MEDICAL PRACTICE

Clinical Problems

Accuracy of Predictions of Survival in Later Stages of Cancer

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Summary

Though 83% of 168 cancer patients admitted for "terminal care" died within 12 weeks of admission predictions of the probable length of survival showed little relation to the actual length of survival. A total of 83% of all "errors" were in an "optimistic" direction, the patient being expected to survive longer than he actually did.

No significant differences were found between the accuracy of predictions made at referral by general practitioners, by doctors at other hospitals, by hospice physicians on the day of admission, or by ward sisters and senior nurses at the same time. A week after admission predicted and actual survival correlated more closely but predictions were still optimistic.

It is concluded that predictions of the length of time which a cancer patient who is at the end of active treatment can be expected to survive should be made and interpreted with the greatest caution.

Introduction

The prediction of the probable length of survival of dying patients is one of the least welcome tasks undertaken by medical and nursing personnel. Our ability to make such predictions correctly is likely to be important to patients and their families. The decision when to admit a patient for "terminal care," what prognosis to give to the relatives, how much time is available for imparting important but emotionally disturbing information, when relatives should be permitted to stay with the patient overnight, when the "death watch" should begin, and how much time is available to allow antidepressant drugs or other medicaments, whose therapeutic effects may not become apparent at once, to have their full effect are only a few of the reasons why it is important for us to make predictions which are accurate or, if this is not possible, to have some idea of the reliability of those predictions we do make.

Glaser and Strauss[1] claimed that "Death expectations are a key determinant in how everyone acts during the dying process. . . . Miscalculations in forecasting or perceiving trajectories can play havoc with the organization of work—as when one or more patients unexpectedly and swiftly begin to die." They also pointed out that unexpected lingering can be equally disruptive.

Contrary to popular belief St. Christopher's Hospice, Sydenham, is not solely concerned to provide terminal cancer care. Nevertheless, many patients are admitted who have cancer, who are not thought suitable for "active" treatment, and who are thought by their physician to have a prognosis of six weeks or less. Other criteria which determine priorities of admission of such cases are (1) residence in the South-east Metropolitan region, (2) younger rather than older patients (although modal age is 60-69 years), (3) complaints of pain, or (4) strong social grounds for admission. Before they arrive at the hospice, therefore, patients have already undergone a screening procedure which relies inter alia on the assumption that doctors can predict how long their patients have to live.

The research described here was an attempt to determine the correctness of these predictions.

Method

Patients with a diagnosis of cancer who were admitted to St. Christopher's Hospice during 1970-1 were included in the study. Predictions of expected survival were obtained in two ways. (1) From replies made by referring general practitioners

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or hospital medical staff on forms of application for admission of cancer patients to the hospice. They were asked to state the expectation of life in weeks. Only those patients who were admitted within a month of the date of assessment were included in the study (15 were excluded on this criterion). (2) From assessments made by experienced medical and nursing staff of the hospice on a short questionnaire. This included a request to indicate the patient's probable length of survival by making a mark on a 10-cm line marked in 12 divisions from "0" to "12 weeks or more." These assessments were made on the day of admission and, on a separate series of patients, a week after admission.

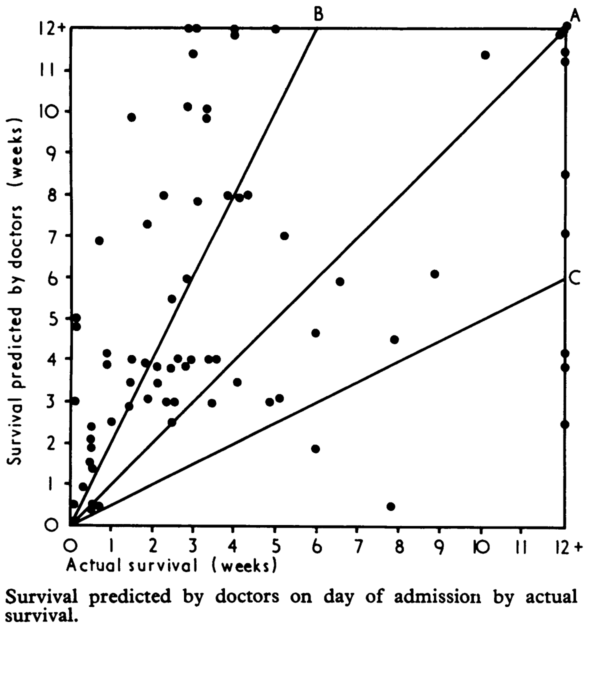
Each of these predictions was subsequently compared with the actual length of time which the patient survived, measured from the day on which the assessment was made.

Results

In 140 out of 192 successive referrals by general practitioners and 55 out of 80 referrals by hospital medical staff the referring physician had been unwilling to commit himself to a precise prediction of the probable length of survival of the patient. This left 52 forms from general practitioners and 25 from hospital doctors which contained such a prediction.

Admitting physicians and ward staff at the hospice were expected to complete their forms routinely, and we have no record of any of them refusing to do this. Nevertheless, it seems likely that a few were missed. Any bias introduced by the omission of those patients about whom predictions were not made is likely to be in the direction of omitting from the study some of the cases in which prediction was thought to be most difficult.

In the end 293 predictions of survival were made on 168 cancer patients (83% of whom subsequently died within 12 weeks of admission). The Chart shows the actual length of



Survival predicted by doctors on day of admission by actual survival.

survival among 74 patients plotted on a scattergram against the length of survival predicted by the admitting physician after he had completed his initial history and examination on the day of admission. Completely accurate predictions (of which there were six) appear on line O-A. Optimistic predictions (of which there were 49) appear above that line; in each of these cases the survival of the patient was predicted to be longer than it actually was. Pessimistic predictions (19 in number) appear below line O-A. Clearly the admitting physician was likely to be optimistic in his predictions, since there were more than twice as many optimistic as pessimistic predictions.

Lines O-B and O-C represent 100% error in optimistic and pessimistic directions. Thus the survival of any patient who appears on line O-B had been predicted to be twice as long as, in fact, it was, and any patient on line O-C had, in fact, survived twice as long as predicted. Patients appearing above line O-B or below line O-C are referred to as "errors." Using this criterion admitting physicians made 38 errors, 51% of their total predictions. Altogether 87% (33) of these errors were in an optimistic direction.

The predictions made by admitting physicians were not significantly better or worse than the predictions made by general practitioners, physicians at other hospitals, or senior nursing staff. This is shown in Table I, which compares the

TABLE I—*Errors in Prediction of Survival Made by Various Medical Attendants at Various Times*

Prediction made by:	n	100% Errors		r	t
		No.	%		
Hospital doctors on referral forms ..	25	10	40	0·27	1·34
General practitioners on referral forms ..	52	31	60	0·27	2·02*
Hospice physicians on day of admission ..	74	38	51	0·28	2·51†
Hospice physicians seven days after admission	23	13	56	0·42	2·12*
Ward sisters and senior nurses on day of admission	83	47	58	0·24	2·25†
Ward sisters and senior nurses seven days after admission	36	15	42	0·37	2·32*
All predictions	293	154	53		

*P <0·05 (two-tailed).
†P <0·01 (two-tailed).
r = Product moment correlation coefficients between predicted and actual survival time after excluding predictions or survivals in excess of 12 weeks.

proportion of errors made by each of these personnel. Overall the rate of error was 53%. Although there was a significant association between predicted and actual survival in most cases the level of correlation was low ($r = 0{\cdot}24–0{\cdot}28$).

A week after admission an interesting paradox was apparent. Predictions made at that time by hospice physicians were even more likely to be errors than they were on the day of admission, but the correlation between prediction and survival had risen to $r = 0{\cdot}42$. This is explained by an increase in the consistency of the errors. Dividing all predictions by two would have reduced the proportion of errors by half (to 30%).

Ward sisters and senior nurses also showed an increase in correlation between prediction of survival and actual survival when the predictions were made a week after admission ($r = 0{\cdot}37$), but unlike those made by the physicians these were associated with a reduction in the number of errors made (42%).

The proportion of "optimistic" errors are shown in Table II. Here too there is no significant difference between groups.

TABLE II—*Optimistic and Pessimistic Errors of Prediction of Survival made by Various Medical Attendants at Various Times*

Prediction made by:	No. of Optimistic 100% Errors	No. of Pessimistic 100% Errors	Proportion Optimistic/ Pessimistic
Hospital doctors on referral forms ..	8	2	80%
General practitioners on referral forms	27	4	87%
Hospice physicians on admission ..	33	5	87%
Hospice physicians seven days after admission	11	2	85%
Ward sisters and senior nurses on admission	39	8	83%
Ward sisters and senior nurses seven days after admission	10	5	67%
All 100% errors	128	26	83%

Predictions were consistently optimistic (83% of all errors were in the optimistic direction).

Conclusions

These findings throw serious doubt on the accuracy with which doctors and nurses are able to predict when a patient in the later stages of cancer is likely to die. Not that such predictions are meaningless; the fact that 83% of these patients died within 12 weeks of admission is itself a confirmation that the patients were rightly regarded as being in a "terminal" state.

These patients cannot, of course, be regarded as completely typical of cancer patients because of the means of selection of cases for admission, but neither are they highly atypical. We have no reason to believe that cancer patients dying in south-east London are different from those dying elsewhere. Most cancer patients die in hospital (61% according to figures for England and Wales in 1968[2]), and although patients in the older age bracket are under-represented the sample did include many elderly patients.

One possible explanation for the consistent optimism which must be considered is the possibility that the treatment which is provided for patients at St. Christopher's Hospice actually shortens their lives. If this were the case we would expect that the physicians and nurses at the hospice, whom one would expect to adopt the institutional "norm" of survival, would be more realistic in their expectations than those who work in other settings. But this is not the case, nor was there any evidence that patients given diamorphine (the principal drug given for pain in that institution) died sooner than those who did not receive this drug. It seems, then, that this explanation must be set aside.

Because uncertainty is hard to bear relatives and even patients sometimes press their doctors to give them a precise estimate of prognosis. We often hear the phrase "The doctor gave him x weeks to live," usually followed by a "but" and a disclosure of the magnitude of the doctor's error.

More often than not such anecdotes refer to pessimistic errors, and the patient's powers of survival despite the doctor's gloomy predictions are cited as evidence of his courage, determination, or laudable stubbornness. Our data suggest that doctors and nurses are more likely to be optimistic than pessimistic in their estimates at such times, a finding which suggests that their judgment is clouded by their hopes for the patient's survival or by their wish to reassure patients and relatives. It is almost as if, by doubling our realistic expectations, we can will a little more life into the patient.

Whatever the value of these speculations it does seem that until reliable indicators of prognosis have been established precise estimates of life expectancy in terminal cancer patients should be most cautiously given and interpreted.

This study was planned and initiated by the late Dr. Ronald Welldon shortly before his own unexpected death in 1969. It was carried out with the assistance of grants from the Department of Health and Social Security and the Sir Halley Stewart Trust. Thanks are due to Dr. Ann Cartwright for helpful comments on the draft.

References

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2 General Register Office, *Statistical Review of England and Wales for the Year 1968, Part 1, Tables, Medical*. London, H.M.S.O., 1970.

Scientific Basis of Clinical Practice

Control of Blood Pressure

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Four mechanisms are recognized by which the blood pressure is maintained in normal circumstances. They are (1) catecholamine release, (2) the renin-angiotensin mechanism, (3) aldosterone-sodium chloride retention, and (4) the autonomic nervous system. The first three are hormonal and are concerned mainly with sustaining a background level of vascular tone, while the fourth is neurological and is responsible for fine adjustment of the blood pressure to transient changes in the condition of the body. Each of these mechanisms may be disturbed in pathological states so as to affect blood pressure, and any of them may be interfered with by medical or surgical means in the treatment of high or low blood pressure.

Catecholamine Release

The catecholamines, adrenaline and noradrenaline, are secreted by the adrenal medulla.

A functioning tumour of the adrenal medulla, the phaeochromocytoma, liberates excessive amounts of catecholamines into the blood stream causing hypertension which is often paroxysmal. Other manifestations of sympathetic over-activity such as pallor, sweating, glycosuria, and increased metabolic rate also occur. The diagnosis of phaeochromocytoma is usually established by estimation of catecholamines in the urine, though an assay of blood levels is possible.

The manifestations of a phaeochromocytoma depend on the relative amounts of adrenaline and noradrenaline it produces. Adrenaline increases the pulse rate, the systolic blood pressure, and the cardiac output, while noradrenaline increases peripheral vascular tone and blood pressure. These different actions correspond with those mediated by beta-sympathetic and alpha-sympathetic transmission. Thus the effects of excessive circulating catecholamines in a patient with phaeochromocytoma can be blocked by using alpha-sympathetic and beta-sympathetic-blocking drugs.

Alpha receptors, which are responsible for vasoconstriction, hypertension, sweating, and contraction of the erector pilae muscles, may be blocked by such drugs as phenoxybenzamine or phentolamine. Beta receptors are blocked by drugs like propranolol. Alpha-sympathetic and beta-sympathetic-blocking drugs play an important part both in the diagnosis of phaeochromocytoma and particularly in the management of the patient during surgical treatment.

Another aspect of the differing effects of catecholamines is in their administration for therapeutic purposes. The administration of adrenaline makes good sense in patients with bronchial asthma or heart block, but is clearly contraindicated in hypo-

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