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On the Yield of New Information from the Selective Requesting of *Post Mortem* Examinations in Oncology Patients

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Abstract—*Traditionally, a high rate of* post mortem *(PM) examinations has been advocated, primarily for the quality control of clinical diagnosis. In days of increasing scrutiny of medical costs, the role of the 'routine' requesting of any investigation must be questioned, and we report here the results of a policy to request* post mortem *examinations selectively when there was a reasonable expectation that it would yield new information.*

Between 21/3/82 *and* 12/2/86 *there were* 1356 *deaths in patients registered with the Department of Radiation Oncology, Westmead Hospital. During this period,* 100 *PM examinations were performed. The overall* post mortem *rate is thus* 6.7%, *but for patients dying whilst under our direct care it is* 23%.

The cause of death was changed in 9% *of cases following PM examination. The* ante mortem *assessment of the remission status of irradiated volumes was confirmed in* 69% *but was not recorded in the* post mortem *report in* 22%, *in spite of the medical record being available to the pathologist.*

Minor modifications were made by PM examination to the establishment of primary tumor site, sites of metastatic disease, histological diagnosis and other significant pathological states.

The autopsy is an expensive investigation: we conclude that the low yield of relevant new information in this selective series is a powerful argument against the traditional routine request. Indeed the yield of new information in cases when the histological tumour type was known was even lower. The necessity for a problem-orientated approach is apparent from the data on the remission status of treated sites.

INTRODUCTION

PLINY credits Herophilos as 'the first man who searched into the causes of disease' by dissection of the human body, around 300 BC. [1]. Although it is unclear as to exactly what he learned, the modern *post mortem* (PM) examination is still felt by many to fulfil certain roles, the primary one being that of a quality control mechanism for clinical diagnoses. Teaching, research and the acquisition of medico-legal and epidemiological data are secondary functions [2–6].

A high PM rate has been advocated by many in the past and some authors continue to do so [2, 4, 5, 7, 8]. Indeed, a high rate of PMs has previously been a major prerequisite for the accreditation of Australian teaching hospitals. Over the last few years, however, the concept that everyone who dies in a teaching hospital should undergo a *post mortem* examination has been challenged on a cost–benefit basis.

An autopsy is an expensive and time-consuming investigation. In days of increasing scrutiny of medical costs, the need for the selective use of resources is obvious and the 'routine' request for autopsy must be questioned [6, 9] as strongly as one would question the routine request for any other time-consuming expensive investigation such as a CT scan, particularly when the basis for the request is that new information might *possibly* become available.

The practice in the Department of Radiation Oncology, Westmead Hospital, has been to request PM examination only when specific indications exist, e.g. those cases in which there is reasonable clinical doubt as to the exact tumor type or its extent, the cause of death or the outcome of specific therapy. For example, a patient with metastatic

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breast cancer and a long clinical course would typically have had detailed documentation of the disease activity, by clinical, biochemical and radiological means. When such a patient dies, the cause of death is legitimately ascribed to disease progression and such cases should not undergo PM examination.

MATERIALS AND METHODS

Between 21/3/82 and 12/2/86 there were 1356 deaths in patients registered with the Department of Radiation Oncology, Westmead Hospital. These dates were selected to correspond with 100 consecutive PM examinations. Eight of these cases were Coroner's cases and were excluded on the grounds that they had been selected for PM examination for reasons other than departmental policy. Another patient who had undergone surgery for a suspected uterine cancer was shown to have a large uterine fibroid, the non-malignant nature of the case being established *ante mortem*. *Post mortem* examination was performed after the patient suffered a cerebrovascular accident. This case was also excluded. The effective PM rate for the above-mentioned period was therefore 6.7%, but it must be emphasized that not all deaths occurred at Westmead Hospital or while the patient was under our direct supervision. All autopsies were performed by registered pathologists, or by registrars in pathology under the close supervision of a senior member of staff.

Data were obtained by a review of both the departmental and hospital record for all patients. Death certificates are filed only in the hospital record but PM reports are filed in both. In 37 cases (41%), there was no death certificate available in the hospital record. Of these 37 cases, three were patients who died elsewhere (home or nursing home) but on whom an autopsy was performed at our institution. In a further seven cases, the PM was performed elsewhere at our request.

The primary site of disease and tumour histological type were compared before and after PM examination. The primary sites of disease in the study series were compared with those in a control series. The control series consisted of 91 consecutive cases who died but who did not have a PM, the last case being accrued just prior to the last case in the study series.

In patients subjected to radical radiotherapy, the *ante mortem* status of the primary site and primary drainage nodes was accepted as the last adequate assessment of the disease status at these sites prior to death. This was then compared to the disease status at these sites as determined by the *post mortem* examination. Sites of disease treated with palliative intent were not evaluated.

Sites of metastatic disease documented at any stage of a patient's clinical course were directly compared with the PM findings.

The given cause of death was deemed to be in error if a disease listed on the PM report was judged to have led directly to death and was not correspondingly listed on the death certificate. Where no death certificate was available, the records were used to construct a 'best estimate' for death certification. Other conditions or diseases not clinically recorded but revealed by the PM were reviewed.

The retrospective nature of this study has certain benefits. Prior knowledge of the study could not have influenced the clinicians' selection of cases for PM, the proffered clinical diagnoses or the thoroughness of the pathologist.

RESULTS

There were 48 male and 43 female patients. The age range was 22–90 years, with a median age of 61 years and a mean age of 60 years. Median time from the date of the first definitive treatment to death was 2.6 months, mean 7.9 months. This contrasts with the control series, in which the median and mean time from first definitive treatment to death was 11.8 and 17.5 months respectively and reflects our policy not to request a PM when detailed knowledge of disease status has already been accumulated.

Primary site

The study series differed significantly from the control series in the distribution of primary sites (Table 1a). This confirms selective requesting of PM examinations.

In only nine out of the 20 patients in the 'primary not known' group, was the primary site identified by the PM examination in contrast to a second series of 287 patients from this hospital with this diagnosis, in which PM demonstrated the primary site in 79% of patients [11]. In another three cases, the primary site was possibly identified by the *post mortem* examination and in one patient with metastatic small cell carcinoma of the lung, the PM also demonstrated a clinically unsuspected ACUP (adenocarcinoma, unknown primary) (Table 1b).

In two patients, the PM revealed metachronous, but clinically unsuspected, localized primary tumours in prostate and bladder. The PM thus uncovered a total of three (3.3%) unsuspected primaries.

Two patients in the study series had double primaries: one patient presented with a malignant fibrous histiocytoma of the thigh and simultaneous non-small cell lung cancer; another patient with Hodgkin's disease, treated with chemotherapy, developed acute myelogenous leukaemia. Apart from nine of 20 cases classified originally as primary site unknown (Table 2), the classification of the primary sites was not altered in the remaining 71 cases.

Table 1*a. Primary sites of disease*

	Post mortem series (*ante mortem* diagnosis) (n = 91)	Control series (n = 91)
Female genital	19	8
Primary not known	20	11
Bronchus, non-small cell	16	33
Lymphoma	7	2
Alimentary tract	5	14
Urinary tract	4	5
Central nervous system	4	2
Bronchus, small cell	3	5
Breast	3	3
Head and neck	3	2
Skin	3	4
Other	6*†	2
	93	91

*Includes AML in one patient with Hodgkin's disease.
†Includes soft tissue sarcoma in one patient with small cell carcinoma of bronchus.

Table 1*b. Primary sites of disease*

	Ante mortem (n = 91)	*Post mortem* (n = 91)
Female genital	19	19*
Ovary 10		
Cervix 5		
Uterus 3		
Vulva 1		
Primary not known	20	12
Bronchus, non-small cell	16	18
Lymphoma	7	8
Alimentary tract	5	10
Urinary tract	4	7
Central nervous system	4	4
Bronchus, small cell	3	3
Breast	3	3
Head and neck	3	3
Skin	3	3
Other	6	6
	93†	96‡

*Classification by site unchanged within the group.
†Two cases, double primary site.
‡Three new malignancies found by PM.

Histological diagnosis

Ante mortem histological proof of malignancy was present in 84 patients (92%). Reasons for the lack of histology in the remaining seven cases are shown in Table 3. The PM supplied the histological diagnosis of malignancy in six cases. In a further patient, the presumed diagnosis was metastatic malignancy to liver, primary not known. *Post mortem* examination established that the hepatic abnormality was massive necrosis, cause not known.

In one patient, histology was altered from ACUP to non-Hodgkin's lymphoma. However, the patient was elderly and presented with widespread malignancy and died the day after initial consultation. In a further two patients with ACUP, histology was altered (small cell carcinoma of the renal pelvis and hepatoma, respectively). *Ante mortem* knowledge of the ultimate histology would have been unlikely to have altered the outcome in any of these three patients.

Results of radiotherapy

Radical radiotherapy with curative intent was delivered to 33 sites in 33 patients, either alone (79%) or in combination with surgery or chemotherapy (21%). In 22 of the 33 patients, the radical dose volume also included the primary drainage nodes. This gave a total of 55 sites evaluable for the response to radical irradiation. The effect of PM examination on the *ante mortem* classification of both primary and nodal sites as either disease-free or persistent/recurrent disease is summarized in Figs. 1a and 1b.

The *ante mortem* assessment of the status of the irradiated sites was therefore correct in 38 (69%), incorrect in five (9%) but not stated in the *post mortem* report in 12 (22%).

Disease extent

Prior to *post mortem* examination, 26 patients (29%) were assessed as having localized disease, the remaining 65 (71%) being cases in which distant metastases had been documented (Fig. 2). PM confirmed distant metastases in all for whom adequate information was available. In three cases in which the examination was performed elsewhere insufficient data were provided to allow us to make an adequate assessment.

Of the 26 patients with localized disease at the last *ante mortem* assessment, 13 (50%) were found to have distant metastases at *post mortem*. Of these patients, one metastatic site was found in seven cases and at least three sites in the remaining six.

Table 2. The effect of PM examination on those cases classified as 'primary site unknown' (ante mortem: n = 20)

	Post mortem	
Primary site unknown		9*
Newly identified		9
Adenocarcinoma lung	2	
Non-Hodgkin's lymphoma	1	
Adenocarcinoma pancreas	1	
Adenocarcinoma stomach	1	
Adenocarcinoma caecum	1	
Small cell carcinoma renal pelvis	1	
Hepatoma	1	
Liver necrosis, aetiology unknown	1	
Possibly identified		3
Adenocarcinoma lung	2	
Adenocarcinoma thyroid	1	

*Includes one newly identified ACUP in a patient with small cell lung cancer.

Cause of death

Post mortem examination substantiated the given cause of death in 75 cases (82%) (Table 4). In eight cases (9%), the cause of death was altered by PM, the remaining eight cases being unable to be assessed (Table 5).

The eight cases in which the cause of death was changed by PM are summarized in Tables 6 and 7. In only one of these patients would *ante mortem* knowledge of the amended diagnosis possibly have affected the outcome: a 75-year-old female (Table 7, patient 4) with an anaplastic brain tumour (?lymphoma) and presumed progressive intracranial disease despite radiotherapy, was shown to have no evidence of tumour at PM, the cause of death being bronchopneumonia. Another patient (Table 7, patient 3) with metastatic carcinoma to cervical lymph nodes, in which multiple cerebral haemorrhages had been included in the differential diagnosis of the cause of the patient's neurologic deterioration prior to death, the record indicated that the given cause of death was most likely due to progressive intracranial metastatic disease. *Post mortem* examination amended this diagnosis. In one other patient (Table 6, patient 3) the death certification of 'locally advanced carcinoma of the laryngopharynx' was inappropriate on review of the clinical record, as it was apparent that the cause of death was directly attributable to recent surgery.

Table 3. Cases in which there was no pre mortem *histological proof of malignancy* (n = 7)

Reason	No. of patients	Histology as determined by PM
Died shortly after first attendance (Range 0–5 days)	3	Adenocarcinoma ovary Adenocarcinoma lung Squamous carcinoma cervix
Histology suggestive of, but not diagnostic of, malignancy	2	Squamous carcinoma oesophagus Astrocytoma Grade III
Failed FNA/fluid cytology	2	Squamous carcinoma cervix Liver necrosis, aetiology unknown

Additional information obtained from post mortem *examination*

In 56 patients (62%), *post mortem* examination failed to reveal additional pathological diagnoses which were not known *ante mortem*. In the remaining 35 patients (38%), 40 new pathological diagnoses were revealed. Of these diagnoses, 29 were judged to have arisen during the end-stage of the patient's clinical course when active therapeutic measures had been withdrawn, and we believe are of little relevance. For example, bronchopneumonia was noted as a new finding in 13, pulmonary thromboembolic disease in five and pulmonary oedema/congestion in seven patients. However, in only one instance, a 75-year-old patient in whom the cause of death was altered from progressive intracranial malignancy to bronchopneumonia (with no evidence of tumour), did PM examination reveal a potentially reversible condition.

In 10 patients in whom 10 additional new diagnoses were revealed by PM it was likely that the disease occurred prior to the end-stage of the patient's illness, when an active management course was being pursued. However, seven of these diagnoses we feel were academic (e.g. severe atheroma without a history of vascular disease, asymptomatic benign tumours or renal cysts). The remaining three diagnoses were of greater interest (paracolic abscess, subdural haematoma and renal infarction).

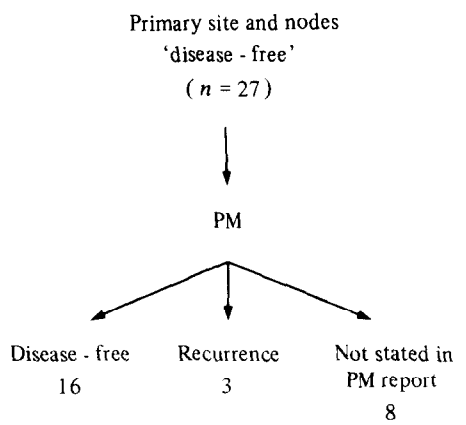

Fig. 1a. Results of radical radiation therapy.

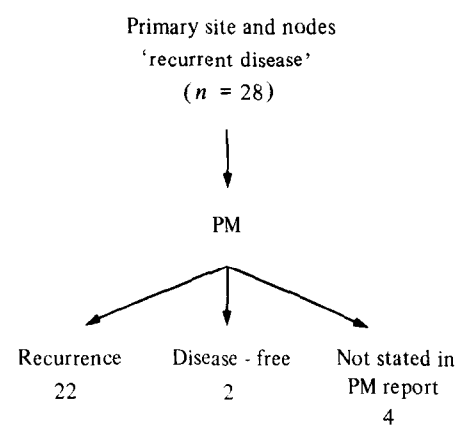

Fig. 1b. Results of radical radiation therapy.

DISCUSSION

This study has demonstrated a low yield of relevant new data derived from *post mortem* examinations performed in a selective way on patients who died after referral to a large department of radiation oncology. This finding is supported by a number of other authors [3, 5, 9]. Bearing in mind that patients were selected for *post mortem* examination on the grounds that there was a reasonable expectation

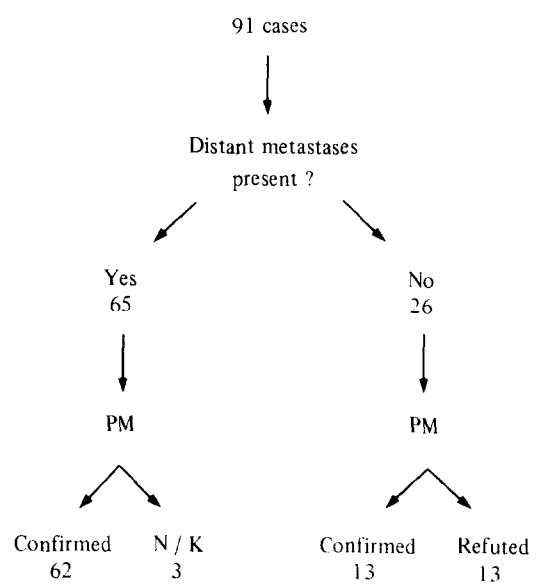

Fig. 2.

Table 4. The contribution of the post mortem *examination to the assessment of the principal cause of death*

	Death certificate present in record			
	Yes	No	Total	Percentage
Cause of death substantiated	48	27	75	82.4
Cause of death altered	4	4	8	8.8
Not assessable	2	6	8*	8.8
			91	100

*See Table 5.

of additional useful information being gained (e.g. rare or difficult case), it follows that routine requests for PM would yield even less, a concept supported by Rippey and Chatgidakis [2].

The low overall yield deserves further comment. It is well documented that *post mortem* examination is more productive in cases of sudden death, cases in which the duration of hospitalization for a newly diagnosed illness is less than one day and in patients over the age of 70 years [3, 4, 5, 9, 10]. Relatively few patients in this study fall into these categories. As well, recent technical advances in imaging and laboratory investigation may well have led to better *ante mortem* assessment and diagnosis in the cancer patient. A further factor is that the *post mortem* request form is usually completed by a junior resi-

Table 5. *Reasons for the inability to assess the PMs contribution regarding cause of death*

Patient died outside this institution, but PM performed here	3
PM elsewhere and insufficient details available	3
Death certificate unintelligible	1
Death certificate given from the PM report	1
	8

Table 6. *Cases in which the cause of death was changed by the* post mortem *examination (Death certificate available)*

	Age/sex	DC diagnoses	PM findings
1.	61F	Renal failure; carcinoma, primary site not known, metastatic to liver	Massive hepatic necrosis ?aetiology; pulmonary oedema
2.	60F	Disseminated carcinoma of ovary	Acute myocardial infarcation; disseminated carcinoma of ovary
3.	69M	Locally advanced carcinoma of laryngopharynx	Post operative oesophageal wound dehiscence. No tumour found
4.	61M	Cerebrovascular accident; disseminated carcinoma of prostate	Cerebral oedema; disseminated carcinoma of prostate. Massive pulmonary embolus

Table 7. *Cases in which the* ante mortem *assessment of the cause of death was changed by the* post mortem *examination (Death certificate not available)*

	Age/sex	Presumed cause of death	PM findings
1.	52F	Carcinoma ovary; presumed hepatic metastases; negative liver biopsies	Veno-occlusive disease of liver. No tumour found
2.	62M	Adenocarcinoma lung; presumed multiple cerebral metastases	Adenocarcinoma lung; cerebral mycosis
3.	65M	Carcinoma, primary site not known, metastatic to cervical lymph nodes; multiple cerebral metastases	Multiple cerebral haemorrhages. No tumour found
4.	75F	Cerebral tumour: ?lymphoma, ?anaplastic glioma; progressive intracranial disease and death during X-ray therapy	Bilateral bronchopneumonia; CNS negative

dent medical officer, and sometimes one not actively concerned with that patient's management when death occurs during the night for example. It follows that the pathologist may not always be provided with appropriate information which the clinician would feel was of importance in individual cases, and hence the yield from PM may be compromised.

It must be emphasized that the vast majority of patients treated within our department do not die under our care. The actual (as opposed to effective) PM rate of patients dying under our care during this study was 23%. This compares with the effective PM rate of 6.7%, which refers to those patients who died whether or not they were under our care.

As would probably be expected, *post mortem* examination changed the primary site of disease in no cases, except those of adenocarcinoma, primary not known, in which the primary site of disease was identified in nine out of 20 cases (45%). This percentage is somewhat lower than that reported in other series [11, 12].

Histological diagnosis was altered in only three cases, all of which were classified as ACUP prior to PM. In no case would the prognosis have changed if this information was known prior to the patient's demise. The *post mortem*, however, was useful in providing histological proof of clinically suspected malignancy in six cases and proving the non-malignant nature in one other. Again, these revelations were independent of prognosis.

Regarding the PM's contribution to the assessment of the results of radiotherapy, an interesting point to emerge was that although *ante mortem* assessment of the treatment volume status was incorrect in five cases (9%), this was greatly overshadowed by the number of cases in which no comment was made on the PM report as to the disease status at these sites (22%). This surely casts doubt on the efficiency of the PM as a quality control mechanism under the current system where problem-orientated requests and problem-orientated reports are unusual—perhaps a relic of the era of the 'routine *post mortem*'.

In only one case of eight in which the cause of death was altered by PM, was the outcome likely to have been altered if this diagnosis had been known prior to death (a 75-year-old female with presumed progressive intracranial malignancy whose cause of death was shown to be pneumonia, without evidence of tumour). This finding is in accordance with other series [3, 8, 9]. Although the change in death certification in the remaining seven cases would be important for epidemiological studies, it is of questionable clinical value.

Post mortem examination reclassified half of the patients felt to have localized disease *ante mortem*, as disseminated disease. However, it is important to note that our policy is not to undertake a vigorous search for metastatic disease in asymptomatic cases for which an effective systemic therapy does not exist. Such a search would no doubt have resulted in a greater proportion of patients identified as having metastatic disease *ante mortem*, for little possible gain.

As for any investigation, the total cost of a *post mortem* examination must carefully be weighed against its possible contribution. It has been adequately demonstrated that the yield of important new data in this series is relatively low. The cost of a PM at Westmead Hospital has been estimated at between $750 and $1000 per examination [13] (i.e. 2–3 times the cost of a CT scan [14]). These facts must surely cast doubt on the cost-effectiveness of a policy of *routinely* requesting *post mortem* examinations, or CT scans for that matter, in oncology patients. One possible way of improving the yield from *post mortem* examination would be the development of a problem-orientated request form, which would require the signature of the clinician in charge of the case prior to PM being performed. The form would require the inclusion of questions whose resolution would be of specific relevance to the case in question, along with the other clinical details usually supplied. In this way the pathologist would be better able to direct limited time towards areas of more clinical relevance. The *post mortem* as a quality control mechanism for clinical diagnoses may thereby be improved.

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