

## Case Report

# Recovery Room: Evaluation of Efficacy and Safety in a Cancer Center after 13 Years of Activity

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**Abstract**

The aim of this study was to assess the characteristics of patients admitted to a recovery room [RR] in an oncological department. The secondary outcomes were to evaluate how RR was able to prevent immediate postoperative complications and which are the principal factors influencing RR stay.

A consecutive sample of cancer patients who were admitted in RR was surveyed. Patients who received some form of anesthesia by specialized staff were included. Patients were discharged to their ward when they achieved a safety score and adequate symptom control. The patient's level of consciousness, respiration, hemodynamics, mobility of the extremities, oxygen saturation [SO<sub>2</sub>] were recorded, on a scale from 0 to 2 [modified Aldrete score], as well as pain intensity, vomiting, shivering, and drugs administered in RR. Patients, who were expected to need respiratory support for the subsequent 24-48 hours after evaluation in RR, were discharged to continue non-invasive ventilatory support [NIV] in a sub-acute unit, according to local policy.

1185 patients were surveyed. The mean age was 59.4 yrs [SD 14]. At RR admission, the mean SO<sub>2</sub> was 98.1 [SD 2.2], with 10[0.8%] patients having a SO<sub>2</sub> of less than 90%. The level of consciousness was normal in 847 patients, patients were sedated [score 1] in 246 cases, and 8 patients had more profound level of unconsciousness [score 2]. (NOTE: this does not make sense – do you mean unconsciousness?). On admission to RR, 1079 patients were spontaneously breathing, one patient was intubated and breathing spontaneously, three patients had a laryngeal mask airway, 87 were intubated and manually ventilated but extubated shortly after arriving to RR. Seven patients were intubated on arrival to the RR and received CPAP. One patient underwent controlled ventilation. Two patients had to be re-intubated in RR, and one patient needed a laryngeal mask airway to be inserted. The mean duration of RR stay was 61.3 minutes [SD 54]. Using an univariate analysis, the duration of RR stay was correlated to age, duration of surgery, ASA, gender [male], obesity, cardiovascular disease, renal disease, and abdominal surgery. Significant correlation was found only with gender, ASA, obesity, cardiovascular disease, and duration of surgery. In order to maintain respiratory support mainly through non-invasive ventilation [NIV], 51 patients [4.3%] were discharged from RR to a sub-intensive Care unit for a median duration of 1 day.

RR is of paramount importance for the management of cancer patients undergoing different types of surgery. Patients can be monitored and stabilized after an appropriate treatment until the best balance is achieved. Thus, admission to RR improves patient safety and efficacy of treatment.

**INTRODUCTION**

For anesthesiologists, involvement in optimizing safe recovery from anesthesia is a key component of peri-operative medicine. Admission to a recovery room [RR] post-operatively is considered vital for quality of post-anesthetic care and patients' safety [1]. A significant number of surgical and anesthesia related complications occur shortly after the patient leaves the operating room. It has been shown that an elevated percentage of complications, either surgical or anesthesiological, occur soon after discharge from the operating room [2,3].

In recent years a SIAARTI study group has developed recommendations for post-anesthetic care. They recognized

the need for an area specified and specially equipped for recovery in close proximity to the operating rooms where the patients' cognitive function, respiratory and muscular activity, hemodynamics, diuresis, and temperature could be monitored closely. Moreover, symptoms such as shivering, pain, nausea and vomiting, as well as the consequences of surgery [bleeding, draining etc] could be assessed for an eventual therapeutic intervention [4]. These recommendations also provide indications on the criteria of discharge and transport to surgical wards. Moreover, a law which defines the presence of RR as essential criteria for accreditation for operating rooms, has been published in 1997 in Italy [5]. However, RRs are lacking in the majority of Italian hospitals and immediate postoperative

monitoring is guaranteed in a minority of patients due to infrastructure problems, as many hospitals were built in the sixties-seventies [6].

The aim of this study was to assess the characteristics of patients admitted to RR, in an oncological department. The secondary outcomes were to evaluate how RR was able to prevent immediate postoperative complications and what are the principal factors influencing RR stay.

## PATIENTS AND METHODS

Data from a consecutive sample of cancer patients who were admitted to RR at La Maddalena Cancer Center after surgery ereover was collected for a period of 9 months. Patients who received some form of anesthesia by specialized staff were included, while patients who received local anesthetics only, were excluded.

La Maddalena Cancer Center is an oncological department with 75 beds with medical oncology units, radiotherapy, pain and supportive care, and different surgical specialties, including an abdominal-general surgery unit, a breast unit, a gynecological unit, a thoracic-endoscopic procedure unit, and occasionally other interventions requiring external consultants.

In 1999 La Maddalena Cancer Center followed the recommendations of SIAARTI and constructed a RR that is located close to the operating theatres [4]. After operation, patients are admitted to a four bed RR, where they are monitored until full recover from anesthesia is achieved. Anesthesiologists accompany the patient during transportation from the operating theatre to RR, and provide handover information to the nurse accepting the patient. They also provide instructions to the RR nurse including the need to ventilate, inotropic infusion, pain killers, and so on. Patients who are unable to be extubated in the OR are transferred to RR intubated and ventilated. Although there is a central nursing station where it is possible to concentrate all data deriving from the single monitors on one single screen, all patients are under the supervision of one trained nurse. Assisted by auxiliary staff. A special form is used to record the principal parameters during the patient's stay in RR. The patient's level of consciousness, respiration, hemodynamics, level of activity of extremities, oxygen saturation [O<sub>2</sub>] [on a scale from 0 to 2], according a modified scale of Aldrete and Froulik [7], were recorded Pain intensity, vomiting, shivering, drugs administered in RR are also recorded. Patients with a pain intensity of  $\geq 4/10$  [on a numerical scale of 0-10] [NOTE: Is this based on pain intensity? – you need to clearly define] receive intravenous opioid dose titration, generally with morphine. The successful doses are used to calculate the dose for the next 24 hours [8]. In particular the effective dose is multiplied by four and the same dose is prescribed as needed. Analgesia of patients with epidural catheter is re-assessed and infusion rate of local anesthetics changed according to the clinical need and hemodynamics. Changes of treatment [extubation, intubation, or starting ventilation], are performed according to the clinical need during RR stay according to the evaluation of the anesthesiologist responsible for the case. Warming is provided by blankets and meperidine is used for shivering. Despite formal handovers, informal communication and friendly environment between

anesthesiologists and nurses are common. Anesthesiologists are available in the operatory rooms for any question, and occasionally a supervisor is present in RR for specific cases.

Patients are discharged to their ward when they achieve a safety score and adequate symptom control [pain intensity less than 4/10, no shivering etc] NOTE: Again please define what is adequate]. Nurses and physicians sign a form to allow the discharge and a postoperative prescription for the first 24 hours is provided for the ward. Alternately, patients who are expected to need respiratory support for the subsequent 24-48 hours after evaluation in RR, are discharged to continue non-invasive ventilatory support [NIV] to a sub-acute unit, according to local policy.

## Statistics

Statistical analysis of quantitative and qualitative data, including descriptive statistics, was performed for all data emelements. Continuous data were expressed as mean  $\pm$  standard deviation, unless otherwise specified. The continuous variables that were independently prognostic of RR duration were assessed using univariate and multivariate linear regression models. Slope coefficients and standard errore were calculated. Data were analyzed using the Epi Info software [version 6.0, CDC, Atlanta, GA, US] and the SPSS Software 14.0 version [SPSS, Inc., Chicago, Ill, US]. All P values were two-sided and P values less than 0.05 were considered statistically significant.

## RESULTS

1185 patients were surveyed. The mean age was 59.4 yrs [SD 14], 257 patients were males and 928 were females. 108and One-hundred-eight and 596 were gynecological and breast surgery patients, respectively, 345 were abdominal-general surgery patients, 101 were thoracic surgery patients, 31 were urologic patients, three patients received an orthopedic intervention, and one patient was hematological [bone marrow transplantation]. Anesthesia techniques are described in table 1.

421 [35.5%] patients had a cardiovascular disease, requiring preoperative medical treatment, and 93 [7.8%] had abnormal urea or creatinine values. 106 were considered obese. The mean ASA status was 2.4 [SD 0.5], with 31[2.6%] patients belonging to ASA 4 group.a techniques. The mean duration of all procedures was 61 minutes [SD 53], with the maximum duration of 680 minutes. 55 patients received blood products during operation or during RR admission. Vasoactive medications were administered to maintain hemodynamic stability in 115 patients. Emergent procedures were deemed necessary in 21 patients.One patient with advanced myeloma died two days after an urgent tracheotomy. This death was attributed to the terminal stage of disease.

**Table 1:** Anesthesiological techniques.

|                                        |      |
|----------------------------------------|------|
| General anesthesia                     | 565  |
| General and epidural anesthesia        | 217  |
| General anesthesia with laryngeal mask | 248  |
| Spinal anesthesia                      | 65   |
| Profound sedation, without intubation  | 86   |
| Total                                  | 1185 |

On admission to the RR, the mean SO<sub>2</sub> was 98.1 [SD 2.2], with 10[0.8%] patients having a SO<sub>2</sub> of less than 90%. The mean HR was 108.3 [SD 100]. The level of consciousness was normal in 847 patients, patients were sedated [score 1] in 246 cases and 8 patients had more profound levels of unconsciousness[NOTE: again do you mean unconsciousness?] [Score 2]. At RR admission 1079 patients were spontaneously breathing [score 0], one patient was intubated and breathing spontaneously, three patients had a laryngeal mask airway.

Eighty-seven patients arrived intubated and manually ventilated to RR but were extubated few minutes after. Seven patients arrived intubated and received CPAP in RR, and one patient underwent controlled ventilation. Two patients were re-intubated in RR, and in one patient a laryngeal mask was inserted.

Of the 1185 patients, 51 patients [4.3%] were discharged from RR to a sub-intensive ward unit with a non-invasive ventilation [NIV] with a face-mask, for a median duration of 1 day. No patient remained intubated or was transferred to an intensive care unit. Postoperative NIV was associated with male gender,  $p < 0.0005$ , cardiovascular diseases [ $p < 0.0005$ ], type of surgery [abdominal and thoracic,  $p < 0.0005$ ], use of red cell transfusions [ $p < 0.0005$ ], and inotropics [ $p < 0.0005$ ], poor hemodynamic control [ $p < 0.0005$ ], obesity [ $p = 0.014$ ], oliguria [ $p < 0.0005$ ], advanced age [ $p < 0.0005$ ], higher ASA status [ $p < 0.0005$ ], duration of surgery [ $p < 0.0005$ ], lower SO<sub>2</sub> [ $p < 0.0005$ ], duration of RR stay [ $p < 0.0005$ ].

Twelve patients vomited in RR. 230 patients had uncontrolled pain requiring immediate treatment in RR with intravenous opioids. 250 patients had shivering requiring treatment, mainly with meperidine. Delirium was observed in 14 patients [one of them was oligophrenic].

The mean duration of RR stay was 61.3 minutes [SD 54], and 152 patients needed monitoring for more than 1 hour in RR. Regression analysis regarding factors influencing the duration of RR stay is shown in table 2. Using univariate analysis, the duration of RR stay was found to significantly correlate to advanced age, duration of surgery, ASA, gender [male], obesity, cardiovascular disease, renal disease, and abdominal surgery. Using multivariate analysis, a significant correlation was found between RR stay and male gender, ASA, obesity, cardiovascular disease, and duration of surgery. Hemorrhage requiring monitoring, transfusion or rewas recorded in 8 patients during RR staying, and 7 patients were re-operated successfully.

## DISCUSSION

The activity of a RR which has been working for 14 years, described in this study, has shown that patients are optimally managed reducing the risk of complications or preventing unpredictable negative events. Differently from other models where patients stay overnight with obvious economical considerations [9], this RR provides fast-track intervention and duration of stay proportional to the cases according to simple and reliable scoring system and close clinical monitoring. About 1/10 of cancer patients undergoing surgery manifested problems prolonging recovery which were resolved during RR stay, sparing time for operatory room activities. For example, in some cases patients were transferred to RR for a faster turnover from one operation to the next to save time and planning removal of tubes or laryngeal masks soon after in the RR, as reported in a process optimization study [10]. Of interest, ASA levels were high in a large number of patients, and only a minority were admitted to a sub-intensive care unit, with monitoring facilities and NIV, and none were transferred to intensive care unit. NIV was prevalently used in thoracic surgery patients, and was discontinued within 24 hours in most cases. Thus, admission to intensive care unit was not necessary despite the severity of patient conditions and duration of surgery. As expected, a series of factors were positively related to RR stay, including the duration of surgery, major abdominal surgery [like pancreatic and liver surgery], male gender [possibly because the large number of patients with breast surgery with RR stay of about 30 minutes], ASA level, and comorbidities like cardiovascular disease and obesity. Immediate surgical complications were diagnosed allowing an immediate treatment. A certain amount of patients stayed more than 60 minutes in RR.

Aggressive pain and symptom control was necessary in about 25% of patients. The opioid titration performed in a safe environment such as RR allows quantifying the requests to be prescribed subsequently in the postoperative period, as reported in previous studies [8]. It has been reported that the careful use of opioid in RR was not associated with additional morbidity or length of stay [11]. Thus, this approach may be useful to start the postoperative pain management and facilitate the subsequent treatment [12].

All guidelines agree on the fact that postoperative patients must be observed in a protected and safe environment [13]. In a study performed more than 20 years ago, 6% of incidents [NOTE: what type of incidents?] occurred in the RR and were associated with significantly more adverse outcomes than incidents in the

**Table 2:** Factors influencing duration of RR staying. Univariate and multivariate analysis.

| Regression models       | Duration of RR      |        |                       |        |
|-------------------------|---------------------|--------|-----------------------|--------|
|                         | Univariate analysis |        | Multivariate analysis |        |
|                         | Coefficient B [SE]  | p      | Coefficient B [SE]    | p      |
| Age                     | 1.0354[SE 0.203]    | 0.001  | -0.39495[0.221]       | 0.075  |
| Sex                     | 60.5185[6.874]      | 0.0001 | 42.0675[7.258]        | 0.0001 |
| ASA                     | 47.7917[4.959]      | 0.0001 | 20.6439[5.693]        | 0.0003 |
| Obesity                 | 53.0138[10.109]     | 0.0001 | 20.4168[9.325]        | 0.028  |
| Coronary artery disease | 39.5354[5.987]      | 0.0001 | 18.7425[6.139]        | 0.0023 |
| Renal disease           | 36.2605[10.801]     | 0.0008 | 4.3862[10.107]        | 0.664  |
| Type of surgery         | 15.0110[2.647]      | 0.0001 | -1.88590[2.746]       | 0.492  |
| Duration of surgery     | 0.7821[0.049]       | 0.0001 | 0.66519[0.050]        | 0.0001 |

operating theatre, most of them would have been detected by a simple oximetry [14]. Despite RR being a fundamental part of perioperative medicine, data regarding description of RR are poor. SIAARTI considers that this is due to dishomogeneity of the Italian health care system and in particular the physician and nursing staffing models as well as the physical buildings and health care technology [1]. In one-year experience of a similar sample of patients, but reporting only 9% of the global surgical activity, the presence of RR has been reported to contribute significantly to a reduction in the postoperative complication rate [NOTE: Reduction of what rate? – Need to clearly define] [15]. In that study however, most of patients were ASA 2 while only 0.48% were ASA 4 and majority were non cancer patients, in comparison with a four-fold incidence of ASA 4 cancer patients observed in the present sample. Of interest the average time of RR stay was 3-4 hours, which was different from patients reported in the present experience with a mean stay of about one hour. RR stay was significantly longer in patients who underwent prolonged surgery, for example abdominal surgery, including liver resection or pancreatectomy [duration of surgery in the range of 4-8 hours]. In Italian reality, many hospital operating rooms are not centralized, and adjoining recovery areas to monitor the patient before discharging to the ward have been proposed [6], although this solution seems to be suboptimal.

Good risk management practice, as well as the economic issues for services rendered, requires that health personnels follow basic accepted standards of care and documentation. The use of a specific sheet to collect vital parameters as a guide to discharge patients may be of paramount importance in the case management. Although scoring criteria are reliable tools, they do not replace the critical thinking and professional judgment of the nurse. Discharge scoring criteria may have advantages and disadvantages, and the outcome can be improved with flexibility and training of nurses. The achievement of the optimal score and a clinical judgment by nurse, like the model used in this study, may shorten RR stay, and anesthesiologists may be consulted again only in case of problems. Anesthesiological records were filled in with recommendations for post-operative care, signed, and handed over to nurse who measured parameters at short intervals [5-10 minutes], while observing eventual clinical changes in patient status.

About 20% of patients may experience a discharge delay, depending on the definition used [16]. It has been found that predetermined discharge criteria result in a 24% decrease in RR time [17]. Multiple causes exist for a discharge delay. The principal reason was the unavailability of an anesthesiologist to obtain an order in a timely manner. It is likely that the autonomy to discharge the patient for criteria might empower and encourage RR nurse to facilitate the process in most unproblematic cases. Other reasons rely on lack of transport availability, bed assignment, or floor nurse availability [16]. Although this parameter was not calculated in this study, this occurred principally during nurse shift occurring at 2 PM. Thus, using pre-defined discharge criteria and simple verbal communication could prevent discharge delays, and anesthesiologist is easily available from a close operating room [17].

No cases of lost information were recorded in this survey.

Loss of information occurs frequently during handover and may affect the continuity of care [18]. Formalized handover procedures are advocated for the promotion of safety, although informal elements may help limiting inherent tensions [19]. Patient handover in the RR are largely informal. Technical and communication errors may negatively impact patient safety in the postoperative care. Barriers to safe, effective postoperative handovers, including the incomplete transfer of information and other communication issues, inconsistent or incomplete teams, inefficient execution of clinical tasks, and poor standardization, still remain challenging for anesthesiologist and other personnels involved in the perioperative care [20].

Finally older patients with comorbidities undergoing complex surgeries of long duration, and receiving major support in RR, stayed for a longer period of time in RR and were more likely to be transferred to subintensive ward units for continuing NIV started in RR. This approach provided a safe discharge and management, without burdening the intensive care unit. Similar observations focusing at this specific aspect have been published [21]. While NIV performed out of the intensive care unit is routine in our daily activity, for example also in patients with hematologic diseases [22], this aspect deserves further studies to establish the efficacy, safety, and cost effectiveness of the system. A secondary analysis has been planned in this subgroup of patients treated by NIV. Of interest, NIV could be discontinued within 24 hours in almost patients.

In conclusion RR is of paramount importance for the management of cancer patients undergoing different types of surgery. Patients can be monitored and stabilized after an appropriate treatment until the best balance is achieved. Admission to RR improves safety and efficacy of symptom treatment. According to the response to treatment obtained by patients it is possible to plan a more intensive post-operative treatment in the ward. RR should be mandatory in all the operative theatre areas.

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