Demographics and Clinical Outcomes of Patients Admitted to a Respiratory Intensive Care Unit Located in a Rehabilitation Center

Piero Ceriana MD, Monica Delmastro MD, Ciro Rampulla MD, and Stefano Nava MD

INTRODUCTION: A recent survey of respiratory intensive care units (RICU) in Italy showed that RICUs in Italy are mainly (85%) located in acute care hospitals. Forty-seven percent of the patients are admitted from emergency departments, and only 18% are admitted from intensive care units (ICU), so the percentage of patients admitted for difficulty in weaning is low (8%). Patient demographics and admission patterns in RICUs located outside acute care hospitals have not been previously described. METHODS: We analyzed admission patterns, demographics, treatment, and outcomes of patients during the first year of operation of a 7-bed RICU located in a rehabilitation center that does not have an emergency department. RESULTS: In the 1-year study period, 96 RICU patients were admitted for acute or chronic respiratory failure. The patients' mean Simplified Acute Physiology Score II was 28.9 ± 3.6. Sixty-five percent of the patients were transferred from the ICU, 17% from medical wards of other hospitals, 7% and 5%, respectively, from the medical and surgical wards of our hospital, and 6% came directly from home for a periodic check. Difficulty in weaning from mechanical ventilation was the main reason for admission (42%), followed by simple monitoring (37%) and need for acute ventilatory invasive or noninvasive support (21%). Thirty-one patients had COPD, 23 had acute hypoxemic respiratory failure, 30 had post-surgical complications, and 12 had neuromuscular disease. Twenty-seven of 40 patients admitted for difficulty in weaning were liberated from ventilation. Intrahospital mortality was 13%. Fifty percent of patients were discharged directly to home; those patients' mean Dependence Nursing Scale score (which measures the degree of patient independence) improved during hospital stay (decreased from 23 to 12 [$p < 0.05$]), whereas the remaining patients were transferred to long-term facilities or an acute care hospital. CONCLUSIONS: The admission pattern at our RICU in a rehabilitation center is quite different from that of an RICU in an acute care hospital. Most of our patients are admitted from ICU because of difficulty with weaning. This may be the consequence of the institutional philosophy of rehabilitation centers, which strive to achieve greater patient independence. *Key words: respiratory, intensive care unit, weaning, rehabilitation.* [Respir Care 2003;48(7):670–676. © 2003 Daedalus Enterprises]

Introduction

Human health comprises many different states, ranging from perfect health to critical illness, so medical facilities should be able to provide medical assistance tailored to the patient's degree of disease. Unfortunately, there is frequently a "gap" between intensive care units (ICU), which care for patients with life-threatening conditions, and general wards, which care for patients with conditions ranging from mild to severe but stable. Hence, it can happen that a patient can remain in a critical care bed without needing intensive care, but rather only monitoring,[1] or that an acutely ill patient can be transferred to an overly busy general

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ward that does not have facilities adequate to care for that patient.

Respiratory intensive care units (RICUs) have been opened in the United States[2] and in Europe[3] to fill the gap between the ICU and general medical ward, to decrease medical costs,[4] to spare critical care beds,[5] and to treat the patient in a more comfortable environment.

A recent survey of RICUs in Italy found that 85% of Italian RICUs are in acute care hospitals; the other 15% are located in rehabilitation centers.[6] Almost 47% of RICU patients are admitted from emergency departments and only 18% are transferred from ICUs. Twenty-nine percent of patients are admitted for monitoring of clinical instability, 63% require noninvasive or conventional mechanical ventilation, and 8% are admitted for weaning from mechanical ventilation.

In an RICU located in acute care hospital the reasons for admission, the interventions employed, and the case mix are probably different than in an RICU in a rehabilitation center. In Italy an RICU in a rehabilitation center can admit unstable patients with respiratory failure from other hospitals or from other medical wards within the same hospital, but not from an emergency department.

The survey of Italian RICUs reported by Confalonieri et al[6] mainly reflects the situations of RICUs located in acute care hospitals. We analyzed the admission patterns, demographics, treatment, and outcome of patients during the first year of operation of a 7-bed RICU located in a rehabilitation center.

The Italian National Health Service is primarily government funded: a large majority of public hospitals (about 85% of hospital beds) and a minor share of private hospitals receive most of their funds through the National Health Service. A series of health care reforms introduced in 1995 in Italy substantially changed hospital financing, moving from a global budgeting approach to a prospective payment system based on the diagnosis-related group (DRG) per case, with the aim of controlling hospital costs and making hospitals more accountable for their productivity. The reforms also involved new rules regarding the use of hospital beds; the majority of the beds are devoted to the treatment of acutely ill patients, independent of the baseline disease (eg, medical, surgical), with a minor share devoted to the care of patients in need of comprehensive rehabilitation. These rehabilitation wards can be located within acute care hospitals, but generally they are structured as rehabilitation hospitals, which provide the full range of therapies for chronic diseases. With respect to the reimbursement method, there is a substantial difference between acute care beds and rehabilitation beds. With acute care beds the DRG-based per case is applied. Rehabilitation beds are reimbursed on a per diem basis, with some possible increases according to the DRG classification. Therefore the charge per diem per patient is closely linked to the underlying diagnosis. Furthermore, the reimbursement system adopted for rehabilitation beds has tight budget constraints, since the fee per diem is applied only to a limited number of days (40–60 d, depending on the DRG); beyond that the charge is drastically curtailed. Another important difference lies in the presence of emergency out-patient departments in acute care hospitals, whereas this is not the case for the rehabilitation hospitals, where patients are transferred from other wards (including general ICUs) or are admitted from home according to a scheduled therapeutic program.

Setting

Our 7-bed RICU is located within the respiratory department of a 350-bed rehabilitation hospital that serves an urban area that has a population of $>$ 200,000 and a regional university hospital with more than 1,000 acute care beds.

Our rehabilitation hospital provides a full range of rehabilitation treatments for patients affected by chronic respiratory, cardiac, and neurologic diseases, and those recovering from major neurologic, cardiac, and orthopedic surgery. The hospital also has full facilities to deliver cancer treatment, palliative treatment, and pain treatment. Our respiratory ward is fully equipped for invasive and noninvasive ventilation and monitoring.

Noninvasive mechanical ventilation for stable patients suffering from obstructive or restrictive diseases or from obstructive sleep apnea is usually carried out in the respiratory ward, whereas invasive or noninvasive ventilation of unstable patients is carried out in the RICU beds.

The RICU staff includes 8 physicians, 3 physical therapists, and 20 nurses. In the RICU there is always at least one physician and one physical therapist present. The nurse/patient ratio is 1:3 during morning and afternoon shifts and 1:6 at night.

Methods

Patient Admission

In the absence of an out-patient department for emergency admissions, patients are transferred to our RICU from:

1. Non-RICU beds in our ward if continuous monitoring becomes mandatory or for invasive ventilation if noninvasive ventilation fails
2. Other wards in our hospital if the patient develops respiratory insufficiency refractory to medical therapy
3. Medical or surgical wards of other hospitals
4. ICUs of other hospitals

In the first 2 cases the decision to admit the patient into our RICU is made by a staff physician, after examining the patient. In the latter 2 cases the patient's case history is briefly summarized during a telephone call from the referring hospital, then a form (to be filled in by the physician on duty) is faxed in order to collect all the information about the patient's clinical status; upon evaluation of the form the final decision to transfer the patient is made and the admission is scheduled.

Therapies

Every patient started a program of intensive physical therapy that lasted throughout his or her stay in our RICU. This program has 4 steps, of increasing difficulty: postural positioning, walking retraining, respiratory muscle training, and lower extremity rehabilitation.[7] The rehabilitation program was started as soon as the clinical conditions allowed; in fact, we even started the basic rehabilitation interventions (ie, positioning and passive mobilization) in a large portion of unstable patients (ie, those on noninvasive ventilation or with cardiac arrhythmia) under close monitoring.

As was previously done in the study by Confalonieri et al,[6] for data analysis we divided the patients into 3 groups, according to the objective of therapy: monitoring, ventilation, or weaning. Patients in the monitoring group did not receive mechanical ventilation; they had almost completely recovered from acute illness but were not yet ready for a general care ward; they needed continuous monitoring, bronchial toilet, and nursing.

The group that required mechanical ventilation included patients previously enrolled in long-term domiciliary ventilation programs, for whom the possibility of weaning had already been ruled out, and/or patients needing temporary noninvasive assistance for acute respiratory failure.

Patients in the weaning group were invasively ventilated via tracheotomy. Their respiratory failure was potentially reversible, so they were in the weaning program to evaluate the possibility of freeing them from ventilator dependence.[8] On arrival in the RICU invasive ventilation was started in pressure-support mode, with a respiratory frequency < 30 breaths/min and a mean tidal volume of about 6–8 mL/kg. Upon achieving clinical stability (absence of acute infection, neurologic deficit, or gross metabolic abnormality), the weaning program was started with a trial of spontaneous ventilation to test the patient's degree of ventilator dependence. Then, during the following days, after optimization of medical therapy and acquisition of further data about the patient's respiratory mechanics, spontaneous ventilatory capacity was gradually improved by progressive reduction of mechanical ventilatory support level and longer periods of disconnection from the mechanical ventilator.[8]

The Simplified Acute Physiologic Score II (SAPS II)[9] was used to evaluate the severity of disease and was recorded within 24 hours of RICU admission.

Data Collection

We prospectively recorded age, sex, where the patient was admitted from, underlying disease causing respiratory failure, presence of tracheostomy, SAPS II score, therapeutic interventions, and discharge information. The degree of functional disability was evaluated using the Dependence Nursing Scale (DNS),[10] a score correlated to the degree of assistance needed to satisfy basic personal needs such as self care, hygiene, speech, sputum clearance, and feeding. A higher score corresponds to a higher level of assistance required. DNS was measured at admission and at discharge from our RICU.

For patients transferred from ICU for weaning purposes we also recorded the number of days of previous mechanical ventilation, percentage of weaning success, and duration of the weaning process. "Weaned" was defined as no need for mechanical ventilation after 48 hours of spontaneous breathing. Weaning duration was considered to begin at RICU admission and to last until definitive liberation from ventilation.

We also recorded the time (in days) between the request by the referring intensive care specialist for RICU admission and actual admission into the RICU.

Baseline diseases were divided into 4 groups:

1. Chronic pulmonary disease (diagnosed based on medical history and functional data)
2. Acute respiratory disease (refractory hypoxia, pneumonia, pulmonary embolism, post-acute phase of acute lung injury/acute respiratory distress syndrome)
3. Postoperative respiratory failure
4. Respiratory failure in the context of a neuromuscular disease

Patients gave written informed consent for anonymous handling of their patient data for scientific purposes.

Outcome Measures

Our main aim in rehabilitation is to improve the patient's degree of disability, and we chose 3 indexes to evaluate improvement during RICU stay:

1. Weaning from mechanical ventilation
2. Change in DNS score
3. Weaning from tracheostomy

Regarding weaning from tracheostomy, we devised and validated a decision flow chart.[11] The tracheal cannula was

Table 1. Causes of Respiratory Failure

Disease	Patients (*n*)
Chronic Pulmonary Disease	
COPD exacerbation	25
Bronchiectasis	1
Kyphoscoliosis	4
Idiopathic interstitial fibrosis	1
Total	31
Acute Pulmonary Disease	
Refractory hypoxia	4
Post-ARDS fibrosis	3
Lung abscess	2
Cardiogenic pulmonary edema	9
Pneumonia	4
Pulmonary embolism	1
Total	23
Post-Surgical Respiratory Failure	
Cardiovascular surgery	13
Trauma	3
Abdominal surgery	3
Neurosurgery	5
Lung surgery	6
Total	30
Neuromuscular Disease	
Myositis	1
Mitochondrial muscle disorder	1
Amyotrophic lateral sclerosis	5
Charcot-Marie-Tooth disease	2
Degenerative spinal cord disease	3
Total	12

COPD = chronic obstructive pulmonary disease
ARDS = acute respiratory distress syndrome

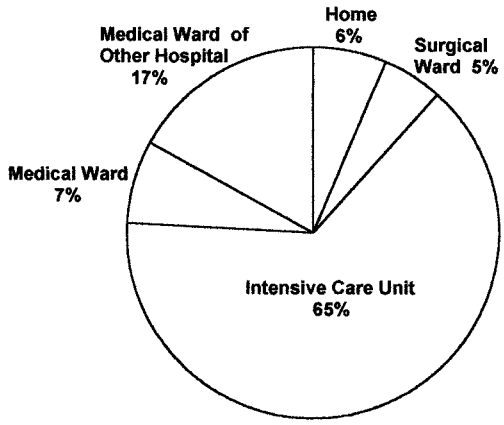

Fig. 1. Locations from which the RICU patients were admitted.

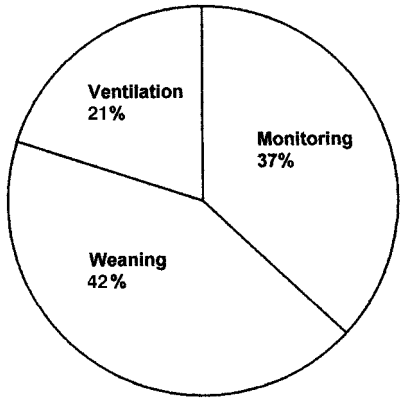

Fig. 2. Percentages of patients assigned to the 3 therapeutic intervention groups.

removed when all the following requirements had been met: clinical stability, $P_{aCO_2} < 60$ mm Hg, absence of delirium or other psychiatric disorders, absence of tracheal or glottic stenosis, adequate secretion clearance, proper swallowing function, patient's consent.

Statistical Analysis

We used the chi-square and Wilcoxon tests to compare the admission and discharge DNS scores and to compare the number of patients admitted and discharged with tracheal cannulae. Differences were considered statistically significant when $p < 0.05$.

Results

Ninety-six patients (58 men, 38 women, mean age 67 ± 12 y) were admitted to our RICU during the first year of activity. They had a mean SAPS II score of 28.9 ± 3.6. Eighty-three patients were discharged.

Table 1 lists the baseline lung diseases and causes of respiratory failure. Figure 1 shows from where the patients were admitted. Figure 2 shows the types of therapy performed.

Patients admitted for weaning from mechanical ventilation were transferred from 18 different ICUs, located in 4 regions of northern Italy. With patients transferred from ICUs a mean of 6.5 ± 4.5 days elapsed between the admission request from the ICU and admission to the RICU.

Table 2 shows the weaning group's ($n = 40$) days of previous mechanical ventilation, rates of weaning success, and duration of weaning. Twenty-seven patients (67.5%) were successfully weaned. Thirteen patients (32.5%) were not weaned. Of those 13 patients, 4 died during the weaning program, 1 was totally ventilator-dependent because of end-stage pulmonary fibrosis, and the remaining 8 patients were not totally ventilator-dependent but needed ventilatory support at least at night. Of the latter 8 patients, 1 had a progressive neuromuscular disease (Charcot-Marie-Tooth

Table 2. Mechanical Ventilation Weaning Data*

Baseline Disease	Patients (*n*)	Patients Weaned (*n*)	Patients Not Weaned (*n*)	Duration of Mechanical Ventilation Before RICU Admission (d)	Duration of Weaning (d)
Chronic pulmonary disease	18	9	9	30 ± 18	12.5 ± 7
Acute pulmonary disease	10	9	1	41 ± 24	7.2 ± 5
Post-operative respiratory failure	10	8	2	51 ± 10	7.1 ± 2
Neuromuscular disease	2	1	1	32 ± 8	4
Total	40	27 (67.5%)	13 (32.5%)	38 ± 15	7.7 ± 4

*Patients admitted for weaning from mechanical ventilation, grouped according to baseline disease.

syndrome [peroneal muscular atrophy]), and the remaining 7 had end-stage chronic obstructive lung disease.

The mean DNS scores at admission and discharge were, respectively, 22 ± 5 and 13 ± 3 ($p < 0.05$). Seventy-eight patients (81%) had tracheostomy on admission and 41 patients (41/83, 49%) were discharged weaned from tracheostomy ($p < 0.05$).

Figure 3 shows the disposition of patients upon discharge: 50% went home, 30% completed the rehabilitation program in other wards or were transferred to long-term facilities, 7% required specialized therapies in acute care hospitals, and 13% died.

Discussion

According to our institutional rules, an RICU should admit (1) patients suffering from acute or acute-on-chronic respiratory failure and who do not yet need tracheal intubation; (2) patients in the post-acute phase of a critical illness who still needing monitoring, nursing, and physiotherapy; and (3) patients to be weaned from mechanical ventilation.[12] The presence of an emergency department in an acute care hospital causes admission of a great number of unstable patients suffering episodes of recent-onset acute respiratory failure and who mainly require monitoring and ventilatory assistance. In contrast, rehabilitation centers generally see more clinically stable patients and have a therapeutic approach inspired by rehabilitation philosophy. The primary goal of rehabilitation is to restore the patient to the highest possible level of independent function.[13] Applying this concept to patients on invasive mechanical ventilation, the primary objective is weaning the patient from ventilator dependence and, hopefully, from tracheostomy. Hence, rehabilitation RICUs should be oriented toward weaning as the main therapeutic intervention.

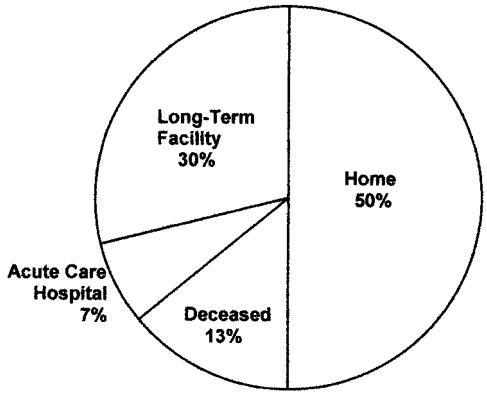

Fig. 3. Disposition of the RICU patients upon discharge.

Thirty-seven percent of our patients were admitted for monitoring, 21% for ventilation therapy, and 42% for weaning, whereas in the survey of Italian RICUs[6] the corresponding percentages were 29%, 63%, and 8%. Sixty-five percent of our patients came from a general ICU, 17% from a medical ward of a different hospital, 7% from a medical ward within our hospital, 5% from a surgical ward, and 6% from home. In contrast, data pooled from the survey report by Confalonieri et al[6] indicate that the majority of patients were admitted from emergency departments (47%), whereas only 18% came from general ICUs, and lower percentages came from other wards. We suspect that acute care RICUs receive mainly patients suffering new-onset acute respiratory failure, admitted directly from emergency departments, whereas rehabilitation RICUs mainly receive patients in need of ventilator weaning and who are transferred from ICUs.

It is clear that the presence of an emergency department strongly influences the pattern of RICU admissions, but both acute and rehabilitation RICUs achieve the primary goal of unloading critical care units, either by filtering out patients who are not so ill as to require ICU admission or by "draining off" patients who no longer require intensive treatment but cannot safely be sent to a general ward. Furthermore, rehabilitation RICUs preferentially admit patients from ICUs because their institutional philosophy is oriented toward ventilator weaning, which is fundamental to achieving greater patient independence.

Fifty percent of the discharged patients were discharged to home. This patient-discharge pattern has also been proposed as a published decision flow-chart.[14] Nevertheless, it is noteworthy that most patients had an interim stay in our rehabilitation ward to complete the program.

Our data on weaning outcome are consistent with those reported from other weaning centers[15,16] and demonstrate that good results can be achieved in specialized centers in which diverse cases are seen, especially when the approach to the ventilator-dependent patient is strongly focused on rehabilitation.[17] However, it must be said that North American RICUs, such as regional weaning centers and step-down units, admit only ventilator-dependent patients and are therefore true specialized units entirely devoted to ventilation therapy and weaning, whereas RICUs in Italy collect a more diverse case mix, including patients who need only monitoring and noninvasive ventilation, mainly because of the lack of other intermediate-care wards.

In our study cohort the baseline underlying disease significantly impacted duration of weaning and final outcome, which agrees with data from other authors,[17] who reported easier, faster weaning with patients who suffered postoperative respiratory failure than with those who suffered chronic obstructive pulmonary disease.

With respect to the time lag between the request for an RICU bed and admission into the RICU, it is true that more than a week can be a long time to wait, especially when overly-busy ICUs must quickly discharge patients in order to make beds available for more critically ill patients. However, it is also true that there are fewer RICU beds in Italy ($n = 155$) than the estimated requirement ($n = 600$),[18] so the RICU beds are almost always full and are rarely available quickly. On the other hand, the analysis of the mean SAPS II score indicates that when the patient is admitted to the RICU, the severity of his or her condition is still considerable (mean score $> 28.9 \pm 3.6$), so the time elapsed before transferring the patient from the ICU has been less than that needed to achieve the patient's complete stability and transfer him or her to a general care ward. Therefore, a considerable number of ICU-days/patient are saved anyway.

The importance of this is even more apparent when we consider: (1) the average daily cost of an ICU bed in Italy (about $1,500)[19] compared to the daily cost of an RICU bed (about $800)[20] and (2) the shortage of ICU beds that, in Italy, account for 1.7% of total hospital beds, according to data collected in 1992 from the Italian Central Service for Health Planning.[21] Therefore, in Italy's multi-tiered care delivery system RICUs find their ideal location and role between ICUs and general wards. However, the average per diem reimbursement is still far below the actual expenses.

The present, mainly descriptive, report has some limitations. First, it deals only with the situation in Italy. However, we think our data might be representative of the European Community, because Italy, Germany, and France are the leading European countries with respect to RICUs.

Second, a cost-effectiveness analysis was not performed. However, such a study might be very difficult to perform, because the patients are admitted from various places, which makes it difficult to collect baseline assessment data at the time of the patient's acute decompensation.

Conclusions

Our data indicate that a certain degree of subspecialization is achieved in RICUs: those located in acute care hospitals preferentially treat acute episodes of respiratory failure, whereas those located in rehabilitation hospitals act mainly as weaning centers. That difference is almost entirely due to the different sources of admission and, far from being any sort of "distortion" of the system, can be desirable and greatly contribute to patient outcomes.

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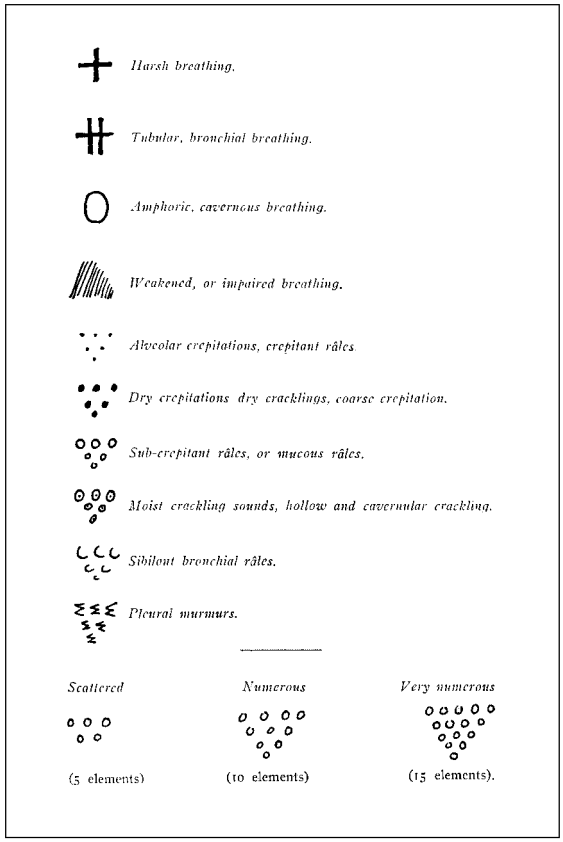

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