rate of approximately 20% in 1975, this had fallen to approximately 6,6% during the study period 1990/1991. These figures reflect non-forensic autopsies only. Forensic autopsies were performed upon approximately 6,7% of patients dying in GSH (of which approximately 3,7% were trauma- related) during 1990 (Personal communication, Department of Forensics). It was decided not to include forensic cases in this study as the high non-natural death rate in Cape Town at the present time of social unrest would have distorted our hospital autopsy data and hindered comparison with overseas studies. The GSH experience is not unique, and such a fall has occurred throughout the world (4, 5, 8, 14, 43, 49, 50, 55). Personal correspondence (unpublished) with other South African teaching hospitals has shown a similar drop in autopsy numbers in most, but not all, of these instituitions. The explanation for the decline which has occurred would not seem to be simple.

Perhaps one of the most significant reasons is the belief amongst clinicians that the autopsy no longer provides information that was not already known during life. This is born out in the prospective study which showed that clinicians were confident or fairly confident of their diagnosis in 76% of cases that came to autopsy. But despite this high level of clinical confidence, major discrepant diagnoses were present in 20% of the Groote Schuur cases. Of these discrepant diagnoses, 8% were considered serious enough to have significantly altered patient survival. In addition, missed minor pathology, some of which may have had an impact on survival, was revealed in no less than 21% of

Groote Schuur Hospital autopsies. The fact that concordant diagnoses represented only 55% of GSH cases, and 44% of satellite hospital cases, emphasizes the value of the autopsy in the audit of clinical medicine, and serves to remind us that those who feel that post-mortems are of little value are "floating on the clouds of uncontrolled optimism."

One would expect clinical confidence to correlate well with the frequency of diagnostic errors. In fact, one of the many arguments put forward against increasing the autopsy rate, especially in the current economic climate where cost curtailment is a high priority, is that clinicians should request autopsies only on those cases where there was an element of clinical doubt. Many feel that the clinician is well placed to make the decision as to which cases will prove the most fruitful at autopsy, and therefore which cases should be selected for referral to the pathologist. It has been suggested that a high proportion of diagnostic discrepancies should be found amongst cases selected for autopsy when clinically uncertain, as these cases have been selected for precisely that reason. By inference, one would not expect discrepancies among those cases for whom the autopsy is sought when clinical confidence is high because the clinicians are satisfied with their diagnosis. However this has proved not to be the case in this study. Most major discrepancies (7,1%) were found when the clinicians were "fairly certain" of their clinical diagnosis (Figure 11). These data suggest that the clinician is not always well placed to judge the potential value of an autopsy. Autopsies often show important discrepancies, sometimes when least expected, and lessons can be learnt. A more predictable trend is noted with the relationship of clinical confidence and concordant diagnoses; the clinical and autopsy diagnoses being more likely to correlate when clinical confidence is highest.

Several studies have shown that autopsies identify an unexpected cause of death (see Appendix 1) in approximately 20% of cases; in half these cases correct pre-mortem diagnosis would probably have prolonged survival (2, 4).

The system used in this study was modified from the categories proposed by Goldman et al (2) to try and achieve meaningful grouping of findings, but without being so restrictive that results were too difficult to categorize. Nevertheless, certain cases proved difficult to classify. In these cases discussion with a clinician was helpful, and was especially meaningful in the prospective study when the doctor involved in the case could provide the insight and understanding which is not always easily gleaned from the records. Although categorization of a clinical picture is somewhat crude, it does allow a measure of objectivity and facilitates comparison with other surveys. The results from this study correlate well with those of similar studies (Table 8) (43).

These findings have been consistent over time and in hospitals with varying autopsy rates. However, a word of caution with regard to the latter statement seems appropriate, and applies to all the studies. When an autopsy is not performed in almost every case, the material becomes selected. Deceased patients of younger ages, certain disorders and generally "difficult" cases are over-represented, which must influence the frequency of inaccurate diagnoses established at autopsy (16). This may explain the higher percentage of missed major diagnoses in the smaller satellite hospitals (38%) than in Groote Schuur Hospital (20%) (Figure 8). It is perhaps that much more difficult for the clinician to arrange an autopsy from a peripheral hospital than it is from Groote Schuur. Thus it is only those cases in which the clinician has had a particular interest and which was particularly complex which will be autopsied. Hence their cases

TABLE 8

SELECTED PUBLISHED AUTOPSY STUDIES CONCERNING ACCURACY OF ANTEMORTEM DIAGNOSES

SOURCE, YEAR	NO. OF PATIENTS	% MAJOR DISCREPANCIES	COMMENTS
Battle et al. (9)	2067	13,2	Additional 20,6% missed major clinical diagnoses with possible impact on survival.
Britton (17)	383	7,3	
Burrows (68)	252	6,0	Overall 11,7% showed "major" differences.
Cameron (69)	154	15,0	
Clarke (70)	1076	9,0	
Frederici and Sebastian (71)	1682	10,2	Overall 61% showed important unexpected findings.
Goldman et al. (2)	300	10,3	Additional 11,8% missed major diagnoses with possible adverse impact on survival.
Holler and Demorgan (72)	200	8,0	
Kircher et al. (73)	272	4,0	Encompasses all deaths, including coroner's cases; overall, 29% showed major disagreement on underlying cause of death.

TABLE 8 continued

SELECTED PUBLISHED AUTOPSY STUDIES CONCERNING ACCURACY OF ANTEMORTEM DIAGNOSES

SOURCE, YEAR	NO. OF PATIENTS	% MAJOR DISCREPANCIES	COMMENTS
Sandritter et al. (74)	1096	18,7	
Thurlbeck (75)	200	11,0	9,5% involved cause of death and 1,5% involved major underlying disease.
Wheeler (76)	286	11,0	
Wilson (72)	265	7,0	
Present study	272	20	Most diagnostic errors made when clinical confidence = "fairly certain"

are more likely to have more enigmatic disease and therefore more missed pathology. It is reasonable to assume that missed diagnoses do not represent malpractice or negligence, but rather indicate that advances in medicine have left a residuum of obscure diagnoses, thus preserving the value of the autopsy (2).

Factors influencing autopsy rates

Autopsy is not a legal requirement in all hospital deaths in South Africa. The autopsy rate is dependent on public attitude to the granting of consent (it is Groote Schuur official policy that consent must be obtained from the family before an autopsy can be performed), and the enthusiasm with which the doctors pursue this. Groote Schuur Hospital has an official policy that 40% of patients dying within the hospital must be autopsied; a policy that is clearly not implemented.

Autopsy rates in this study vary from service to service (Figures 2a & 2b), and amongst cultural groups (Figures 6 & 7). The super-specialized services of haematology and cardiac surgery have the highest autopsy rates. It is likely that the high autopsy rate in the haematology service is due to a close link between the clinical haematologists and the pathologists, and the fact that many of the clinical doctors in this discipline have some pathology training. This underscores the critical role that the attitude of the clinician towards the autopsy has in the requesting of autopsies. It would seem that the greater the doctor's appreciation of pathology, the greater will be his perceived value of the autopsy. In addition, haematology is at the forefront of new treatment development, and the value of the autopsy in detecting treatment-related

complications and efficacy is well appreciated by these clinicians. Perhaps of additional importance is the long duration of patient stay in the haematology wards. The resultant education of the patients and their families into the disease processes makes the consent of the relatives for an autopsy all that more informed and therefore willing.

The high autopsy rate in cardiac surgery may be, in part, due to the increased contact that the Head of the Pathology Department has with this department (in which he has a special interest) and the clinical pathology meetings that those clinicians have with him.

Some of the surgical registrars have rotated through pathology. This background in pathology may have increased their desire to know of missed pathology or of the complications of surgery.

The Intensive Care Units' (ICU) low autopsy rate may be due to the doctors' belief that the ICU cases are so extensively investigated by the time they die that they do not believe that the autopsy can reveal any further information.

The low autopsy rate amongst neurosurgery patients may be due to the extensive use of NMRI, CT scans and histology in their assessment. Many clinicians feel that such advanced techniques render the autopsy superfluous. There may also be a feeling amongst the super-specialists that as long as their specialty-related pathology is known and treated, "who needs to know about other pathology?"

More males came to autopsy than did females, but there were more male deaths in GSH during the study than there were female deaths. Therefore there was a higher overall autopsy rate amongst females (6,68%) than amongst males (6,55%). However this is not statistically significant according to the chi square test. Racial, and by inference cultural, differences are noted. Proportionately more Whites came to autopsy than did members of other races (Figures 6 & 7). It is postulated that the White population group as a whole have a closer link with first world medicine than do other population groups. The cultural, more first world, attitudes of the White patients and their relatives are more likely to be akin to those of the doctors requesting the autopsy, who themselves are predominantly White and trained in a first world environment where the autopsy has less taboo attached to it than in other settings. Thus, they are more likely to accede to requests for an autopsy than are other population groups.

In addition, whereas the difference in numbers of males and females coming to autopsy was slight within the Coloured, Black and Asian communities, nearly twice as many White males came to autopsy compared to White females (Figure 7). The differences in the distribution of deaths in the different categories of race and sex cannot account for this finding (Figure 6), and perhaps this too is related to differences in cultural attitudes towards the granting of permission for autopsy. Perhaps there is more of an emotional barrier to the granting of permission for an autopsy to be performed on a female patient from a White family than there is on a male patient from a White family. It is possible that an autopsy on a female is considered more "invasive" or "threatening" to these family members than is the case with males.

Overall, most autopsies were performed on patients in the 50-59 year age group (Figure 4). This is not due to most patients in the hospital being in this age group. In fact, most patients admitted are in the 20-29 year age group. Peak autopsy rates vary with age group and sex. Amongst females, the highest autopsy rate was in the 20-29 year age group (23,5%) (Figure 5). This finding may be related to the increased proportion of young females with auto-immune diseases, which are an important cause of morbidity and mortality. Frequently auto-immune diseases prove difficult to diagnose clinically and many of the autopsies in this age group are probably requested because they were particularly "difficult" clinical cases. Therefore autopsy rates were highest in this category where the clinicians perceived the value of the autopsy to be highest. The peak autopsy rate for males was for the age group 40-49 (14,5%). Respiratory and cardiac pathology accounted for most of the pathology in this category of patient. Ischaemic heart disease results in death from the initial myocardial infarct more frequently in younger patients than is the case with older patients. Hence these young males probably have a more unexpected clinical presentation and outcome than their older counterparts, and so an autopsy is more likely to be requested on these younger patients, thereby increasing the autopsy rate in males in the 40-49 year age group.

Factors Influencing Diagnostic Accuracy

Age

Discrepant major clinical diagnoses increased, as a general trend, with increasing age (Figure 12). These findings are not unexpected, as with increasing age, multiple pathologies are more likely to occur. In addition, clinical

presentation is frequently atypical in the elderly, and clinical histories are more frequently poor, with consequently more difficulty in making an accurate clinical diagnosis. Latent malignancy is also more likely to be found at autopsy in the older age groups. Because of the above findings, and the fact that the aged represent an increasing segment of the population on whom health decisions have to be made, this age group should be targeted for special attention when considering increasing the autopsy rate (c.f. the current GSH status, with a peak autopsy rate in the 40-49 year old age group for males, and in the 20-29 year age group for females). This study has also shown the converse to be true (figure 13). There was no discrepancy between clinical and autopsy findings in the <10 age group, but there was a general trend toward less concordant diagnoses as patient age increased. Similar conclusions may be drawn to those described above, although small numbers of patients in the categories at the extremes of age make such interpretations less reliable.

Body System In Which The Pathology Occured

In an attempt to ascertain which system categories were the most difficult to diagnose, these categories were compared with the class of diagnostic error or concordance (Figure 9). Several studies have shown discrepancies most frequently in the diagnosis of pulmonary embolus, infection, endocrine and haematological conditions and least commonly in the diagnosis of malignancy (17, 25). This study analysed system categories in an anatomical way, and no statistically significant differences in accuracy of diagnosis with regard to system could be demonstrated using the Chi Square test. This probably reflects a defect in the methodology, with the overlap of diseases such as infection or

malignancy in the different anatomical categories being too great to allow statistically significant trends to be analysed.

Special Investigations

In the 1980s the face of investigative medicine was revolutionized by the advent of ultrasound scanning, Computerized Axial Tomography (CT) scanning and Nuclear Magnetic Resonance Imaging (NMRI). Increasingly clinicians are relying on these tests. Confidence in new investigative procedures can only be gained after they have been adequately assessed for accuracy and specificity, and after there has been sufficient experience gained by the operator. It is clear that the autopsy, which must still rank as the "gold standard" investigation, is a vital part of this assessment. Even the most accurate diagnostic test, including the examination of a biopsy specimen, can give misleading results. Over-reliance on new procedures occasionally contributed to missed diagnoses. In one case (see Appendix 2), a dissecting abdominal aortic aneurysm was suspected clinically, but was not seen on CT scan, and the patient was therefore not treated for it. The patient subsequently died and autopsy revealed an abdominal aortic aneurysm and that had caused most of the symptomatology. A further example is provided in appendix 3. Ultrasound detected probable metastases in the liver, and the pancreas was thought to be the likely source of the primary. However, the autopsy revealed that there was a primary hepatocellular carcinoma and that the pancreatic mass was a haematoma in the region of the head of the pancreas. There is, therefore, the danger of clinicians not correctly interpreting the results of investigations, not correctly understanding the meaning of the test results, or of placing undue emphasis on the test, even in the face of clinical evidence to the contrary. All of

these limitations are more likely to be less well understood soon after a new test is introduced. Thus, it seems that advances in diagnostic technology have not reduced the value of the autopsy, and that a goal-directed autopsy remains a vital component in the assurance of medical care (2).

An overwhelming majority of diagnostic procedures provided correct or potentially helpful information. Assessments made at the time of surgery, interpretation of biopsy specimens and endoscopic evaluations were most often correct, providing a diagnosis confirmed at autopsy in 82% of cases (Figure 14). Furthermore, this group of investigations proved misleading in only 2% of cases. Such high diagnostic rates probably relate to their degree of direct visualization of the pathology, and the fact that they are relatively well established investigations with doctors being experienced in their execution and interpretation.

The newer diagnostic tests of Ultrasound, CT scanning and NMRI also provided a high degree of concurrence with autopsy findings (77%), and a low rate of misleading results (3%). These figures compare favorably with assessments made at the time of surgery, interpretation of biopsy specimens and endoscopic evalutations. NMRI, CT scanning and ultrasound scanning show a higher diagnostic concurrence with autopsy findings than do standard radiological investigations. This finding forms an interesting comparison with a similar study conducted in the three decades beginning respectively in 1960, 1970 and 1980 (2). In that study, standard radiology provided better correlation with autopsy findings than did these newer investigations, and provided fewer misleading diagnoses. This may well be related to current doctors having greater experience with these newer tests and better clinical understanding and

response to the results generated by these tests than doctors had in the eras mentioned above. Indeed, these newer tests are probably even more accurate and specific than these figures indicate, for many of the patients on whom these tests were requested probably did not die, due to the therapy instituted on the basis of the test results. Thus, the overall ratio of conclusive to misleading results in all patients studied by these tests may be much higher than that indicated in this study.

Standard radiology in this study provided correct information in 56% of the cases in which the investigation was employed; a proportion considerably lower than those of the other diagnostic groups, despite more experience with this group of investigations. However, this modality provided potentially helpful results in a higher proportion of cases than did the other investigations. This result should, however, be interpreted with caution because standard X-Rays are requested in a very high proportion of patients. In other words, the selection criteria for standard radiological procedures are perhaps less stringent than those required before embarking on, for example, surgery, biopsy or NMRI. Therefore one might expect a lower yield of correct diagnoses and a higher rate of useful, although not necessarily completely accurate, information from this group of investigations. It seems reasonable to conclude, therefore, that this lower rate of "correct" diagnoses with standard radiology should not detract from the usefulness of this procedure, nor detract from the skill of those involved in the interpretation of X-Rays.

Five percent of standard radiological reports were misleading . For example, a patient with clinical and radiological evidence of pulmonary oedema or interstitial lung disease was found at autopsy to have bronchioloalveolar carcinoma (Appendix 4). The residuum of misleading diagnoses will always

remain, no matter how accurate and specific the test, and no matter how much experience the doctors have with the procedure. It must then be obvious, to even the most skeptical individual, that the autopsy remains the final audit of clinical medicine, and a procedure that can be ignored only at the peril of high medical standards and progress.

Community attitudes

If the downward trend in autopsy rates is to be halted and indeed reversed, the medical profession must first convince itself of the value of the autopsy, and then persuade society that a high autopsy rate is in the best interests of the community. The results of the questionnaire provide interesting insights into the perceptions of the autopsy held by pathologists. Although there is virtually unanimous agreement that the autopsy is an important part of the pathologist's work and is an important part of the clinical audit, there is a general reluctance on behalf of the pathologists to spend their time performing autopsies. Most of those questioned prefer to spend that time spent on autopsies doing other tasks. Such attitudes seem disparate, but possibly reflect a feeling that other tasks, such as the reporting of general surgical specimens, are of even greater importance than that of the autopsy. This may seem a reasonable attitude if one considers the benefits of the surgical specimen and that of the autopsy in a particular patient only. However, we are missing the most important benefit of the autopsy; namely the benefit to society as a whole by being the custodian of medical standards. This may be analogous to the argument of curative versus preventative medicine. Perhaps this attitude reflects the low status that the autopsy has amongst the medical profession, compared with its previously glamorous role. Most autopsies are performed by registrars, and it is not

surprising that more registrars found performing autopsies less enjoyable than did their senior colleagues who were only involved in the checking of the cases. It is of interest that both registrar and consultant pathologists tend to agree that autopsies further one's own education; a point that underlies the fact that all answers are not always predictable in medicine, even in the mortuary. All agreed that autopsies are valuable in the teaching of medical students. In view of all the above mentioned advantages of the autopsy, as recognized by informed doctors, the most noteworthy finding was the answer to the question dealing with the granting of consent for an autopsy to be performed on a member of the pathologist's family. Amongst the registrars there was a tendency toward, but by no means unanimous support for, the granting of an autopsy on family members. This was not as marked as amongst the consultants. 45% of the consultant staff would unconditionally grant autopsies on family members, but no registrars had such definite positive feelings on the subject. It is thus clear, that even amongst a segment of the population acutely aware of the benefits of the autopsy, there still remain some irrational objections toward the autopsy. This may represent one of the most difficult hurdles to overcome with respect to reversing the decline in the autopsy rate.

Risk To The Pathologist

Whilst the autopsy is clearly of great value, it is also a source of potential danger to the pathologist. Hepatitis B and Jakob-Creutzfeldt disease are possible lethal pathogens that the pathologist has traditionally taken precautions to avoid. Tuberculosis represents yet another danger to the pathologist, with tremendous potential for heavy aerosolisation of the bacilli upon removing the thoracic block. More recently, the Human Immunodeficiency Virus has become

a source of great concern, especially as its presence may frequently be unknown to the requesting clinician. An additional cause for concern is the data published by Nyberg et al (61) which states that HIV capable of replication in culture may persist in the host for at least six days, and in stored native tissue for at least fourteen days postmortem. Such data raises the question of the desirability of performing autopsies in patients with AIDS. However, several authors unequivocally emphasize the appropriateness of the autopsy in AIDS patients (61, 63, 64, 65). The issue of transmission of HIV to health-care workers in the health-care setting has been specifically studied. Thus far no evidence of transmission of HIV, documented by either sero conversion or clinical AIDS, to a pathologist or autopsy room assistant has been certified (65). Therefore, provided the currently advocated guidelines for high risk autopsies are adhered to (66, 67), and considering the multiplicity of benefits to the medical understanding of diseases such as AIDS that the autopsy provides, the AIDS patient autopsy can no longer be refused. The same is true for all infectious disease autopsies, with the possible exception of the haemorrhagic fevers.

There are several steps which may be helpful in improving the value of the autopsy in clinical medicine (4):

1. Develop methods to minimize bias in the selection of cases for autopsy. Bias would be decreased by higher autopsy rates, but could also be eliminated by including a random sample of cases in which autopsies would not be routinely performed.
2. Improve the process for obtaining consent for an autopsy (4, 35, 43). Ideally, this should be made by the individual during health, much like the

decision as to whether or not they would like their organs to be used for transplant purposes. However this is not the case and for this reason special training should be available to those whose job it is to obtain consent for the autopsy. Especially in the South African multi-racial, multi-cultural society, knowledge regarding the different cultural perceptions about death and life after death should be detailed so as not to offend relatives and to encourage as much public support as possible for an increased autopsy service.

In this country, consent is sometimes requested over the telephone, and this is not the optimal method for such a sensitive issue. In addition, consent is often requested in a language which is not the mother tongue of the relative, and this can lead to misconceptions about the autopsy procedure and its indications. In these instances, provision of an interpreter is of vital importance to clarify areas of possible misapprehension. Duties of the requesting physician should include adequate explanation to the family of the value of the autopsy in that particular patient (to confirm the cause of death, to reassure the family that all possible care was given, the beneficial role that the autopsy has in medical progress, in the identification of inherited diseases, etc.), and to discuss concerns that they may have with regard to disfigurement of the body, delay of the funeral arrangements and the cost to the family (none), religious and quasi-religious problems, and the widely held belief that the deceased has "already suffered enough."

This study, and that done by Stubbs et al (59), show that pathology staff, in general, feel that the requesting of autopsies should not be the role of the pathologist. This is probably a valid point, as the clinical staff have more likely had contact with the family whilst the patient was alive, and therefore have

more rapport with them, and will be better positioned to handle the emotionally difficult task of requesting an autopsy.

3. Evaluate the cost effectiveness of autopsies. Insufficient data are available to prescribe the most cost-effective autopsy rate. Expressed optimal autopsy rates are between 57% and 65% (18). The medical community as a whole, including community-based services, who benefit from accurate epidemiological figures should contribute to the financing of autopsies as a necessary investment in the future. Accurate autopsy-generated diagnoses may result in considerable long-term savings for the community by, for example, providing accurate information about community disease trends, high risk groups, and by avoiding unnecessary follow-up of contacts for incorrectly diagnosed communicable diseases such as tuberculosis. Thus, the cost should not be borne solely by research institutions.

4. Standardization of autopsies in an effort to maintain high standards throughout the country and, indeed, a department. One study showed uneven quality of prosectors to be the second most important deficit in the pathology service (18). A comprehensive written protocol for the autopsy procedure and report should be available. A minimum number of routine tissue sections should be taken to facilitate future research and to assist in the comparability of autopsies. All diagnoses should be classified according to the internationally recognized SNOMED (Systemized Nomenclature Of Medicine) system, published by the College of American Pathologists, to improve health statistics. Autopsy reports should address the clinicians' concerns, and the new societal values of autopsy such as benefits to families, and monitoring of environmental hazards. At the same time as addressing pertinent clinical questions, reports should not

be threatening to the clinicians. Many diagnoses seem "simple" or "straight forward" with the benefit of hindsight. As fear of potential litigation will probably become an ever-increasing concern of clinicians, autopsy reports should be careful not to be too critical of care, or carry sweeping statements, and thereby carry the potential for litigation.

5. Integrate autopsy findings into an educational feedback system. One of the criticisms leveled at the autopsy service, and indeed one of the reasons given for the decline in the autopsy rate, has been the excessive delay in the feedback of autopsy results. Many clinicians have lost touch with the case by the time the autopsy findings are sent to them, thus defeating much of the educational value of the autopsy. The mean delay in generating a final autopsy report in one study was 3,5 months (43). In fact the lack of prompt and appropriate communication with attending physicians was ranked as the most important deficit in the autopsy service in a questionnaire responded to by 122 academic medical institutes in the United States of America (18). This perception is held by the majority of both clinicians and pathologists.

In an attempt to circumvent this problem at Groote Schuur Hospital, a provisional autopsy report based on macroscopic findings is generated on the day of the autopsy, and a checking system has been instituted to investigate all cases not signed out within 3 weeks. This has met with success, and most reports are now generated within six weeks. Even this time scale is far from optimal. Part of the reason for this delay in this institution is the lack of clerical staff, as a consequence of widespread staff cuts in state hospitals in South Africa, which has led to typing delays. This is inevitable, as autopsy reports will

always take second place to surgical reports when prioritizing documents to be typed.

A second significant factor in the delay of autopsy reporting is the prolonged time (3-4 weeks) needed to fix a brain adequately before it can be sectioned and submitted for histology. In many cases the brain is of vital importance to the autopsy case. However, this problem can be circumvented to a certain extent by the issuing of the neuropathology report as an addendum to the main autopsy report.

Clinicians should attend the organ reviews of autopsies that they have requested, and the mortuary environment should be conducive to such meetings. Major and unexpected autopsy findings should be discussed at regular interdepartmental meetings. Interventions should focus on strategies to reduce rates of treatable major unexpected findings, with an emphasis on improving the care delivered to future patients. With regard to the latter statement, the information revealed at autopsy should be correctly utilized in completing, if necessary, an updated death certificate. Using autopsy diagnoses to complete death certificates would increase the reliability of health statistics enormously and improve the uses to which they are put. Unfortunately, individual death certificates, with few exceptions, do not contain autopsy information and are frequently not corrected once autopsy data becomes available. Clearly this problem needs to be addressed (28, 39, 42, 47, 50, 53). One proposal to circumvent this latter problem would be the completion of a second-part death certificate by the person performing the autopsy. It would then be the duty of the pathologist to forward this information to the registrar of deaths (44). Alternatively, it is quite legitimate for the clinician to fill in the

death certificate only once he has attended the autopsy and the cause(s) of death have become more apparent.

6. Quality control of the autopsy itself is essential if it is to be used as the "gold standard" for the rest of the medical audit. In most institutions the majority of autopsies are performed by registrars. Unlike GSH, not all hospitals have consultants supervising autopsies (43) and in these instances consultant input may often improve the autopsy performance. Review of a predetermined sample of performances, including both adequacy of the report and timeous completion of such a report, by other members of the department should be implemented. In the 18 month period reviewed, only one autopsy (<0,5%) was considered inadequate. However, no such inadequacies would have been detected had the review not been implemented. In order to overcome resistance to the introduction of such a review, the reviewing pathologist should be unaware of the prospector responsible for the report. Only the senior pathologist should then be responsible for any constructive criticism.

7. Improve public relations. Clearly the best way of overcoming public antipathy to the autopsy is to educate the public as to the benefits of this procedure.

A post-autopsy conference with the family to inform them of the cause of death is an idea that may seem foreign to the majority of pathologists. Relatives are often desperate for a logical explanation for their loss, and this is perhaps particularly acute with infantile death. With parents who have lost a child, strong feelings of guilt are frequently present, as children are so dependent on parents for care and protection, and the cause of death as found at autopsy

often provides great solace. Such conferences should take place approximately 3 weeks after the death, at a time when the family has recovered from the worst of their grief. Present in a quiet and private setting should be the family, the clinician involved, a genetic diseases expert where appropriate, the pathologist, and junior clinical and pathology staff who could use it as a learning experience for use in the future. This approach would help give the family accurate information regarding the cause of death, understanding of any possible related genetic problems, and exonerate them from any perceived guilt if appropriate. If there were any actions by the family which contributed to the death of the patient, such as the administration of inappropriate enemas (a practice that is not infrequently seen in the Black population), these can be addressed and appropriate advice given to ensure that a repeat tragedy does not occur. Such post-autopsy conferences are not, however, a new idea. Shortly before his death Napoleon issued the following instructions to his personal physician, the Italian Antomarchi: "After my death I want you to make an autopsy. Do not let any English physician other than Dr Arnott touch my body. Preserve my heart in alcohol and deliver it to Marie Louise in Parma, give her all the details of my death. Examine well my stomach, *and make a detailed report to my son. Indicate to him what remedies or mode of life he can import, for my father died of scirrhous of the pylorus, and symptoms very much like mine.*" Dr Antomarchi, who had been Professor of Anatomy in Florence before becoming Napoleon's personal physician, performed the autopsy on May the 6th 1821. He confirmed Napoleon's self-diagnosis of gastric carcinoma ("scirrhous") and found large metastases in the lymph nodes. Napoleon's advice to follow high risk groups especially carefully is as apt today as it was then (Bechet 1928; Ficarra 1942).

CONCLUSIONS AND FINAL COMMENT

There has been a decrease in the perceived value of the autopsy, as is manifest by the decreasing autopsy rate both in this country and abroad. The Groote Schuur Hospital figures have dropped from a 20,3% autopsy rate in 1975 to only 8,0% in 1991.

The reasons for this are many and varied. One of the principal explanations is that with today's sophisticated equipment the major clinical diagnosis is accurately made in most cases, and little may be gained by requesting an autopsy. The results from this study, however, show that 20% of autopsies identify major diagnostic errors (8% Class I discrepancies and 12% Class II discrepancies). In addition, it has become apparent that most diagnostic errors occurred when the clinical confidence was stated as "fairly certain" (7%). Thus, it is apparent that clinicians cannot predict which autopsies would be the most informative.

Medicine is continually evolving as a profession, and the autopsy is the gold standard for quality control of all aspects of medical care in a hospital, viz. monitoring the effects and side effects of new treatment regimens, diagnostic procedures and death certificate data. Major discrepant diagnoses occurred more frequently with increasing age, being most common in the 60-69 and 80-89 year age groups (29%). Targeting such age groups when aiming to increase autopsy rates will yield maximal information.

This study has shown that the interpretation of biopsy specimens, assessments made at the time of surgery and endoscopic evaluations are the most accurate

investigations (82% accuracy). This degree of diagnostic accuracy is closely rivaled by ultrasound, computerized axial tomography and nuclear magnetic resonance scanning which show a 77% accuracy rate. This represents a change in the accuracy of these newer procedures compared with 30 years ago (2).

It is primarily the role of the medical fraternity to address the issues that have led to a decrease in the perceived value of the autopsy in clinical medicine. Efforts should be made to minimize bias in the selection of cases for autopsy, the process for obtaining consent should be improved, the autopsy findings should be integrated into an educational feedback system, there should be quality control of the autopsy, and public relations should be improved. Improved usage of the autopsy in the undergraduate teaching of medical students would also be beneficial in maximizing the value of the autopsy.

In conclusion, the autopsy remains a procedure that can be ignored only at the peril of high medical standards and progress, and the decline in the autopsy rate is an issue that urgently needs to be addressed.

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APPENDIX 1

CLINICAL DATA

85 year old White female.
Past medical history of peptic ulceration and a fractured hip.

She presented with acute onset of confusion, right-sided weakness and dysphasia.

Examination revealed dysphasia, a right-sided gaze palsy, right-sided weakness, increased reflexes on the right and bilateral up going plantar reflexes. There was nil else of note on examination.

Her condition remained poor. The day after admission, before a CT Scan could be performed, she demised.

A chest X-ray showed upper lobe scarring on the right.

Clinical diagnosis - Cerebrovascular accident
- (or) subdural haematoma.

AUTOPSY FINDINGS

Poorly differentiated adenocarcinoma of the gall bladder, with metastatic spread to the hilar and peri-pancreatic lymph nodes, small pulmonary arteries and liver.

Associated cholecystitis and cholelithiasis. Emphysema, pulmonary oedema and bronchopneumonia.

Small watershed area infarcts of the brain in the distribution of the middle and left posterior cerebral arteries.

APPENDIX 2

CLINICAL DATA

52 Year old White male.

Past medical history of a pituitary adenoma with acromegaly and associated hypertension. Managed with trans-sphenoidal hypophysectomy and anti-hypertensive drugs. Subsequent pituitary function tests normal. Presented with sudden backache and associated sweating and confusion. On examination - hypotensive with poor peripheral pulses and a tender epigastrium.

Differential diagnosis:
- Ruptured abdominal aortic aneurysm.
- Perforated peptic ulcer.
- Appendicitis.

Course in Hospital - The following day he became hypotensive, confused, dysarthric and developed a right sided hemianopia. The next day he developed an acute abdomen. Surgery revealed superior mesenteric artery occlusion with dusky coloured, but viable, bowel, thought to be on an embolic or atheromatous basis. Embolectomy was performed and a prosthetic graft was inter-positioned. The following day a re-look laparotomy revealed viable bowel and a well perfusing graft. The post operative course was uneventful, apart from increasing weakness of the right arm and leg. However, on the fifth post operative day he suddenly collapsed and attempts at resuscitation failed. Probable cause of death was assessed as being a massive myocardial infarction.

SPECIAL INVESTIGATIONS

Emergency abdominal X-Ray was normal. Emergency CT Scan Abdomen (with contrast) showed no evidence of an aortic aneurysm or leak. No free fluid was found. There was a small, possibly non functioning left kidney. Fluid level in the bowel, especially the colon, suggested an ileus. Emergency endoscopy revealed nil of note; specifically no evidence of a perforated peptic ulcer. Serum amylase: normal. CT Scan of the Head showed an ill-defined, but extensive left occipital, posterior temporal and posterior parietal low density area suggestive of ischaemia in the left posterior cerebral artery territory. An embolic cause was considered most likely. Follow-up abdominal X-Ray showed dilated bowel with air-fluid levels.

AUTOPSY FINDINGS

There was a tear in the aorta 3cm above the aortic valve, with dissection distally into the abdominal aorta. The posterior aspect of the ascending aorta was the site of external rupture into the pericardial sac with cardiac tamponade (which was the final cause of death). In addition there was dissection of the left common carotid artery, left renal artery and superior mesenteric artery distal to the graft. The superior mesenteric artery graft was patent. There was complicated atheroma of the major arteries, which was especially prominent in the abdominal aorta. No cystic medial necrosis was evident on histological examination. It is probable that the dissection was on the basis of systemic hypertension. The small bowel was viable although congested. There was no ulceration of the stomach or duodenum. The kidneys were unremarkable. There

was no residual pituitary neoplasm. Posterior cerebral artery territory infarction was present.

APPENDIX 3

CLINICAL DATA

A 38 year old Black male presented with a 3 week history of abdominal pain and distention, diarrhoea and marked loss of weight. There was a background of alcohol and cigarette abuse. Examination revealed an ill man with jaundice and sacral oedema. No signs of chronic liver disease were seen. Abdominal examination revealed ascites and a tender, irregular liver. Clinical assessment was that of either hepatocellular carcinoma or tumour metastases to the liver. He died on the day of admission.

SPECIAL INVESTIGATIONS

Chest X-ray showed clear lung fields and an elevated right hemidiaphragm. Ultrasound scanning of the abdomen showed an enlarged liver with multiple lesions compatible with metastases. Ultrasound scanning also showed a large inhomogeneous mass in the left flank anterior to the kidney and posterior to the stomach, either arising from the stomach or the tail of the pancreas (the latter was favoured). Gross ascites was demonstrated. Radiologist's comment on the ultrasound: Multiple metastases to the liver, with a probable primary in the pancreatic tail or in the stomach. Ascitic fluid cytology showed no malignant cells.

AUTOPSY FINDINGS

Hepatocellular carcinoma against a background of a micronodular cirrhotic liver with evidence of haemochromatosis. Pancreas and stomach showed no evidence of malignancy. There was a haematoma of the lesser sac (weighing 1032g) which appeared to have originated from the head of the pancreas.

APPENDIX 4

CLINICAL DATA

This 58 year old Black female had a background history of rheumatic heart disease with mitral incompetence which required mitral valve replacement with a Starr-Edwards prosthesis. She was also hypertensive, with left ventricular enlargement and chronic atrial fibrillation. There was evidence of restrictive lung disease with a low transfer factor and fine diffuse bilateral crackles ie. features suggestive of interstitial lung disease, or, alternatively, as a consequence of left ventricular failure. She also had a history of epilepsy and multi-infarct dementia.

She was admitted with signs of a right lower lobe pneumonia and pulmonary oedema, which required ventilation. Despite treatment, her condition continued to deteriorate, with decreasing renal function and the postulated development of a staphylococcal septicaemia. She died two weeks after admission. Problems considered salient at death were chronic left ventricular failure, interstitial lung disease and pulmonary oedema with resultant respiratory failure, possible staphylococcal septicaemia, and terminal multi-organ failure.

SPECIAL INVESTIGATIONS

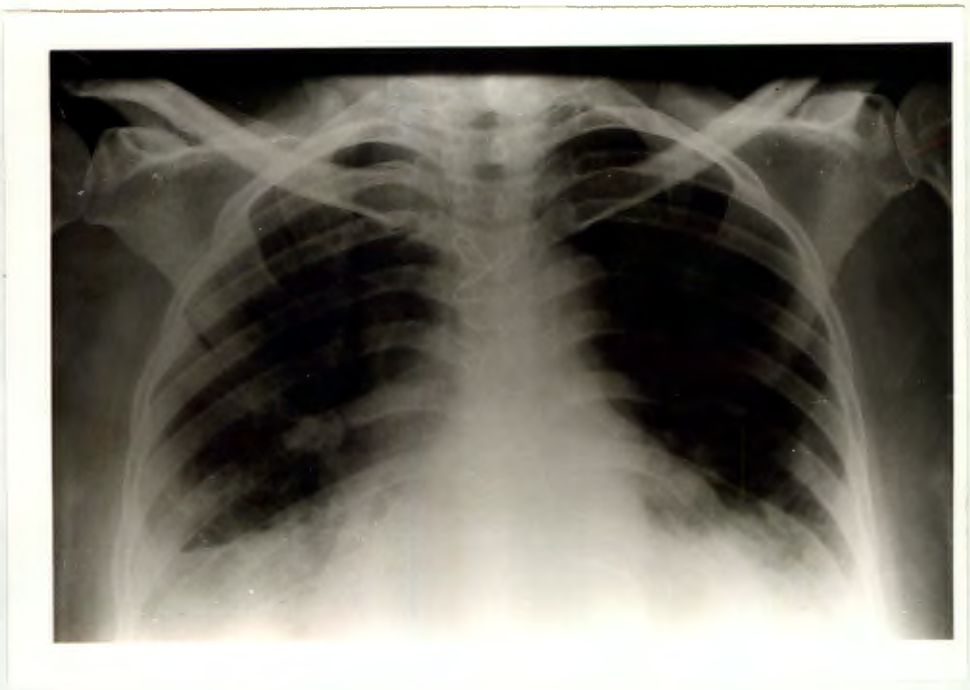
Chest X-ray examination showed confluent opacification of both bases and ill defined nodular opacification of both middle and upper zones. The prosthetic mitral valve was noted. These features were interpreted as being in keeping with chronic pulmonary congestion, but that other interstitial disease could also give this appearance. Blood cultures were negative. Full blood count: Hb 11,6, WCC 27,63, lymphocytes 3%, polymorphs 92%, monocytes 4%, large unstained cells 1%.

AUTOPSY FINDINGS

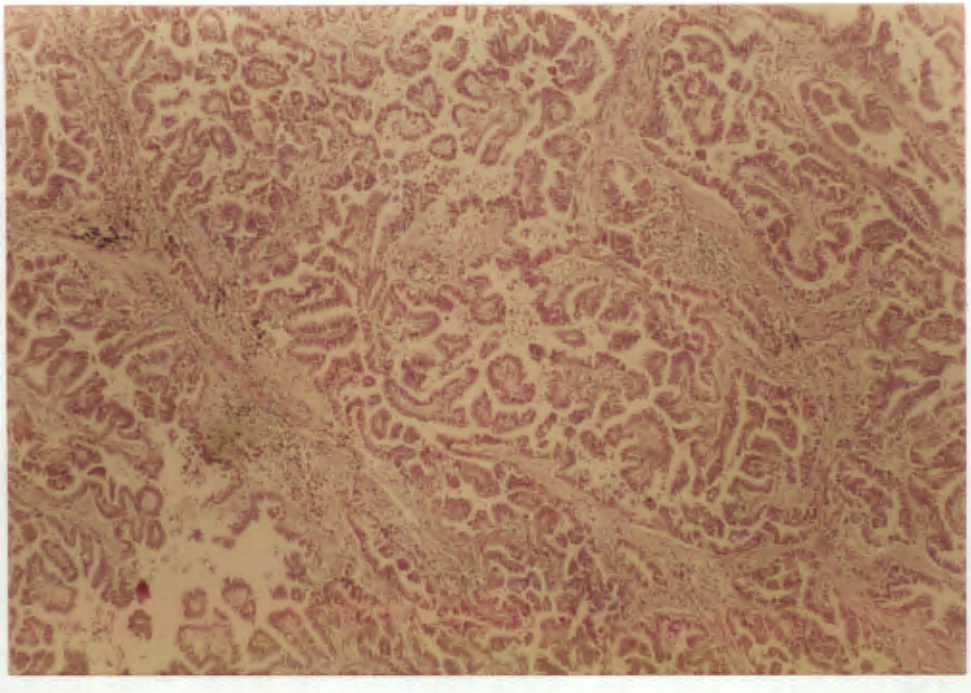
Acute tracheitis compatible with intubation was evident.

Both lungs (right 1022g, left 839g) showed marked, firm, interstitial fibrosis of the lower lobes and dilated, thickened bronchi compatible with bronchiectasis. At the anterior aspect of the base of the right upper lobe there was an abscess measuring 5cm in diameter. Bilateral extensive fibrinous pleurisy was noted. Histology revealed bronchioloalveolar carcinoma of the right and left lower lobes. Also present was interstitial fibrosis, possibly induced by the tumour, but which may have been pre-existing . Histology confirmed the abscess described macroscopically, but a Gram stain did not reveal the causative organisms. The lung parenchyma surrounding the abscess showed features of pneumonic consolidation.

There was left ventricular enlargement, and grade 1 narrowing of the coronary arteries. Thrombus formation was noted in the left atrial appendage and on the mitral valve prosthesis. The brain showed multiple infarcts, compatible with multiple emboli.



APPENDIX 4. CHEST X-RAY - Features in keeping with chronic pulmonary congestion or interstitial lung disease.



APPENDIX 4. HISTOLOGY FROM AREA OF CONFLUENT OPACIFICATION - Well differentiated bronchioloalveolar carcinoma. Tumour cells line respiratory spaces without invading stroma.