Evaluation of Postoperative Complication with Medically Necessary, Time-Sensitive Scoring System During Acute COVID-19 Pandemic: A Prospective Observational Study

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BACKGROUND: High scores in the Medically Necessary, Time-Sensitive (MeNTS) scoring system, used for elective surgical prioritization during the coronavirus disease 2019 pandemic, are assumed to be associated with worse outcomes. We aimed to evaluate the MeNTS scoring system in patients undergoing elective surgery during restricted capacity of our institution, with or without moderate or severe postoperative complications.

STUDY DESIGN: In this prospective observational study, MeNTS scores of patients undergoing elective operations during May and June 2020 were calculated. Postoperative complication severity (classified as Group Clavien-Dindo $<$ II or Group Clavien-Dindo $\geq$ II), as well as Duke Activity Index, American Society of Anesthesiologists (ASA) physical status, presence of smoking, leukocytosis, lymphopenia, elevated C-reactive protein (CRP), operation and anesthesia characteristics, intensive care requirement and duration, length of hospital stay, rehospitalization, and mortality were noted.

RESULTS: There were 223 patients analyzed. MeNTS score was higher in the Clavien-Dindo $\geq$ II Group compared with the Clavien-Dindo $<$ II Group (50.98 $\pm$ 8.98 vs 44.27 $\pm$ 8.90 respectively, $p < 0.001$). Duke activity status index (DASI) scores were lower, and American Society of Anesthesiologists physical status class, presence of smoking, leukocytosis, lymphopenia, elevated CRP, and intensive care requirement were higher in the Clavien-Dindo $\geq$ II Group ($p < 0.01$). Length of hospital stay was longer in the Clavien-Dindo $\geq$ II Group (15 [range 2−90] vs 4 [1−30] days; $p < 0.001$). Mortality was observed in 8 patients. Area under the receiver operating characteristic curve of MeNTS and DASI were 0.69 and 0.71, respectively, for predicting moderate/severe complications.

CONCLUSIONS: Although significant, MeNTS score had low discriminating power in distinguishing patients with moderate/severe complications. Incorporation of a cardiovascular functional capacity measure could improve the scoring system. (J Am Coll Surg 2021;233:435−444. © 2021 by the American College of Surgeons. Published by Elsevier Inc. All rights reserved.)

Coronavirus disease 2019 (COVID-19) caused a shift in healthcare and resulted in allocation of large amounts of equipment and human resources to COVID-19 patients.[1,2] The consequence of such an allocation is a mandatory decrease in elective surgical procedures in order to preserve necessary equipment, both disposable (such as personal protective equipment) and nondisposable (such as ventilators), as well as hospital bed capacity and healthcare staff.[3,4] Furthermore, the possibility of operating on an asymptomatic but undetected COVID-19 patient may cause concern because it is hazardous to both the patient and the staff involved in care.[5,6] Therefore, many countries declared a temporary postponement of elective surgery during the acute pandemic.

Disclosure Information: Nothing to disclose.

Received January 22, 2021; Revised May 3, 2021; Accepted May 19, 2021.

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https://doi.org/10.1016/j.jamcollsurg.2021.05.028
ISSN 1072-7515/21

Abbreviations and Acronyms

ASA	= American Society of Anesthesiologists
AUC	= area under the curve
BPT	= blood product transfusion
CRP	= C-reactive protein
DASI	= Duke activity status index
MACCE	= major adverse cardiac and cerebrovascular events
MeNTS	= Medically Necessary, Time-Sensitive
MODS	= multiple organ dysfunction syndrome
PCR	= polymerase chain reaction
ROC	= receiver operator characteristic
VAC	= vacuum-assisted wound closure

However, this disruption in care itself can cause advancement of the original disease for which the operation was planned, with negative outcomes. Additionally, a decrease in surgical volume due to anxiety and fear of healthcare centers can result in both emotional and economic burdens in the long run.[7] Yet, although various societies have established guidelines for the initiation of elective surgery,[8-10] the decision to support elective surgery during the pandemic is also complex, as there are no scientific data on outcomes regarding patient prioritization.[11]

The Medically Necessary, Time-Sensitive (MeNTS) scoring system described by Prachand and colleagues[12] has been endorsed by the American College of Surgeons. It is an objective scoring system to triage and make decisions concerning elective surgery during the pandemic.[12] MeNTS score is composed of 3 components: procedure, disease, and patient factors, and calculated using a 5-point scale (eTable 1). The lowest possible score is 21 and the highest is 105, with higher scores assumed to be related to worse outcomes or increased risk of transmission and/or increased resource use. In times of restricted capabilities, proper patient prioritization may prevent case backlog and preserve limited resources. In that sense, prioritization scores also combine elements that are associated with perioperative outcomes. Yet, the MeNTS scoring system has not been studied prospectively in relation to patient outcomes. In this observational study, we aimed to compare the MeNTS scoring system in patients undergoing elective surgery, with or without moderate or severe postoperative complications.

METHODS

Our institute is an established university hospital with 40 operation rooms and approximately 150 elective surgical procedures per day. The Anesthesiology Department is the primary responsible team for 4 intensive care units (ICU) with 38 beds for a mixed population of adult surgical and medical patients, excluding cardiovascular surgical and cardiac medical intensive care units. After the first wave of the pandemic, elective surgery was postponed by the Turkish Ministry of Health on March 17, 2020. At this time, all anesthesiologists and anesthesiology residents were working in shifts in the COVID ICU units or for urgent/emergent procedures. However, in May 2020, we were able to resume elective surgery in a restricted capacity, after a decrease in COVID-19 ICU bed requirements. During this period, we allocated 3 to 4 operating rooms for elective surgery and performed about 5 to 7 operations per day. Again in this period, 15 ICU beds were reserved for the elective cases and non-COVID indications. We resumed full capacity at the end of June according to institutional policy, while redirecting COVID-19 patients to dedicated pandemic hospitals. In this observational study, we report the outcomes of urgent-elective, essential elective, and discretionary elective cases with restricted capacity (May—June 2020) of our institution. Case priority was defined as follows[13]:

1. Urgent-elective: Operations that need to be performed within >24 hours but <2 weeks of admission (eg cardiothoracic/cardiovascular procedures, cerebral aneurysm repair, closed fractures, spinal fractures, and acetabular fractures, scheduled cesarean section);
2. Essential elective: Procedures that can be performed within 1—3 months (eg cancer surgery and biopsies, hernia repair, hysterectomy, reconstructive surgery); and
3. Discretionary elective: Cases that can be performed >3 months (eg cosmetic surgery, bariatric surgery, joint replacement, sports surgery, infertility procedures)

After Ethics Committee Approval (2020/691), we screened all patients undergoing operation in the aforementioned dates and enrolled eligible patients who gave written informed consent for the study. Exclusion criteria were age < 18 years and refusal of enrollment or communications problems causing a barrier for consent. Likewise, patients who had to undergo an operation within 24 hours were not included in this study (Fig. 1).

During this period, our institutional policy was to question all patients before surgery, regardless of their emergency status, for COVID-19 symptoms, and take nasopharyngeal swab samples for polymerase chain reaction (PCR) test (Bio-speedy Direct RT-qPCR SARS-CoV-2, Bioeksen Ar-Ge Tek. Ltd., Turkey). Urgent elective cases other than cesarean sections also had thoracic CT scans performed according to surgeon discretion, as test turnover time at that period was >24 hours in our institution. We included only cesarean section patients who were classified as planned or elective (Categories III and IV), according to the Royal College of Obstetrics and Gynaecologists.[14]

Patients' demographic data, characteristics (type of surgery and urgency, American Society of Anesthesiologists [ASA] physical status class, history of smoking, and cancer) as well as COVID-19 screening, including PCR tests and/or thoracic CT scans, clinical symptoms, and signs in favor of COVID-19 such as fever, cough, dyspnea, and abnormality in laboratory parameters, including lymphocyte and leukocyte count, and C-reactive protein (CRP) values, were recorded. MeNTS scores as well as Duke Activity Status Index (DASI) scores, which estimate functional capacity, were calculated as proposed.[12,15] The surgical evaluation for MENTS score was performed by the most experienced surgeon on the surgical team and verified by one of the surgeon investigators (AFK Gök). After operation, type of anesthesia (general, neuraxial, peripheral nerve block) and duration of surgery were recorded. Postoperative pulmonary complications (PPCs),[16] and postoperative major adverse cardiac and cerebrovascular events (MACCEs)[17] in the first postoperative month were also recorded. All postoperative complications were evaluated and graded by using the Clavien-Dindo classification.[18] Intensive care requirements for the first 14 postoperative days, length of ICU stay, total length of hospital stay, rehospitalization, presence of active COVID-19, and mortality within 30 days were also investigated.

Statistical analysis

This was an observational exploratory study limited to a certain period with restricted capabilities. As we did not know how long this period would continue, we were not able to speculate on the sample size, but rather screened and approached all possible patients in this time period. Patients were classified into 2 groups according to severity of postoperative complications, as the Clavien-Dindo < II Group (no or mild complication) or the Clavien-Dindo ≥ II Group (moderate or severe complications). Data are given as mean ± SD, median (min-max), or number (%). Quantitative data were evaluated for normal distribution with Shapiro-Wilk and Kolmogorov-Smirnov tests. Normally distributed data were tested between the groups with Student *t*-test, whereas non-normally distributed data were tested with Mann-Whitney U test. Mean difference and its 95% confidence interval (95% CI) are also given where applicable. Qualitative data were tested with chi-square tests. The receiver operator characteristic (ROC) curve was generated, and the area under the curve (AUC) was calculated to assess the predictive utility of MeNTS and DASI scores.

RESULTS

Statistical analysis included 223 patients, of whom 110 patients (49.3%) had urgent-elective, 108 patients (48.4%) had essential elective, and 5 patients (2.2%) had discretionary elective surgery during study period (Fig. 1).

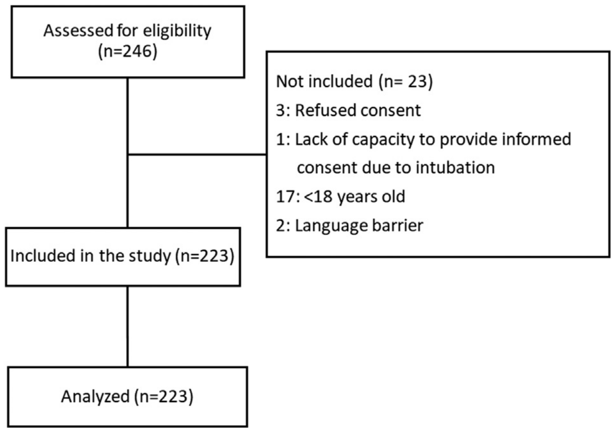

Figure 1. Flow diagram.

Nasopharynx was swabbed for PCR test sampling in all patients before operation. There were 142 patients with both preoperative results of PCR testing and thoracic CT scan; the number of patients who preoperatively had the results of only PCR scanning was 53. We were able to acquire the results of PCR testing in 28 patients in the postoperative period. Of these 28 patients, 22 patients had thoracic CT examination before operation. Six patients who underwent caesarean section did not have either a PCR test result or thoracic CT scan before the operation. In these 6 patients, test results obtained in the postoperative period were negative. One patient,

Table 1. Patient Operative Characteristics

Type of operation	n (%)
General surgery	73 (32.7)
Abdominal	57 (25.6)
Breast	9 (4.0)
Other	7 (3.1)
Orthopaedic	58 (26.0)
Gynecologic and obstetric	38 (17.0)
Oncologic	9 (4.0)
Benign gynecologic-abdominal	10 (4.5)
Benign gynecologic-vaginal	5 (2.2)
Cesarean section	14 (6.3)
Neurosurgery	16 (7.2)
Ear-nose-throat surgery	22 (9.9)
Plastic	7 (3.1)
Thoracic	2 (0.9)
Cardiovasculars	1 (0.4)
Urology	2 (0.9)
Ophthalmology	4 (1.8)

Table 2. Type of Complication by Clavien-Dindo Grade

Clavien-Dindo Classification, total patients, n	Type of complication
Grade 0 (no complication), 121	N/A
Grade I, 23	
2	Atelectasis requiring incentive spirometry exercise
21	Requiring antiemetics, antipyretics, and analgesics
Grade II, 35	
1	Postoperative COVID-19 PCR test positive, requiring antiviral therapy with no organ involvement
3	Pneumonia
1	Pleural effusion-without tube thoracostomy
1	Intra-abdominal infection
7	Wound site infection requiring antibiotherapy
3	Other infection
2	Hypertension requiring medical treatment
1	Arrhythmia requiring medical treatment
2	Enteral nutrition via nasogastric tube
2	Total parenteral nutrition
12	BPT
Grade II—II, 7	
1	BPT + wound site infection + dysarthria (neurotoxicity)
1	BPT + Pleural effusion (empyema)
1	BPT + catheter-related infection requiring antibiotherapy
1	BPT + urinary tract infection requiring antibiotherapy
1	BPT + wound site infection requiring antibiotherapy
1	BPT + pneumonia
1	Oliguria + total parenteral nutrition
Grade IIIa, 12	
2	Pleural effusion requiring tube thoracostomy
3	Wound site infection + VAC therapy under local infiltration anesthesia in the operating room
6	Reoperation under local infiltration anesthesia
1	Peritonitis - paracentesis
Grade II—IIIa, 5	
1	VAC therapy under local infiltration anesthesia in the operating room + BPT + pneumonia

(Continued)

Table 2. Continued

Clavien-Dindo Classification, total patients, n	Type of complication
1	VAC therapy under local infiltration anesthesia in the operating room + acute renal failure (no dialysis) + BPT
1	Anastomotic leak after colonic resection + colonoscopy + arrhythmia
1	ERCP + arrhythmia (atrial fibrillation) + BPT
1	Abdominal evisceration requiring operation under local infiltration anesthesia + pneumonia
Grade II—IIIb, 6	
2	Reoperation under general anesthesia + pneumonia
1	Reoperation under general anesthesia + pneumonia + seizure
2	Intervention under general anesthesia + wound site infection requiring antibiotherapy
1	VAC therapy under general anesthesia + BPT
Grade IVa, 2	
1	Pulmonary embolism requiring ICU management
1	Stroke requiring ICU management
Grade II—IVa, 2	
1	Arrhythmia (supraventricular tachycardia) requiring ICU management + BPT + intra-abdominal infection
1	Pleural effusion-empyema requiring noninvasive ventilation in ICU + wound site infection requiring antibiotherapy + BPT
Grade IVb, 1	Pneumonia + sepsis + hypoxic-ischemic encephalopathy
Grade IIIa—IVb, 1	MODS- intra-abdominal infection + sepsis + pneumonia + pleural effusion requiring tube thoracostomy
Grade V, 8	Exitus
1	Sepsis + pneumonia + arrhythmia + BPT
1	Sepsis + pneumonia + pleural effusion + intraabdominal infection + urinary tract infection + wound site infection + BPT
1	Sepsis + pleural and pericardial effusion + congestive heart failure + wound site infection + BPT
1	Sepsis + pneumonia

(Continued)

Table 2. Continued

Clavien-Dindo Classification, total patients, n	Type of complication
1	Sepsis + acute respiratory failure + urinary tract infection + BPT
1	Sepsis + pneumonia + myocardial infarction + wound site infection + BPT
1	Sepsis + urinary tract infection + liver failure + BPT
1	Meningitis + pleural effusion + arrhythmia (atrial fibrillation) + cardiac tamponade + BPT

BPT, blood product transfusion; ERCP, endoscopic retrograde cholangiopancreatography; MODS, multiple organ dysfunction syndrome; PCR, polymerase chain reaction; VAC, vacuum-assisted wound closure.

whose first preoperative PCR test was negative, converted to positive postoperatively. That patient did not have any postoperative complications and was discharged per routine.

The mean patient age was 48.5 ± 17.7 years, and median BMI was 25 (17–52) kg/m,^{2} with male sex presented in 112 (50.2%) patients. Patients' surgical characteristics are described in Table 1. The mean MeNTS score of all included patients was 46.65 ± 9.47, and the median DASI score was calculated as 44.70 (2.75–58.2). There were 166 patients (74.4%) who received general anesthesia, 50 patients (22.4%) who had spinal anesthesia, and 7 patients (3.1%) who had peripheral nerve block. Mean operation time was 105 (range 15–480) minutes.

One patient had pulmonary embolism, whereas postoperative pulmonary complications were seen in 25 (11.2%) patients, and postoperative major adverse cardiac and cerebrovascular events (MACCEs) were observed in 9 (4.0%) patients. Table 2 details patient complications, with severity according to the Clavien-Dindo classification.

Table 3 shows the comparison between groups in terms of age, sex, ASA physical status class, BMI, smoking status, leukocytosis, lymphopenia, CRP elevation, MeNTS score, DASI score, type of anesthesia, presence of intubation, duration of operation, presence of malignancy, type of operation, intensive care requirement, length of ICU stay, total length of hospital stay, rehospitalization and mortality. Mean MeNTS score was higher in the group with Clavien-Dindo ≥ II compared with the group with Clavien-Dindo < II (50.98 ± 8.98 vs 44.27 ± 8.90, respectively, $p < 0.001$), with a mean difference of 6.71 (95% CI 4.25–9.18). When MeNTS score was divided into its components, there was a statistically significant increase in both procedure- and patient-related factor scores in the group with Clavien-Dindo ≥ II, when compared with the group with Clavien- Dindo < II ($p < 0.001$). However, disease-related factors were similar in both groups (Fig. 2).

Mortality was seen in 8 patients (3.59%). Median MeNTS scores were similar in the deceased and living patients (53.5 [41–61] and 47 [25–68], respectively, $p = 0.063$); whereas median DASI scores were significantly lower in patients who died compared with survivors (3.62 [2.75–18.95] and 45.45 [4.5–58.2], respectively; $p < 0.001$).

MeNTS scores in patients with leukocytosis and elevated CRP were similar to those without elevation (44.53 ± 11.26 vs 46.97 ± 9.15 for leukocytosis, $p = 0.189$; 46.05 ± 9.61 vs 46.76 ± 9.46 for elevated CRP, $p = 0.682$, respectively). Likewise, MeNTS scores in patients with lymphopenia were similar to those in patients without (47.89 ± 9.04 vs 46.53 ± 9.52, $p = 0.551$).

The ROC curve determining the performance of MeNTS score for predicting Clavien-Dindo Grade II and above is shown in Figure 3A. At the threshold of 45.5, the sensitivity and specificity of MeNTS scores to discriminate the patients with Clavien-Dindo score II and above were 74.7% and 53.5%, respectively. When MeNTS scoring is categorized using the cut-off value of 45.5, there is a significant increase in length of hospital stay, number of patients with ICU need ≥ 48 hours, and length of ICU stay in patients with MeNTS ≥ 45.5 hours (Table 4).

The ROC curve determining the performance of DASI score for predicting Clavien-Dindo Grade II and above is shown in Fig. 3B. At the threshold of 22.07, the sensitivity and specificity of DASI score to discriminate the patients with Clavien-Dindo score II and above were 86.8% and 53.2%, respectively.

DISCUSSION

In this prospective observational study, we found that MeNTS scores were higher in patients who had postoperative moderate or severe complications. MeNTS scoring system is a recently proposed system calculated retrospectively in a limited number of patients (n = 41).[12] The authors alluded to the fact that higher scores would reflect poorer patient outcomes because, per design, higher scores are assigned to worse situations in procedure and patient factors (such as prolonged surgery or severe disease). Understandably, as patient outcomes were not the scope of this proof of concept study, the only result noted was that MeNTS scores of cancelled patients (n = 6) were high, suggesting agreement with the decisions of the clinical team before construction of the scoring system.

Table 3. Comparison According to Clavien-Dindo Classification

Parameter	Clavien-Dindo <II (n = 144)	Clavien-Dindo ≥II (n = 79)	p Value
Age, y, mean ± SD	43.9 ± 15.5	56.8 ± 18.5	<0.001
Sex, m, n (%)	64 (44.4)	48 (60.8)	0.02
ASA physical status class, n (%)			<0.001
ASA 1	35 (24.2)	3 (3.8)	
ASA 2	98 (68.1)	44 (55.7)	
ASA 3	11 (7.6)	26 (32.9)	
ASA 4	0 (0)	6 (7.6)	
BMI, kg/m^2, median [min−max]	25 [20−52]	25 [17−41]	0.2
Presence of smoking, n (%)	41 (28.5)	41 (51.9)	0.001
Patients with leukocytosis, n (%)	11 (7.6)	19 (24.1)	0.001
Patients with lymphopenia, n (%)	5 (3.5)	14 (17.7)	<0.001
Patients with elevated CRP, n (%)	10 (6.9)	26 (32.9)	<0.001
MeNTS score, mean ± SD	44.27 ± 8.90	50.98 ± 8.98	<0.001
DASI score, median [min−max]	50.70 [9.95−58.2]	20.70 [2.75−58.2]	<0.001
Type of anaesthesia, n (%)			0.47
General	108 (75)	58 (74.3)	
Central nerve block-spinal	33 (22.9)	17 (21.5)	
Peripheral nerve block	3 (2.1)	4 (5.1)	
Intubated patients, n (%)	99 (68.8)	56 (70.9)	0.74
Duration of operation, min, median [min−max]	90 [15−300]	120 [25−480]	0.001
Malignancy, n (%)	42 (29.2)	27 (34.2)	0.43
Type of operation, n (%)			0.32
Urgent elective	66 (45.8)	44 (55.7)	
Essential elective	74 (51.4)	34 (43.0)	
Discretionary elective	4 (2.8)	1 (1.3)	
Patients with ICU need ≥48 h, n (%)	3 (2.1)	35 (44.3)	<0.001
Length of ICU stay, d, median [min-max]	0 [0−3]	1[0−30]	<0.001
Length of hospital stay, d, median [min−max]	4 [1−30]	15 [2−90]	<0.001
Rehospitalization, n (%)	6 (4.2)	14 (17.7)	0.001
Mortality, n (%)	0 (0)	8 (10.1)	<0.001

CRP, C-reactive protein; DASI, Duke Activity Status Index; MeNTS, medically necessary, time-sensitive.

Operating room scheduling, postoperative planning, and patient safety already requires questioning of some components of MeNTS scoring, including procedural factors such as operating room time, ICU need, surgical team, surgical site and patient factors such as chronic diseases, and medications as a part of routine screening of surgeons and anesthesiologists. But the MeNTS scoring system for prioritization has not been studied extensively. Cohn and colleagues[19] studied the scoring system in terms of its overlap for patient prioritization comparing surgical branch consensus/expert opinion-based and individual surgeon-based systems, whereas others questioned the reliability of modified MeNTS scores for different types of surgical branches for triage.[20,21] A modified scoring system for pediatric patients (pMeNTS) was also described by Slidell and associates,[22] and it was mentioned that deferred cases had higher scores, similar to the results of Prachand and coworkers.[12] However, until this study, score has not been evaluated in real life circumstances with postoperative complications and outcomes data. This novel study demonstrates, for the first time, that patients with moderate or severe postoperative complications had higher preoperatively calculated MeNTS scores.

Although there are several single organ and composite outcomes scores for standardized definitions of postoperative complications,[16,23−25] we preferred classification of complication severity via Clavien-Dindo because it is popular in a wide variety of surgical fields.[26−29] This classification can differentiate between mild complications that result in either temporary harm and/or can be rectified with brief intervention, and severe complications that may result in increased hospital stay, disability, and/or permanent function loss and possible death.[30−32] In this sense, neither Grade 0 (no complication), nor Grade I

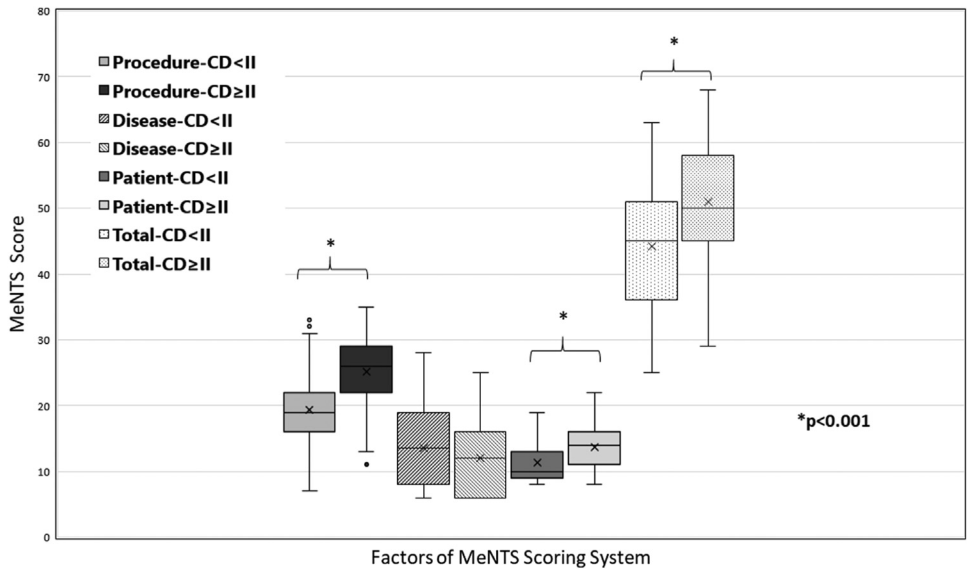

Figure 2. The box and whisker plot of the scores of procedure-, disease-, and patient-related factors of Medically Necessary Time-Sensitive (MeNTS) score (total) in the Clavien-Dindo < II (CD < II) group and the Clavien-Dindo ≥ II group (CD ≥ II).

(any deviation from the normal postoperative course without the need for pharmacologic treatment or surgical, endoscopic, and radiologic interventions) may result in prolongation and/or aggravation of the postoperative course. Age and ASA physical status class are higher in Clavien-Dindo ≥ II patients. Presence of smoking, which is a known factor for perioperative complications, is also encountered more frequently in this group.[33]

Regarding abnormal preoperative laboratory evaluations, leukocytosis has long been associated with perioperative complications, morbidity, and mortality in colorectal, hepatic, ovarian and cervical disc operations.[34–37] Likewise preoperative elevated CRP is associated with higher morbidity and mortality in abdominal and thoracic cancer surgical patients.[38] There is scant evidence of the possible role of preoperative lymphopenia on postoperative complications.[39] The presence of leukocytosis, lymphopenia, and elevated CRP in our study is also associated with more severe complications. Interestingly, when the patients with these abnormalities were compared to those without, MeNTS scores were similar. MeNTS score, as a part of patient factors, questions the presence of influenza-like illness (fever, cough, body aches, sore throat, diarrhea) for COVID symptoms, but does not incorporate laboratory values similar to other prioritization scores or modifications proposed,[19–22] which may be a limitation of the scoring. Questioning of COVID symptoms/exposure may seem redundant in this era given that PCR testing has been an accepted standard for surgery during the pandemic. However, PCR testing can have false negative results,[40] which may require extensive questioning of symptoms and possible exposure in order to rule out the need for repeated testing.

ASA physical status classification has been proposed and developed to communicate patient comorbidities between anesthesiologists, but is often used in combination with other risk scores to predict patient outcomes.[41] Likewise, DASI is a 12-item self-reported questionnaire that measures functional capacity by questioning the ability to perform daily and recreational activities.[15] Although it is basically a cardiopulmonary fitness index, recently, DASI scores < 34 were shown to identify patients with elevated risk of myocardial injury, infarction, moderate to severe complications including noncardiac complications such as respiratory failure, and new disability.[42] In our study, ASA physical status class was higher and median DASI scores were lower in patients with Clavien-Dindo scores ≥ II. Indeed, we observed very low scores of DASI in patients who died, whereas their MENTS scores were similar to those of survivors. Furthermore, in this study, observation of AUC of ROC curve < 0.7 highlights the relatively low discriminating power of MeNTS score for prediction of Clavien Dindo ≥ II patients.

MeNTS score, although indicating the presence of some comorbidities (pulmonary disease, obstructive sleep apnea, cardiovascular disease, diabetes, and immune deficiency), does not evaluate the functional capacity of the patient. Therefore, other incapacitating comorbidities or their combinations can be overlooked. Furthermore, the severity of comorbidities in MeNTS score is based on

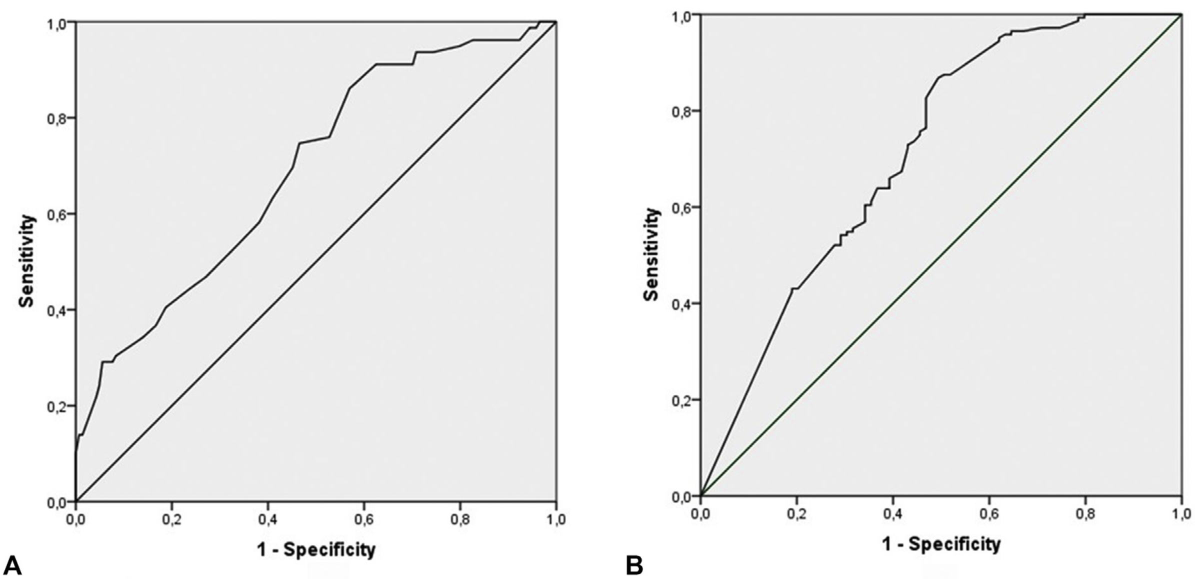

Figure 3. (A) Receiver operator characteristic (ROC) curve determining the performance of Medically Necessary Time-Sensitive (MeNTS) score for predicting Clavien-Dindo Grade II and above. Area under the curve (AUC) = 0.69, 95% CI 0.619–0.762. Sensitivity 74.7%, specificity 53.5%. (B) ROC curve determining the performance of Duke activity status index score for predicting Clavien-Dindo Grade ≥ II. AUC = 0.71, 95% CI 0.638–0.787. Sensitivity 86.8%, specificity 53.2%.

drug consumption rather than functional capacity measurement, which may be affected by patient compliance to therapy. Last but not least, MeNTS is not a weighted score, ie it does not differentiate whether 1 factor is more significant than another, or not.

In our study, the MeNTS scores ranged between 25 and 68, similar to those in the study by Prachand and colleagues.[12] The cut-off value in predicting moderate or severe postoperative complications was 45.5 in our study, which was lower than their graphed value for lower threshold of unjustified procedures. One should be aware that MeNTS score, when used for prioritizing, is a dynamic threshold with upper and lower values, which should be adapted according to local conditions. One strength of our study is that we did not postpone surgery according to possible complications, disease severity, or surgery characteristics. Rather, we continued operating to eliminate surgical lists created on a first-come-first-serve basis, as long as the patients presented for their scheduled surgery. In this regard, although we may have actually observed patients with unfavorable outcomes, we cannot comment on possible gains related to delaying surgery in these patients in terms of resource allocation. The interesting fact that disease-related factors, one of the MeNTS components, did not differ from each other in respect to Clavien-Dindo classification, may also stem from this approach and/or the possibility of an evaluation bias in disease-related factors. Indeed, differentiation of intermediate categories (such as differentiation of slightly worse from moderately worse) may pose a problem because no evidence-based quantitative measurement is questioned. Of note, there are limited data on reliability of MeNTS scoring, with only 1 reference stating a strong agreement between raters in a modified gynecologic version.[20] Furthermore, although we observed longer operation times and hospital stays, with higher need for postoperative ICU and rehospitalization in the Clavien-Dindo ≥ II group, we cannot comment on their economic burden because they were not calculated. Likewise, it is not surprising that higher scores in both procedure-related and patient-related components of MeNTS scoring are associated with moderate to severe complications.

Table 4. Hospital Stay, ICU Requirement, and ICU Stay by Classified Medically Necessary, Time-Sensitive Score

Variable	MeNTS score <45.5 (n = 97)	MeNTS score ≥45.5 (n = 126)	p Value
Length of hospital stay, d, median [min–max]	5 [1–45]	8 [1–90]	<0.001
Patient with ICU need ≥48 h, n (%)	5 (5.2)	33 (26,2)	<0.001
Length of ICU stay, d, median [min–max]	0 [0–6]	1 [0–30]	<0.001

MeNTS, medically necessary, time-sensitive.

There are several limitations of this study. First, although all surgical fields are represented in our study, not all types of operations are included, and their distribution across surgical fields is not uniform. Second, we did not include patients who needed an operation within 24 hours after admission because these patients are exempt from a priority listing. Third, this study included 223 patients in its analysis, which is a low number for an outcome study. However, this was a single center study, restricted to a time period with limited resources, which also reflected real conditions for which such information may be applicable. MeNTS scores can also decrease the risk of COVID-19 transmission to the healthcare team by helping to identify infected patients, and therefore, limiting hospital resource use. The scope of this study was patient outcomes by analyzing postoperative complications, need for ICU, and length of hospital stay, and we did not evaluate COVID-19 transmission to the healthcare team. Although there were no reported cases of COVID-19 among anesthesiologists and surgeons, we did not investigate other components of the teams including perioperative nurses and ward personnel.

CONCLUSIONS

The MeNTS score was designed to systematically integrate factors that are novel to the COVID-19 pandemic, and was proposed to rule the process for decision making and triage for patients during this period. Higher scores were associated with poorer perioperative patient outcomes. In this prospective observational study, we found that MeNTS scores were higher in patients with moderate and severe complications, as graded $\geq$ II according to the Clavien-Dindo classification. Yet, the discriminating capacity of this scoring system was below acceptable for moderate/severe complications. ASA physical status class and DASI, which measures functional capacity, are also associated with adverse patient outcomes. MeNTS scoring can be improved by adding cardiorespiratory functional capacity measures for a better prediction in addition to objective prioritization. Further studies are needed, and MeNTS score should be validated in larger populations with multicenter studies.

Author Contributions

Study conception and design: Dinçer, Gök, Koltka
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Analysis and interpretation of data: Dinçer, Orhan-Sungur, Özkan-Seyhan, Koltka
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eTable 1. Medically Necessary, Time-Sensitive Scoring System[12]

Variable	MeNTS Score 1	2	3	4	5
Procedure factor					
OR time, min	<30	31–60	61–120	121–180	≥181
Estimated LOS, h	Outpatient	<23	24–48	49–72	≥96
Postoperative ICU need, %	Very unlikely	<5	5–10	11–25	>25
Anticipated blood loss, mL	<100	100–250	250–500	500–750	≥751
Surgical team size, n	1	2	3	4	5
Intubation probability, %	≤1	1–5	6–10	11–25	>25
Surgical site	None of the following row variables	Abdomino-pelvic MIS	Abdomino-pelvic open surgery, infraumbilical	Abdomino-pelvic open surgery, supraumbilical	OHNS/upper GI/thoracic
Disease factor					
Nonoperative treatment option effectiveness	None available	Available, <40% as effective as surgery	Available, 40% to 60% as effective as surgery	Available, 61% to 95% as effective as surgery	Available, equally effective
Nonoperative treatment option resource/exposure risk	Significantly worse/not applicable	Somewhat worse	Equivalent	Somewhat better	Significantly better
Impact of 2-wk delay in disease outcome	Significantly worse	Worse	Moderately worse	Slightly worse	No worse
Impact of 2-wk delay in surgical difficulty/risk	Significantly worse	Worse	Moderately worse	Slightly worse	No worse
Impact of 6-wk delay in disease outcome	Significantly worse	Worse	Moderately worse	Slightly worse	No worse
Impact of 6-wk delay in surgical difficulty/risk	Significantly worse	Worse	Moderately worse	Slightly worse	No worse
Patient factor					
Age, y	<20	21–40	41–50	51–65	>65
Lung disease (asthma, COPD, CF)	None	–	–	Minimal (rare inhaler)	> Minimal
Obstructive sleep apnea	Not present	–	–	Mild/moderate (no CPAP)	On CPAP
CV disease (HTN, CHF, CAD)	None	Minimal (no meds)	Mild (1 med)	Moderate (2 meds)	Severe (≥3 meds)
Diabetes	None	–	Mild (no meds)	Moderate (PO meds only)	> Moderate (insulin)
Immunocompro-mised*	No	–	–	Moderate	Severe
ILI symptoms (fever, cough, sore throat, body aches, diarrhea)	None (Asymptomatic)	–	–	–	Yes
Exposure to known COVID-19 positive person in past 14 d	No	Probably not	Possibly	Probably	Yes

*Hematologic malignancy, stem cell transplant, solid organ transplant, active/recent cytotoxic chemotherapy, anti-TNFa or other immunosuppressant, >20 mg prednisone equivalent/day, congenital immunodeficiency, hypogammaglobulinemia on intravenous immunoglobulin, AIDS.

CAD, coronary artery disease; CF, cystic fibrosis; CHF, congestive heart failure; CPAP, continuous positive airway pressure; CV, cardiovascular; GI, gastrointestinal; HTN, hypertension; ILI, influenza-like illness; LOS, length of stay; med, medication; MIS, minimally invasive surgery; OHNS, otolaryngology, head and neck surgery; OR, operating room.