

## Place of the Post-Anesthesia Care Unit in Patient Care after Anesthesia

Research Article

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### Abstract

**Aim:** The aim of this study is to emphasize that the post-anesthesia care unit provides good quality service and is an important place for treatment of patients at high risk of postoperative complications.

**Material And Methods:** Patients admitted to the post-anesthesia care unit with ASA II, III, IV, and V risk group during the postoperative period between 1 March 2013 and 30 September 2013 in Ankara Numune Training and Research Hospital were retrospectively evaluated for data relating to age, gender, disease requiring surgery, surgical procedures, and perioperative anesthesia method, admission criteria for postoperative post-anesthesia care unit, duration of stay in post-anesthesia care unit and patient's follow-up information in the ward.

**Results:** A total of 583 patients who were admitted to the post-anesthesia care unit between 1 March 2013 and 30 September 2013 in Ankara Numune Training and Research Hospital were evaluated, retrospectively. Of patients 74.8% of in risk group ASA III. The average age was 59.36 years. Of patients 51.6% were male and 48.4% were female. In terms of clinic, 38.4% of the patients were operated by general surgery, 30.4% were operated by the department of orthopedics. General anesthesia was administered to 93.7% of the patients. Of patients, 48.7% had respiratory failure and 25.4% had hypotensive care unit.

**Conclusions:** We revealed that the majority of PACU admissions were patients undergoing general surgery procedures and the most frequent cause of admission was respiratory failure. This study shows that PACU has a considerably important place in perioperative patient management.

### Introduction

Each intervention from outside the body may cause unintended and unwanted situations; in other words "complications". If the intervention is a surgical procedure, a variety of complications may be encountered during or after the procedure. When surgical procedures on all areas of the body are included, the largest proportion of complications occurring after surgery are reported to be pulmonary complications [1-3]. As a result, patient monitoring in the PACU is very important. In the United States in 1175 mal-practice suits related to anesthesia, 7.1% involved PACU incidents [4]. Complications that may cause serious results in the PACU are mainly due to respiratory problems (43%) and cardiovascular events (24%) [5].

The aim of this study was to retrospectively evaluate data from 583 patients admitted to the PACU from 01/03/2013-30/09/2013 to emphasize the importance of the care and patient treatment given to the patient group with high risk factors after anesthesia in the PACU.

### Material and Method

The patient data of 583 patients in ASA II, III, IV and V pre-operative risk groups according to the American Society of Anesthesiologists physical situation classification admitted to the Ankara Numune Education and Research Hospital Post-Anesthesia Care Unit after a variety of operations from 01/03/2013 to

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30/09/2013 were retrospectively evaluated.

The ages, sex, ASA groups, surgical diagnosis, applied surgical procedure, applied anesthetic method, PACU admission criteria, duration of PACU stay, and transfer clinic were recorded for patients admitted to the post anesthesia care unit in the postoperative period from 01/03/2013-30/09/2013 and retrospectively evaluated.

**Results**

The data belonging to 583 patients admitted to Ankara Numune Education and Research Hospital Post-Anesthesia Care unit in the postoperative period from 01/03/2013 to 30/09/2013 were retrospectively investigated.

The distribution of patients in terms of ASA classification is given in Table 1. In this period the majority of patients admitted to PACU were in ASA III group (74.8%).

The mean age of patients was 59.36 ± 13.75 years. Of patients 51.6% were male and 48.4% were female (Table 2).

The surgical information of patients is given in Table 3. The majority of monitored patients were operated on by general surgery (38.4%) and orthopedic (30.4%) clinics.

Of patients 93.7% had general anesthesia and 6.3% had regional anesthesia.

The admission criteria for patients in the PACU are given in Table 4. The most common reasons were respiratory support (48.4%) and circulation support (25.4%). Apart from these, patients were admitted to the PACU for bradycardia, hypertension, tachycardia, apnea and pulmonary edema.

It was found that 98.5% of patients stayed in the PACU for 1 day.

Only 6.5% of patients were transferred to intensive care, the others were sent to their clinics. The admission criteria according to transferred clinic are shown in Table 5. The majority of patients transferred to intensive care (71.1%) were admitted to the PACU for respiratory support.

Table 6 shows the admission criteria according to ASA group. In this study, while the most common criterion for admission to the PACU for ASA II and ASA III patients was respiratory support requirements, for ASA IV patients the most common cause was circulation support requirements.

Table 7 shows the admission criteria according to type of anesthesia. While respiratory support was the cause of admission to PACU for 49.8% of general anesthesia patients, circulation support was the cause for 25.5%. For regional anesthesia patients in

**Table 1. ASA Situation.**

ASA	n	%
II	27	4.6
III	436	74.8
IV	99	17.0
V	21	3.6

**Table 2. Sex Distribution.**

Sex	n	%
Male	301	51.6
Female	282	48.4

**Table 3. Surgery Information.**

Surgery information	n	%
Urology <sup>1</sup>	109	18.7
Plastic Surgery <sup>2</sup>	25	4.3
Brain Surgery <sup>3</sup>	30	5.1
ENT <sup>4</sup>	18	3.1
Orthopedics <sup>5</sup>	177	30.4
General Surgery <sup>6</sup>	224	38.4

1- Kidney + Bladder + Prostate

2- Fracture Repair

3- Intracranial Hematoma Drainage + Vertebral Stabilization

4- Laryngectomy +neck dissection

5- Prosthesis + Open Reduction

6- Thyroidectomy + Mastectomy + Gastrointestinal System Surgeries

Table 4. Admission Criteria.

Admission Criteria	n	%
Pulmonary edema	5	0.9
Apnea	7	1.2
Bradycardia	59	10.1
Hypertension	43	7.4
Circulation support requirements	148	25.4
Respiratory support requirements	282	48.4
Tachycardia	39	6.7

Table 5. Admission Criteria according to transferred clinic.

Admission criteria	Relevant ward		Intensive Care		Total	
	n	%*	n	%*	n	%**
Pulmonary edema	5	0.9	--	--	5	0.9
Apnea	7	1.3	--	--	7	1.2
Bradycardia	57	10.5	2	5.3	59	10.1
Hypertension	42	7.7	1	2.6	43	7.4
Circulation support requirements	142	26.1	6	15.8	148	25.4
Respiratory support requirements	255	46.8	27	71.1	282	48.4
Tachycardia	37	6.8	2	5.3	39	6.7
Total	545	100.0	38	100.0	583	100.0

\* Column percentage

\*\* Row percentage

Table 6. Admission Criteria According to ASA Classification.

Admission Criteria	II		III		IV		V		Total	
	n	%*	n	%*	n	%*	n	%*	n	%**
Pulmonary edema	--	--	5	1.1	--	--	--	--	5	0.9
Apnea	1	3.7	6	1.4	--	--	--	--	7	1.2
Bradycardia	3	11.1	48	11.0	8	8.1	--	--	59	10.1
Hypertension	1	3.7	37	8.5	5	5.1	--	--	43	7.4
Circulation support requirement	2	7.4	92	21.1	54	54.5	--	--	148	25.4
Respiratory support requirement	15	55.6	219	50.2	29	29.3	19	90.5	282	48.4
Tachycardia	5	18.5	29	6.7	3	3.0	2	9.5	39	6.7
Total	27	100.0	436	100.0	99	100.0	21	100.0	583	100.0

\* Column percentage

\*\* Row percentage

Table 7. Admission Criteria According to Anesthesia.

Admission Criteria	General		Regional		Total	
	n	%*	n	%*	n	%**
Pulmonary edema	5	0.9			5	0.9
Apnea	7	1.3			7	1.2
Bradycardia	46	8.4	13	35.1	59	10.1
Hypertension	42	7.7	1	2.7	43	7.4
Circulation support requirement	139	25.5	9	24.3	148	25.4
Respiratory support requirement	272	49.8	10	27.0	282	48.4
Tachycardia	35	6.4	4	10.8	39	6.7
Total	546	100.0	37	100.0	583	100.0

\* Column percentage

\*\* Row percentage

**Table 8. Admission Criteria According to Surgery Clinic.**

Admission requirement	Urology		Plastic Surgery		Brain Surgery		ENT		Orthopedics		General Surgery		General Total	
	n	%*	n	%*	n	%*	n	%*	n	%*	n	%*	n	%**
Pulmonary edema	--	--	2	8.0	--	--	--	--	--	--	3	1.3	5	0.9
Apnea	1	0.9	2	8.0	--	--	--	--	--	--	4	1.8	7	1.2
Bradycardia	13	11.9	2	8.0	4	13.3	1	5.6	30	16.9	9	4.0	59	10.1
Hypertension	8	7.3	--	8.0	11	36.7		0.0	6	3.4	18	8.0	43	7.4
Circulation support requirement	50	45.9	--	8.0	4	13.3	1	5.6	51	28.8	42	18.8	148	25.4
Respiratory support requirement	27	24.8	17	68.0	10	33.3	15	83.3	76	42.9	137	61.2	282	48.4
Tachycardia	10	9.2	2	8.0	1	3.3	1	5.6	14	7.9	11	4.9	39	6.7
Total	109	100.0	25	100.0	30	100.0	18	100.0	177	100.0	224	100.0	583	100.0

\* Column percentage

\*\* Row percentage

PACU, 35.1% were admitted to the PACU for bradycardia.

Table 8 shows the admission criteria according to operating clinic. Admission to the PACU was for respiratory support for 61.2% of general surgery patients and 42.9% of orthopedic clinic patients. This rate was 83.3% for patients of the ear, nose and throat clinic. For brain surgery patients, hypertension was first place as cause for PACU admittance for 36.7% of patients. Admission criteria for urology clinic patients was circulation support for 45.9%, with bradycardia the criteria for 11.9% of urology patients.

**Discussion**

This study presents a retrospective evaluation of patients admitted to the PACU in a 6 month period from 01/03/2013 to 30/09/2013.

Currently with development of surgical techniques, more major surgeries are performed and with the aid of monitoring and medications anesthesia is administered to high risk patients leading to longer durations spent in the recovery room and the need for close monitoring in PACU. PACU should be close to the surgery, with design, equipment and personnel-to-patient numbers in accordance with standards.

Our hospital has a 7-bed PACU and aims to provide service in accordance with known standards.

In our retrospective evaluation, the mean age of patients admitted to the PACU in a six-month period was 59.6 years with 51.6% male and 48.4% female. When the ASA risk assessment of patients is investigated, the majority were ASA III group patients. The reason for the low percentage of ASA IV and ASA V group patients is thought to be linked to these patients being monitored in the intensive care unit in the postoperative period. The low rate of ASA II group patients was identified to be due to post-operative supportive treatments administered in the PACU with monitoring recommendations sent to the wards with the patients.

Nausea, vomiting, pain, agitation, shivering, late waking, hemorrhage and hypothermia are common complications observed after surgery and anesthesia, and the majority are problems that are

resolved in the recovery room without requiring the PACU. However, especially for high-risk patients with comorbidity, respiratory and circulation problems require the PACU. A study reported that 43% of patients were taken to the PACU for respiratory problems with 24% taken due to cardiovascular events [19].

Respiratory problems are the most common severe complications encountered in the PACU [20-22]. The majority of these are related to airway obstruction, hypoventilation or hypoxemia. The most important cause of airway obstruction in the early postoperative period is loss of pharyngeal muscle tonus due to sedation. Inhalation and iv anesthetics, neuromuscular blocking medications and lengthened effect of opioids contribute to pharyngeal loss of tonus in PACU patients [9]. Apart from this, airway edema and patients undergoing lengthy procedures in prone or Trendelenburg position may cause airway obstruction. In tongue, pharynx and neck procedures, carotid endarterectomy, thyroidectomy, and cervical vertebra procedures, local tissue edema or hematoma may cause airway obstruction [12].

Hypoventilation generally occurs due to residual depressant effects on respiratory mechanics due to anesthetic agents. Additionally, insufficient reversal of residual muscle paralysis, overdose, hypothermia, pharmacological interactions, varied pharmacokinetics and metabolic factors may cause residual muscle paralysis characterized by hypoventilation. Apart from this, patients with underlying respiratory tract diseases may encounter respiratory failure characterized by increased shunting linked to type of surgery, proximity to the diaphragm, position and lack of good treatment for postoperative pain. Though observed less commonly, pulmonary edema, pulmonary emboli, and pneumothorax may require respiratory support [23].

In our study, 50.5% of patients admitted to PACU in a 6 month period were monitored due to requiring respiratory support [24]. Of these 0.9% were admitted to the PACU with acute pulmonary edema, while 1.2% had apnea.

Circulation problems are the second most common complications. The most common circulation problems observed in the PACU are hypotension, hypertension and arrhythmia. The most common reason for circulation support requirements in the PACU is

hypovolemia. Insufficient intraoperative fluid replacement, fluid secretion into the third cavity of tissues, wound drainage and perioperative severe hemorrhage are among the most common causes of hypovolemia and hypotension. Hypertension generally occurs due to pain and bladder distension. Additionally postoperative hypertension may be a part of the neuroendocrine response to surgery. In patients with history of systemic hypertension, postoperative hypertension is commonly observed. Apart from these, arrhythmias are another circulation complication. They may be observed due to hypoxemia, acidosis, medication effects, pain and underlying arrhythmias [23].

In a six month period, 49.5% of patients monitored in the PACU were admitted for circulation problems. Of these 10.1% had bradycardia, 7.4% had hypertension, 25.4% had hypotension and 6.7% had tachycardia diagnosis.

It was found that 93.7% of patients were operated under general anesthesia while 6.3% were administered regional anesthesia. While 49% of general anesthesia patients admitted to the PACU required respiratory support, 27% of regional anesthesia patients admitted to the PACU required respiratory support. The observation of respiratory complications at a higher rate in general surgery patients is considered to be due to variations in lung volume linked to respiratory muscle dysfunction because of anesthesia and disruption of chest wall mechanics [19]. Precautions may be taken to reduce the risk of postoperative pulmonary complications. These precautions should begin in the preoperative period and continue through a variety of precautions in the postoperative period. Though high risk patients may be partially identified, as many patients developing postoperative pulmonary complications are not known beforehand, precautions to reduce postoperative pulmonary precautions should be applied to all patients independent of whether they carry risk or not. Though many factors are defined to cause risk of postoperative pulmonary complications, the majority cannot be resolved. However, there are some risk factors that may be removed. One of these factors is smoking. It was proven that patients who stopped smoking 6-8 weeks before orthopedic surgery had reduced requirements for respiratory support in the postoperative period [25]. Though there are no studies showing postoperative pulmonary risk complications reduce after stopping, as it is known that alcohol consumption increases the risk of respiratory complications, stopping intake may reduce the risk. Contrary to this, ASA score and some personal factors like age cannot be changed. To reduce the risk of postoperative pulmonary complications, administering respiratory physiotherapy in the preoperative period has been shown to increase FEV1 (forced expiratory volume 1st gas amount) levels in the postoperative period [26]. However, there is no study showing that this method reduced the incidence of complications. Apart from general precautions, inserting a nasogastric probe to empty the stomach may reduce the chance of postoperative respiratory support by preventing aspiration [27]. In the intraoperative period there are some precautions that may be taken with the aim of reducing postoperative pulmonary complications. Especially to protect against the risk of postoperative pulmonary edema, the anesthesia duration, inspired oxygen concentration and airway pressure should be kept low [28], and fluid infusion should be limited [29]. The agents used for anesthesia may strengthen airway closure and cause intraoperative atelectasis. Ketamine is the only anesthetic that does not cause intraoperative atelectasis [30].

Postoperative care may reduce the incidence of postoperative pulmonary complications. The effects of anesthesia and surgery on the chest wall and lungs may cause secretion, retention and atelectasis. Deep breathing exercises have been shown to reduce the incidence of postoperative pulmonary complications in those undergoing upper abdominal surgery and coronary artery surgery [32]. When used for the same aim CPAP reduced the incidence of pulmonary complications for those undergoing both thoracic and non-thoracic surgery as shown by a randomized controlled study [33]. There are insufficient studies related to the role of insensitive spirometer. Another important factor that may be effective in reducing the incidence of pulmonary complications in the postoperative period is pain control [34].

While 35.1% of patients administered regional anesthesia admitted to the PACU were admitted for bradycardia, 8.4% of patients administered general anesthesia admitted to the PACU were admitted for bradycardia. The reason for the higher incidence of bradycardia with regional anesthesia may be linked to blockage of preganglionic cardioaccelerator ( $T_{1-4}$ ) fibers and reduction in venous return and fall in pressure in the right heart [35].

According to reports in the literature, orthopedic surgery and general surgery procedures are correlated with most postoperative complications and patients in these groups have higher rate of stays in the postoperative PACU [4, 36]. In our study, the majority of investigated patients were operated by the general surgery (38.4%) and orthopedic (30.4%) clinics. For both these clinics, respiratory support requirements and circulation support requirements were the top two admission criteria. After operations by the urology and orthopedic clinics, nearly 50% of patients were determined to have circulation support requirements as admission criteria for the PACU. In the early postoperative period the most common reason for circulation support requirements was hypovolemia [35]. Generally insufficient replacement of intraoperative fluid losses causes hypovolemia. Hypotension linked to other situations is rarely observed in the early postoperative period. As patients operated in the orthopedic and urology clinics are in the geriatric age group and have major surgical operations, perioperative bleeding is determined to be a significant factor in hypotension.

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