The outcome of mechanical ventilation: Report of a five year study

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Summary

In the five years 1979–1983, 486 patients were treated by mechanical ventilation in the Intensive Care Unit of a District General Hospital. Of these 43.6% died in the Unit and a further 8.9% died after discharge to the general wards. Sepsis was a major complication in 28% of patients. Renal failure was almost always a fatal complication. Of patients who had a cardiac arrest 80% died.

At the end of one year 17.2% of patients had returned to their previously normal life.

Introduction

The present Intensive Care Unit at the Royal Devon and Exeter Hospital opened in July 1974, although there had been intensive care facilities in Exeter for many years before that. By 1978 the consultant medical staff had agreed an operational policy for the Unit, an adequate number of nurses were in post, there was a reasonably satisfactory method of junior and senior medical cover and there were accepted guidelines for the management of critically ill patients admitted to the Unit. It seemed therefore, an appropriate time to begin to evaluate the work of the Unit by following up all patients treated by mechanical ventilation. This paper reports the results for the five years 1979 to 1983.

Method

The Unit's trainee anaesthetist kept detailed handwritten notes. The consultant in charge made a daily type-written summary after his ward round. When a patient died or was discharged the following information was put on to punch cards: personal details, the system of the site of the primary disease, diagnosis, complications, previous diseases, duration of stay, outcome and techniques employed. All patients discharged to the wards were seen weekly. One year after discharge from hospital they were sent a questionnaire. All data are now put on to disc.

Results

From 1st January 1979 to 31st December 1983, 1533 patients were admitted to the Unit. This is approximately 1% of all patients admitted to the District General Hospital Unit. 486 patients, 31% of Unit admissions, were ventilated. Of these, 212 patients 43.6% died in the Unit and a further 43 (8.9%) died later in the general ward. 231 patients (47.5%) were discharged from hospital. Of all patients 247 (50.8%) were over the age of 60. Mortality was highest in patients less than two years of age although this is a very small group (Table I).

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Three hundred and forty-three patients (70.6%) developed complications in the Unit (Table II). Sepsis (pulmonary and non pulmonary) was the most common complication, occurring in 137 patients (28%). There was a high associated mortality of 70%. Renal failure was the second commonest complication, developing in 81 patients. A fatal outcome almost always followed. Twelve per cent of patients

TABLE I *Analysis of deaths by age of patients ventilated*

Age	*Patients* $n = 486$	%	*Deaths in ICU* $n = 212$	*% of all ICU deaths*	*% of age group*
0–1	7	1.5	5	2.3	71
1–5	9	1.8	6	2.8	66
6–10	9	1.8	2	0.9	22
11–20	34	7.0	13	6.1	38
21–40	66	13.6	31	14.6	47
41–60	114	23.5	55	25.9	48
61–80	230	47.3	91	42.9	39
81+	17	3.5	9	4.2	51

TABLE II *Complications during mechanical ventilation—486 patients*

Complication	*Patients*	*Died in ICU*	%	*% of all patients*
Pneumonia	72	51	70.8	14.8
Pneumothorax	23	14	60.8	4.7
Lung/lobe collapse	23	5	21.7	4.7
ARDS*	34	28	82.3	6.9
Fat emboli	4	3	75.0	0.8
Cardiac arrest	59	50	84.7	12.0
Dysrhythmia	34	19	55.0	6.9
Renal failure	81	75	92.5	16.6
Jaundice	32	26	81.2	6.5
Electrolyte upset	11	8	72.7	2.2
Non-pulmonary sepsis	65	45	69.2	13.3
Surgical bleeding	38	28	73.6	7.8
DIC†	12	9	75.0	2.4
Other coagulopathy	13	10	76.9	2.6
Brain stem death	44	44	100.0	9.0
Cerebral damage	34	27	79.4	6.9
Other CNS	13	11	84.6	2.6
Depression	4	2	50.0	0.8
Anxiety state	3	0	0	0.6
Confusion	6	3	50.0	1.2
Hyperosmolar state	3	1	33.3	0.6
Pulmonary embolus	1	0	0	0.2
Airway obstruction	1	0	0	0.2

* Adult Respiratory Distress Syndrome.
† Disseminated Intravascular Coagulation.

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had a cardiac arrest which was fatal in 4 out of 5 cases. Brain stem death occurred in 44 patients. Kidneys for transplantation were removed from 23. In the remaining 442 patients mortality rose as the number of complications increased, there being a sharp rise when there were more than two complications (Table III).

TABLE III *Number of complications and mortality*

Number of complications	*Died in ICU** $n = 168$	%	*Left ICU* $n = 274$	%
None	9	6.3	134	93.7
1	44	34	85	66
2	32	47	36	53
3	48	81	11	19
4	20	77	6	23
5	9	81	2	19
6	5	100	0	0
7	1	100	0	0

* Excludes patients with brain stem death.

During 1979–82, 390 patients were ventilated. One year follow-up information was obtained from 360 patients (92%) (Table IV). Of 148 patients discharged from hospital, 37 (10.2% of all patients) were dead within a year. Sixty-two patients (17.2% of all patients, 41.8% of patients discharged from hospital) had returned to their previously normal life at the end of a year. Forty-nine patients had some disability resulting from their illness or accident.

TABLE IV *Outcome at one year of 360 patients ventilated (1979–1982)*

Outcome	$n = 360$	% *of all patients*	% *of patients discharged*
Discharged from hospital	148	41	
Dead within 1 year	37	10.2	25
Alive at 1 year	111	30.8	75
Normal at 1 year	62	17.2	41.8
Disabled at 1 year	49	13.6	33.2

Certain groups of patients occupied a great deal of medical and nursing time. Their management often required complex and invasive monitoring. The records of 188 such patients have been examined in detail for the years 1979–1982 (Table V). Fifty per cent of patients with sepsis arising from the gastrointestinal tract died. Of those who survived 76% were alive after one year. Not surprisingly, mortality following operation for leaking or ruptured abdominal aortic aneurysm was also high (54.8%). Only a third of the patients survived beyond twelve months. Patients in coma did badly. Twenty-three out of 36 severe head injuries died in the Unit as did 80% of those in whom the cause of coma was non-traumatic.

TABLE V *Analysis of those who contribute most to ICU workload 390 patients: 1979–1982*

Sepsis arising from gastro-intestinal tract	34
Emergency aortic aneurysms	31
Primary respiratory disorder	35
Self-poisoning	21
Central nervous disorder	31
Total	188

Based on 390 patients ventilated 1979 1982.

Almost two-thirds of patients with severe chest injuries were alive and well one year after they had left hospital. Poisoning had a hospital mortality of 19%. Five patients with peripheral neurological disease all left hospital. Only eight patients with chronic irreversible obstructive airways disease and two patients with severe acute asthma were ventilated. All but one left hospital and returned to their previously normal lives.

Discussion

There has been a steady rise in the total number of admissions to the District General Hospital Unit, from 25 259 in 1979 to 30 506 in 1983. The proportion of these being admitted to the Intensive Care Unit each year has remained around 1% (0.7 to 1.4%). This is in keeping with the estimate made in 1967 *(1)* that one per cent of acute beds should be used for intensive care.

The high mortality in certain groups of patients treated by mechanical ventilation reflects admission policy. Our mortality of 43.6% is similar to those in some other series. At Northwick Park *(2)* 33% of patients ventilated died in the unit and 20% after discharge to a general ward. In a more recent North American study *(3)* 57% were dead at the end of one month. These patients were classified as 'requiring continuous physician and nurse care; a nurse patient ratio of at least 1:1 and are clinically unpredictable because they need frequent changes of orders and therapy'. Patients in Exeter requiring mechanical ventilation fit this description reasonably well. Intensive care is clearly of benefit to certain groups of patients. Those with severe chest injuries, self-poisoning, peripheral neurological disease and obstructive airways disease would almost certainly have perished had they not been ventilated. Patients in these groups formed only 10% of the total number of patients needing ventilation.

The policy in Exeter is to admit patients who become critically ill because of an accident or life-threatening disease or who develop serious complications during or after surgery. Patients with diseases of known poor prognosis are only admitted after careful consideration. For example following the resection of a leaking abdominal aortic aneurysm in a 75 year old man with ischaemic heart disease, he may be cold, hypotensive, with a poor urine output and a transfusion coagulopathy. If several hours have been spent in the operating theatre trying to save his life, in the circumstances it is difficult to refuse admission. Such an admission policy raises the problem of deciding when intensive care is not likely to improve outcome. To persist with intensive care under these circumstances prolongs the patient's suffering, increases the distress of the relatives, places great stress on staff and squanders resources. Upon what basis can a decision be made that intensive care should be discontinued?

Although mortality is high at the extremes of age, 'being over 65' is not in itself a good reason to stop intensive care. The number of complications which develop is a pointer as to the likely outcome. This knowledge, together with the known prognosis of the underlying disease, provides probably the best guide currently available. In the specific circumstances of cardiac arrest *(4)*, head injury *(5)*, and non-traumatic coma *(6)*, there are now established guidelines to help in predicting outcome. Attempts also have been made to predict outcome by scoring several variables commonly present in critically ill patients and coupling this with a score for the severity of pre-existing disease *(7)*. Such numerical concepts have considerable practical limitations. They do, however, enable the severity of critical illness to be assessed objectively. This is an essential discipline in intensive care. High technology medicine has come under increasing criticism *(8,9)*, some of which is justified. Many of the techniques employed in the care of critically ill, poor risk

patients often improve temporarily the variables being measured. There is little controlled evidence that they improve outcome. Such evidence is hard to obtain because of the difficulties in comparing groups of patients in one unit or between units. To a great extent these can be overcome by using a physiological and previous health scoring system.

Nearly 10% of patients under consideration in this study died in the general ward after they had left the unit. This is probably attributable to the severity of the underlying disease but it may also be explained by too early discharge from the unit. Fewer than one in five patients had returned to their previously normal life at the end of a year. Again, this may often be accounted for by the underlying disease or the severity of the initial accident for example malignant disease and severe head injury. In other cases the reasons are less obvious and merit further investigation.

Intensive care is expensive care; expensive in manpower, equipment, drugs and stress to patients and relatives and sometimes to the staff. Such expenditure and effort must be evaluated regularly. Many factors contribute to the initiation of intensive care; the desire of both patient and family anxious for recovery, previous investment of skill and resources in the care of the patient and the legitimate search for improved methods of treatment. We must constantly ask ourselves the question whether or not to continue with intensive care is in the best interests of each individual patient.

I am grateful to my consultant colleagues who entrust their patients to the Intensive Care Unit, for their help and support; to the medical and nursing staff of the Unit for their dedication and skill and for keeping many of the initial records; to Mrs Andrea Foster for her tireless secretarial help and word-processing expertise.

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Notes on books

Biomechanics of the Knee by P G J Maquet. 2nd edition. 306 pages, illustrated. Springer-Verlag, Berlin. DM 198.

The author has updated his first edition originally published in French, applying the research of O Fischer to augment his previous static studies of stressing. The first three chapters deal with aims of the work, a review of the literature, and methods employed. The mechanics of the normal and abnormal knee are next considered followed by biomechanical treatment.

Proportions of the Aesthetic Face by Nelson Powell and Brian Humphreys. 72 pages, illustrated. Georg Thieme Verlag, Stuttgart DM 80.

The authors point out that before corrections can be made it is necessary to know what is wrong in order to decide how correction can be planned. They consider the make-up of an aesthetically acceptable face, the various sub-divisions, clinical evaluation, and the synthesis of an ideal face. The book is illustrated with line drawings.

Surgical Approaches for Internal Fixation by Th Rüedi, A H C von Hochstetter and R Schlumpf. 187 pages, illustrated. Springer-Verlag, Berlin. DM 147.

This is translated from the German and displays the various methods of exposure in the upper and lower extremities using line drawings and half tone drawings, backed up with text.

Colorectal Surgery by Sir Edward Hughes, A M Cuthbertson and M K Killingback. 433 pages, illustrated. Churchill Livingstone, Edinburgh. £37.00.

This well known and active group of surgeons from Melbourne has written a simply illustrated, comprehensive book on Colorectal Surgery starting with surgical anatomy and physiology then symptoms, investigation and presenting features followed by individual diseases and treatments. The clarity of presentation will undoubtedly make it a best seller.

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