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RETROSPECTIVE EVALUATION OF ASA CLASSIFICATION'S PREDICTIVE ABILITY OF POSTOPERATIVE COMPLICATIONS IN PATIENTS ADMITTED TO INTENSIVE CARE UNIT AFTER MAJOR ABDOMINOPELVIC SURGERY*

MAJOR ABDOMİNOPELVİK CERRAHİ SONRASI YOĞUN BAKIM ÜNİTESİNE KABUL EDİLEN HASTALARIN ASA SINIFLAMASI VE POSTOPERATİF KOMPLİKASYONLAR AÇISINDAN RETROSPEKTİF DEĞERLENDİRİLMESİ

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ABSTRACT

Objective: The American Society of Anaesthesiologists Physical Status Score (ASA) is a useful tool for indicating the need for intensive care unit (ICU) monitoring in postoperative patients. However, physician misclassification can lead to unnecessary bed occupancy and increased costs. This study examined the relationship between preoperative ASA scores and complications following major abdominopelvic surgery.

Materials and Methods: Patients who underwent postoperative monitoring in a tertiary ICU between November 2016 and February 2019 for semi-urgent and urgent major abdominopelvic surgery were evaluated. Data related to morbidity and mortality were analysed, including acute postoperative complications (hypotension, bleeding, desaturation, prolonged intubation, failed weaning, acute kidney injury, cardiac arrest, exitus), length of ICU stay, recurrent ICU admissions, overall mortality incidence, and 30-day mortality incidence.

Results: A total of 122 patients who underwent gastrointestinal, gynaecological, and urological surgeries were retrospectively analysed. Patients were grouped as ASA II (N=59), ASA III (N=45), and ASA IV (n=18). Overall complication rates among the groups did not differ. The exitus rate was significantly higher in ASA IV (p=0.022). Similarly, the duration of ICU stay, recurrent ICU admissions, and 30-day mortality were significantly higher in ASA IV (p<0.05). When patients were grouped as semi-urgent (n=87) and urgent (n=35), respiratory complications such as prolonged intubation, desaturation, and failed weaning, as well as ICU stay and 30-day mortality rates were higher in urgent cases (p<0.001). No exitus was observed in the semi-urgent oncological surgeries in the ICU.

Conclusion: No difference in respiratory complications was observed in the postoperative ICU follow-up of ASA IV major abdominal surgery patients compared with other ASA groups. However, both respiratory complications and mortality rates were significantly higher in the urgent cases. The low rate of complications in semi-urgent oncological surgeries can be explained by the optimal preoperative surgical preparation.

Keywords: Intensive care, major abdominal surgery, major pelvic surgery, oncologic surgery, postoperative complications, mortality

ÖZ

Amaç: Amerikan Anesteziyoloji Derneği Fiziksel Durum Skoru (ASA) postoperatif hastalarda yoğun bakım ünitesi (YBÜ) takibi endikasyonu koymada yararlı bir araçtır. Öte yandan hekimlerin yanlış skorlamaları yatakların gereksiz meşguliyetine ve artan hastane masraflarına yol açabilir. Bu çalışmada major abdominopelvik cerrahi sonrası komplikasyonların preoperatif ASA skorları ile ilişkisi incelendi.

Gereç ve Yöntem: Kasım 2016 ve Şubat 2019 tarihleri arasında üçüncü düzey YBÜ'de postoperatif takibi gerçekleştirilen semi-acil ve acil major abdominopelvik cerrahi hastaları değerlendirildi. Morbidite ve mortalite ile ilişkili veriler; akut postoperatif komplikasyonlar (hipotansiyon, kanama, desaturasyon, uzamış entübasyon, başarısız "weaning", akut böbrek hasarı, kardiyak arrest, eksitus), YBÜ takip süresi, tekrarlayan YBÜ yatışları, genel mortalite insidansı ve 30-gün mortalite insidansı şeklinde analiz edildi.

Bulgular: 122 gastrointestinal, jinekolojik ve ürolojik cerrahi hastası retrospektif olarak analiz edildi. Hastalar; ASA II (n=59), ASA III (N=45) ve ASA IV (n=18) olarak gruplandırıldı. Genel komplikasyon oranlarında gruplar arasında anlamlı farklılık yoktu. Eksitus oranı ASA IV grubunda anlamlı yüksekti (p=0,022). Aynı şekilde YBÜ yatış süresi, YBÜ'ne tekrarlayan yatış ve 30-gün mortalite yine ASA IV grubunda anlamlı yüksekti (p<0,05). Hasta gruplandırması semi-acil (n=87) ve acil (n=35) olarak yapıldığında uzamış entübasyon, desaturasyon ve başarısız "weaning" gibi solunumsal komplikasyonlar, ayrıca YBÜ yatış süresi ve 30-gün mortalite oranı acil vakalarda daha fazlaydı (p<0,001). Yarı-acil onkolojik cerrahilerde YBÜ'de eksitus gözlenmedi.

Sonuç: ASA IV major abdominopelvik cerrahi hastalarının postoperatif YBÜ takibinde solunumsal komplikasyonlar açısından diğer gruplar ile fark gözlenmedi. Buna karşın acil vakalarda hem solunumsal komplikasyon hem de mortalite oranları anlamlı yüksekti. Yarı-acil onkolojik cerrahilerde komplikasyonların az olması preoperatif optimum cerrahi hazırlık sağlanması ile açıklanabilir.

Anahtar Kelimeler: Yoğun bakım, major abdominal cerrahi, major pelvik cerrahi, onkolojik cerrahi, postoperatif komplikasyonlar, mortalite

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INTRODUCTION

Major abdominopelvic surgery can cause major bleeding, hemodynamic instability, capillary leak, and postoperative respiratory complications. With the increased median life span and improved surgical techniques, more comorbid patients receive such surgical treatments. Intensive care units (ICU) play an essential role in the postoperative care of these patients. However, the ICU is a scarce resource, which obviates the need for a pragmatic, reliable, and easy-to-use tool to predict the outcome of major abdominopelvic surgery.

The American Society of Anaesthesiologists Physical Status (ASA) has been used to define patients' preoperative health status since 1941 (1). Due to its simplicity, ASA is frequently and successfully used to predict patient outcomes such as mortality, complications, and ICU admissions. This ability was criticised due to the interrater variability of ASA and was constantly challenged with several other scoring systems such as NSQIP and POSSUM (2).

Several studies have reported that ASA has a low predictive power (3, 4), despite continuing efforts for optimisation (5). Recent clinical studies attempted to improve the statistical results by dichotomising ASA scores to I and II vs III and IV (6). Even though such techniques provide more significant p values, the descriptive ability of ASA is still arguable.

In the current study, it is aimed to investigate the adequacy of sole ASA scoring for postoperative morbidity prediction, and adding the urgency perspective into this evaluation was also explored. Our hypothesis was that ASA IV patients would represent the highest rate of mortality. However, postoperative complications were also investigated both from the perspective of ASA classification and operative urgency.

MATERIALS AND METHOD

Data inclusion and regulatory aspects

After obtaining the approval of the Recep Tayyip Erdoğan University Ethics Committee (Date: 11.11.2019, No: 2019/44), ICU patient records spanning from November 2016 to February 2019 were screened. Patients who were admitted to the ICU for postoperative care following major abdominal surgery were included. Patients who had undergone surgery while they were in the ICU and "elective" major abdominal surgeries such as bariatric surgery patients were excluded.

Outcome measures

Patient characteristics (such as age, gender, surgical indication, operative urgency, ASA), time to extubation, length of ICU stay, length of hospital stay, readmission to ICU, occurrence and timing of postoperative complications and death (both in ICU and after ICU follow-up) were retrieved from the records. Operative urgency was classified as elective, semi-urgent, and urgent. The postoperative period of 24 h was examined for the occurrence of the following complications:

1. Hypotension: mean arterial blood pressure less than 25% of baseline or <65 mmHg, requiring any treatment with intravenous hydration, vasopressors, or blood products.

2. Bleeding: Any bleeding causing a 2 g/dl drop in serum haemoglobin value or required transfusion of blood products.

3. Desaturation: PaO2 value below 60 mm Hg or a SpO_2 value below 92%.

4. Prolonged intubation: inability to extubate the patient within 4 h of the admission to the ICU.

5. Failure to wean: Failure to pass a spontaneous breathing trial or the need for reintubation within 48 h following extubation.

6. Acute kidney injury: Increase in serum creatinine by ≥0.3 mg/dl within 48 h, or increase in serum creatinine by ≥1.5 times of baseline, or urine volume <0.5 ml/kg/hour for 6 h.

7. Cardiac arrest.

The primary outcome was the comparison of mortality rates in the ASA groups. Secondary outcomes included the effects of operative urgency and surgical indications (oncological and non-oncological) on patient outcomes, including postoperative complications and length of stay, both in the ICU and in the hospital.

Statistical analysis

Data were analysed with R version 3.5.1 (R Foundation, Vienna, Austria). The distribution of data was analysed with Kolmogorov–Smirnov test for normality. Patient characteristics were summarised with descriptive statistics.

The incidence of death within 24 h of surgery was cross-tabulated by ASA separately for each category of operative urgency. Elective cases did not take part in the final analyses, yet were demonstrated as a part of the classification tree of the major determinants for mortality.

Two comparative analyses were performed by first grouping the patients according to ASA (II, III and IV), operative urgency (semi-urgent and urgent), and then according to specific surgical indications (gastrointestinal, gynaecological, urological). In all three cases, data other than patient characteristics were analysed with Kruskal–Wallis Test due to nonhomogenous distribution. In case of a significant difference, the Mann–Whitney U test was used for between-groups analysis by adjusting the p value to 0.017.

A two-sided binomial test was used to compare the mortality rates in the semi-urgent and urgent groups. The Cochran-Armitage trend test was used to evaluate the association between increasing ASA and mortality (DescTools package, version 0.99.32). A binary classification tree was formed with the inputs of patient characteristics, ASA, urgency of operation, and surgical indications (rpart package, version 4.1-15).

Sample size

The required sample size was analysed according to Wolters et al.'s study in which the mortality ratio was defined as under 3.5% for ASA II and III patients and 18.3% for ASA IV patients

(7). When the alpha error was 0.05 and with the power of 80%, a total of 120 patients were calculated for statistical significance for the current study.

RESULTS

Flow diagram of the study and patient characteristics are given in Figure 1 and Table 1, respectively. Gender was distributed homogenously between the groups, and ASA IV patients were significantly older. The majority of patients had gastrointestinal surgery. Also, the majority of patients had undergone planned surgeries for malignancy and were defined as semi-urgent. Approximately one-fourth of the patients had urgent surgery due to such indications such as gastrointestinal bleeding, ileus, or bowel perforation.

Comparison of patient characteristics and outcomes according to ASA scoring are given in Table 2. Postoperative complications did not differ between the ASA groups; however, exitus during ICU follow-up or during the postoperative 30 days was significantly higher in ASA IV.

Comparison of patient characteristics and outcomes according to the urgency of operation are given in Table 3. A classification tree was also represented in Figure 2, in which the most important factors determining the mortality are depicted.

Readmission to the ICU, in ICU exitus ratio and length of stay were significantly higher in the ASA IV group, despite the lowest ratio of oncologic cases ($p<0.05$). Consequently, the 30-day mortality ratio was also highest in the ASA IV group ($p=0.024$). When evaluated according to the urgency of the surgery, the number of semi-urgent cases was more in the ASA II group, and on the contrary, the number of urgent cases was statistically more in the ASA IV group ($p<0.05$). 97% of the urgent cases

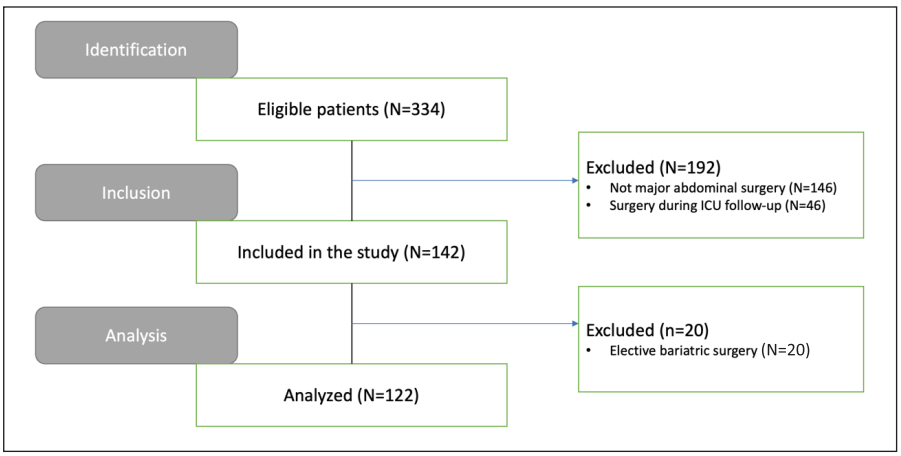

Figure 1. Study flow diagram

ICU: Intensive care unit

Table 1: Patient characteristics (n=122)

Parameter	
Age, years	68±14
Female gender, n (%)	61 (50%)
The type of surgery, n (%)	
Gastrointestinal	95 (78%)
Gynaecological	18 (15%)
Urological	9 (7%)
ASA, n (%)	
II	59 (48%)
III	45 (37%)
IV	18 (15%)
Urgency of operation, n (%)	
Semi-urgent	87 (71%)
Urgent	35 (29%)
Patients with postoperative complications, n (%)	44 (36%)
Readmission to Intensive Care Unit, n (%)	6 (5%)
30-day mortality, n (%)	13 (11%)

ASA: American Society of Anaesthesiologists Physical Status

Table 2: Patient characteristics and outcomes according to the ASA. Categoric data were evaluated with the chi-square test. Nominal data were assessed with Kruskal–Wallis Test

Parameter	ASA 2 (n=59)	ASA 3 (n=45)	ASA 4 (n=18)	p
Age, years	64.2±12.8	69.7±11.7	76.4±16.3	0.001**
Female gender, n (%)	29 (49%)	22 (49%)	10 (56%)	0.877
Urgency, n (%) **Semi-urgent** **Urgent**	 49 (83%) 10 (17%)	 31 (69%) 14 (31%)	 7 (39%) 11 (61%)	 0.002*
The type of surgery, n (%) **Gastrointestinal** **Gynaecological** **Urological**	 45 (76%) 9 (15%) 5 (89%)	 33 (73%) 8 (17%) 4 (9%)	 17 (94%) 1 (6%) -	 0.454
Oncologic cases, n (%)	49 (83%)	37 (82%)	8 (44%)	0.002*
Patients extubated in 24 h, n (%)	5 (9%)	7 (16%)	4 (22%)	0.278
Time to extubation in 24 hours, hours	3 (2 - 5 [1 - 20])	3 (3 - 5 [1 - 20])	3.5 (2 - 7 [2 - 20])	0.676
Time to extubation after 24 hours, days	10 (2 - 16 [1 - 24])	2 (2 - 5 [1 - 27])	3 (3 - 6 [3 - 16])	0.787
Complications in the ICU, n (%) **Hypotension** **Bleeding** **Desaturation** **Prolonged intubation** **Failure to wean** **Acute kidney injury** **Cardiac arrest**	17 (29%) 5 (9%) 1 (2%) 2 (3%) - 2 (3%) 3 (5%) -	17 (38%) 4 (9%) 1 (2%) 2 (4%) 2 (4%) 4 (9%) 1 (2%) -	10 (56%) - - 5 (28%) 3 (17%) - 1 (6%) 1 (6%)	0.115 0.672 0.911 0.395 0.672
In the ICU Exitus	2 (3%)	4 (9%)	4 (22%)	0.022*
ICU stay, days	1 (1 - 2 [1 - 29])	1 (1 - 2 [1 - 29])	3 (1 - 6 [2 - 16])	0.003**
Readmission to the ICU, n (%)	1 (2%)	2 (4%)	3 (17%)	0.036*
Ward stay, days	3 (2 - 6 [1 - 17])	4 (2 - 5 [1 - 29])	2 (1 - 5 [1 - 11])	0.503
30-day mortality, n (%)	3 (5%)	5 (11%)	5 (28%)	0.024*

ASA: American Society of Anaesthesiologists Physical Status, ICU: Intensive care unit. *: Chi-square test, **: Kruskal Wallis Test

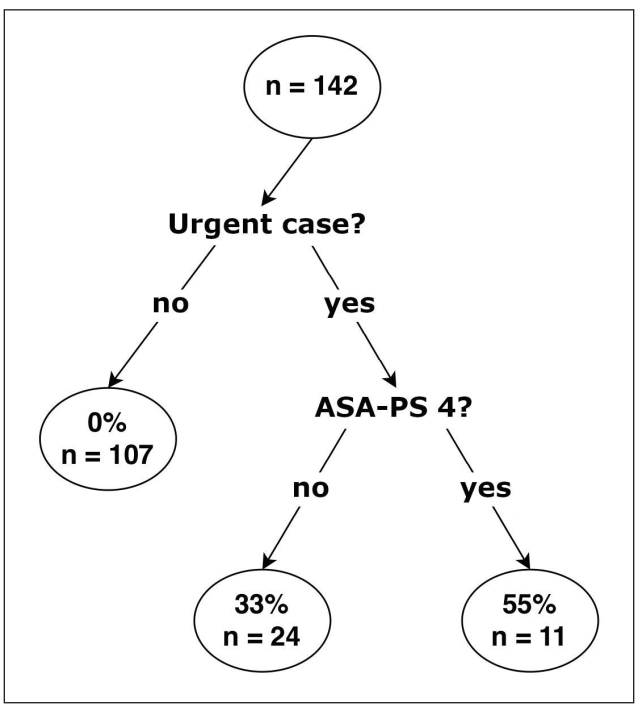

Figure 2: Classification tree showing the important determinants of mortality. Percentages exhibiting the death ratio in the related group

Table 3: Characteristics and outcomes according to the urgency of operation. Categoric data were assessed with the chi-square test. Mann Whitney-U Test was used for between-group nominal data assessment

Parameter	Semi-urgent (n=87)	Urgent (n=35)	p
Age, years	67.2±13	70.2±15	0.207
Female gender, n (%)	41 (47%)	20 (57%)	0.317
ASA, n (%)			
II	49 (56%)	10 (29%)	
III	31 (36%)	14 (40%)	0.001*
IV	7 (8%)	11 (31%)	
The type of surgery, n (%)			
Gastrointestinal	61 (70%)	34 (97%)	
Gynaecological	17 (20%)	1 (3%)	0.005*
Urological	9 (10%)	-	
Oncologic cases, n (%)	79 (91%)	15 (43%)	<0.001*
Patients extubated in 24 h, n (%)	84 (97%)	22 (63%)	<0.001*
Time to extubation in 24 hours, hours	3 (2 - 4 [1 - 20])	7 (3 - 16 [2 - 20])	<0.001**
Time to extubation after 24 hours, hours	24 (24 - 35 [24 - 45])	85 (70 - 380 [45 - 640])	0.009**
Complications in the ICU, n (%)			
Hypotension	22 (25%)	22 (63%)	<0.001*
Bleeding	5 (6%)	4 (11%)	1
Desaturation	1 (1%)	1 (3%)	1
Prolonged intubation	5 (6%)	4 (11%)	<0.001*
Failure to wean	-	5 (14%)	<0.001*
Acute kidney injury	-	6 (17%)	<0.001*
Cardiac arrest	4 (5%)	1 (3%)	0.342
	-	1 (3%)	1
In the ICU exitus	-	10 (29%)	<0.001*
ICU stay, days	4 (3 - 4 [2 - 4])	16 (7 - 20 [3 - 29])	<0.001**
Readmission to the ICU, n (%)	1 (1%)	5 (14%)	0.002*
Ward stay, days	3 (2 - 5 [1 - 24])	4 (2 - 5 [1 - 29])	0.306
30-day mortality, n (%)	3 (3%)	13 (37%)	<0.001*

ASA: American Society of Anaesthesiologists Physical Status, ICU: Intensive care unit, *: Chi-square test.**: Mann-Whitney U test.

were gastrointestinal surgeries, and 91% of the semi-urgent cases were oncological operations. The number of patients weaned from mechanical patients within the first 24 h and the time for extubation were higher in the semi-urgent group. Similarly, this tendency continued after the first 24 h, and the time for extubation following the first 24 h was lower in the semi-urgent patient group (p<0.001). None of the semi-urgent group died during the follow-up, and 14% of the urgent group required readmissions to the ICU, and 29% of the urgent group died during the first ICU followup (p<0.001). As expected, the 30-day mortality was higher in the urgent patient group (p<0.001).

DISCUSSION

Our results revealed a higher mortality but similar postoperative complication rates with ASA IV when compared with the other ASA groups. As ASA is an ordered scoring system, we expected a gradual increase not just in mortality but also in morbidity, which was not observed within our findings. Consequently, ASA appears to be strong at predicting mortality rather than morbidity. However, once the urgency of the case is involved, "morbidity prediction" becomes more evident, and apparently more than half of ASA IV patients die in the postoperative period if the surgery is urgent. None of the semi-urgent cases encountered death after surgery.

ASA is widely used compared to other scoring systems such as NSQIP, POSSUM, and the Charlson comorbidity index (8, 9). These other indexes would represent more benefit in terms of morbidity prediction. As a supporting fact from the current findings, "mortality" would normally be expected to be seen less than postoperative complications, and interestingly, we observed a significant difference in mortality with ASA but "similar" complication rates. The major criticism would be on its extensive definition and subjective nature resulting in misclassifications (4).

Lupei et al. reported that a higher ASA score was related to an increased need for mechanical ventilation (10). However, our findings are in contrast. As it is represented in our results, operative "urgency" would be more determining on postoperative respiratory complications. Urgent surgery patients experience

more prolonged ventilatory support, desaturation or weaning failure. Perhaps, taking "urgency" into consideration would favour more compared to ASA. This proposal seems legited since the ASA class does not focus on the respiratory capacity of the patient, which is exceptionally important to foresee possible respiratory complications in the postoperative period. Yet, in a study with 1332 adults by Hall et al., it was demonstrated that ASA score above II and having chronic bronchitis are independent risk factors for respiratory insufficiency, which was defined as PaO_2 lower than 60 mmHg or prolonged intubation that is more than 24 h (11). Lastly, the renowned ACS NSQIP database-based extensive trials have put an end to the confusion and proved that ASA class is one independent factor for risk "stratification" for "medical" complications that also includes "postoperative pulmonary complications" in abdominal surgeries (12, 13). However, our single centre experience regarding the use of the ASA classification for predicting respiratory complications in patients followed up in the ICU postoperatively did not prove beneficial.

Length of stay in the ICU was considerably longer in patients with ASA IV, yet ward stay was found to be as short as the other groups. This suggests a pattern where comorbid patients with higher ASA are treated in the ICU until they are almost ready to be discharged from the hospital. As we understand, the length of stay in the ICU or ward is surgeon-dependent; therefore, it is a subjective parameter. Although there are some studies implying a prolonged length of stay due to increased postoperative complications in patients with ASA III and above, we can hardly claim that ASA can predict the length of stay in the ICU accurately (14, 15).

ASA was correlated with 30-day mortality in this study. There are studies searching for a better correlation by combining the chronic illness of the patient with their current physical status, and among them, Visnjevac et al. combined ASA with functional status to predict 30-day mortality (16). They reported that every individual's functional capacity was related to postoperative mortality as an independent risk factor and also suggested increasing the ASA score by 1 in functionally limited patients. Most patients in the ICU pose a specific challenge for such examination because they generally require analgesia or sedation, which obscures the actual physical fitness of the patient.

In the current study, the mortality rate in the elective and semi-urgent cases was zero, in contrast to 37% of the mortality in the urgent cases. Although this is an expected finding, it should be interpreted with caution. In this study, significantly more patients with ASA IV underwent urgent surgery, and the literature denotes that mortality rate increases with increasing ASA (12). General understanding regarding delaying urgent surgeries is that it may lead to more complications (17); however, in a study by Sjo et al. the high mortality rates with emergency surgeries and ASA IV were emphasised and some palliative solutions were suggested to avoid immediate surgery in colon cancer (18). These statements are compatible with our findings.

Most oncological interventions are considered to be semi-urgent procedures in medical practise. This retrospective evaluation showed zero in-hospital mortality with semi-urgent cancer surgeries. This is not surprising as patient-centric perioperative care protocols are employed in this institute (19, 20). In other words, patients who had an urgent surgery did not have the chance for preoperative patient optimisation. In our retrospective design, it was impossible to determine if it was possible to optimise patients with ASA IV and whether this optimisation could lead to lower ASA scores such as ASA II or III. No doubt, optimising ASA IV patients would provide utmost benefit, but in our experience, it is questionable whether lowering the ASA from III to II would provide such change. On the other hand, there are other elements such as incision width and duration of the operation that are remarkably important (21). It has been demonstrated that minimally invasive procedures may increase life expectancy or reduce complications in such cases, and this shows that surgical technique is one of the most important determinants (22).

This trial has several limitations. The results from a single-centre obviously are not suitable for generalisation. However, our results are comparable to those of some international trials, which showed a strong correlation between ASA and mortality (12, 23). Considering the statistical techniques, the effect of ASA on the outcomes is further complicated by one final factor; this study included only patients who had a surgery, and patients were not included if they were not operated due to ASA V. However, Horwood et al. demonstrated relatively good recovery ratios in ASA V patients undergoing major surgery (24).

Nevertheless, this work, which was conducted in a regular tertiary hospital, provides a pragmatic explanation for the use of the ASA class for ICU physicians who encounter major abdominopelvic surgery in their everyday practise. Statistically correct explanations by the extensive studies may not be in favour for low patient volume centres since the practise may not fit what is claimed. In summary, the distinctly different results of the ASA IV group suggests that it is a suitable cut-off value for major abdominopelvic surgery, and these patients should be evaluated by including operative urgency. Future studies should include descriptive events to study the possible applicability and effect of enhanced recovery after surgical protocols on urgent surgeries.

Ethics Committee Approval: This study was approved by Recep Tayyip Erdoğan University (Date: 11.11.2019, No: 2019/44).

Informed Consent: All participants received written informed consent after being fully informed about the study.

Peer Review: Externally peer-reviewed.

Author Contributions: Conception/Design of Study- E.S.B., B.E.; Data Acquisition- A.H.; Data Analysis/Interpretation- H.K.; Drafting Manuscript- E.S.B.; Critical Revision of Manuscript- A.H., B.E., H.K.; Final Approval and Accountability- E.S.B., A.H., B.E.,

H.K.; Material and Technical Support- A.H.; Supervision- B.E., H.K.

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