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Effects of preoperative nutritional status on postoperative quality of recovery: a prospective observational study

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Abstract

Quality of Recovery-15 (QoR-15) has received attention as a postoperative patient-reported outcome measure. Preoperative nutritional status has negative effects on postoperative outcomes; however, these associations have not yet been investigated. We included inpatients aged ≥ 65 years who underwent elective abdominal cancer surgery under general anaesthesia between 1 June 2021 and 7 April 2022 at our hospital. Preoperative nutritional status was assessed using the Mini Nutritional Assessment Short-Form (MNA-SF), and patients with an MNA-SF score ≤ 11 were categorised into the poor nutritional group. The outcomes in this study were the QoR-15 scores at 2 d, 4 d and 7 d after surgery, which were compared between groups by unpaired *t* test. Multiple regression analysis was applied to assess the effects of poor preoperative nutritional status on the QoR-15 score on postoperative day 2 (POD 2). Of the 230 included patients, 33·9 % (78/230) were categorised into the poor nutritional status group. The mean QoR-15 value was significantly lower in the poor nutritional group than in the normal nutritional group at all postoperative time points (POD 2:117 *v.* 99, $P = 0{\cdot}002$; POD 4:124 *v.* 113, $P < 0{\cdot}001$; POD 7:133 *v.* 115, $P < 0{\cdot}001$). Multiple analyses showed that poor preoperative nutritional status was associated with the QoR-15 score on POD 2 (adjusted partial regression coefficient, −7·8; 95 % CI −14·9, −0·72). We conclude that patients with a poor preoperative nutritional status were more likely to have a lower QoR-15 score after abdominal cancer surgery.

Key words: **Abdominal surgery: Nutrition assessment: Nutritional status: Patient-centred outcome: Postoperative outcome**

Poor preoperative nutritional status has negative effects on postoperative outcomes, including increased postoperative complications and prolonged hospital stay[1–3]. The European Society for Clinical Nutrition and Metabolism recommends that the preoperative nutritional status of older patients should be assessed using the Mini Nutritional Assessment Short-Form (MNA-SF)[4,5].

A recent consensus statement proposed that patient-reported outcome measures collected directly from the patient should be included as a benchmark for postoperative recovery and recommended the use of the Quality of Recovery-15 (QoR-15), especially in the immediate postoperative period[6]. The association between various anaesthetic, surgical, and patient factors and QoR-15 has been investigated[7]. For instance, laparoscopic surgery improved the QoR-15 score *v.* laparotomy[8], and women were likely to have worse QoR-15 scores than men[9]. The preoperative nutritional status is a measure of biological age and is potentially modifiable if recognised, but the impact of preoperative nutritional status on postoperative quality of recovery remains unclear.

We hypothesised that poor preoperative nutritional status would have deleterious effects on postoperative recovery and aimed to evaluate the following: (1) the effect of preoperative nutritional status on the QoR-15 score after surgery; (2) the differences between the preoperative nutritional status groups in the mean values of each item in the QoR-15 on postoperative day 2 (POD 2); and (3) the association between preoperative nutritional status and length of hospital stay post-operation.

Material and methods

Ethics

This study was conducted according to the guidelines laid down in the Declaration of Helsinki, and all procedures involving human subjects/patients were approved by the Nara Medical University Institutional Review Board, Kashihara, Nara, Japan (approval number 2975, 28 April 2021). The written informed consent was obtained before enrolment by all enrolled patients.

Abbreviations: MNA-SF, Mini Nutritional Assessment Short-Form; POD, postoperative day; QOR-15, Quality of Recovery-15.

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Patients

This study was a planned secondary analysis of a prospective observational study conducted from 1 June 2021 to 7 April 2022 at Nara Medical University Hospital (Kashihara, Nara, Japan). Our initial study analysed the data of 230 patients aged ≥ 65 years who were scheduled for elective abdominal surgery (general, urological or gynaecological). Initially, we aimed to assess the association between postoperative quality of recovery and disability-free survival. Exclusion criteria were poor Japanese comprehension, dementia, psychiatric disease requiring treatment, palliative surgery or a planned postoperative hospital stay < 3 d. This secondary analysis included all 230 patients included in our initial study.

Quality of Recovery-15

The QoR-15 was designed to rapidly assess the recovery process after surgery or anaesthesia in a daily practice, and the Japanese version has been available since 2021[10,11]. The QoR-15 consists of fifteen items, including respiration, rest, well-being, pain, nausea and mental health, with a total score ranging from 0 to 150. Higher scores indicate a higher quality of recovery[10]. In this study, QoR-15 was assessed four times: the day before surgery, and at POD 2, POD 4, and POD 7. Patients discharged on the day of assessment were evaluated by telephone, and their responses were recorded.

Data collection

Patient demographics, co-morbidities, daily medication, laboratory data, handgrip strength, frailty and nutritional status were assessed. The grip strength of the patient's dominant hand was measured three times in succession using a digital Jamar hand dynamometer (MG-4800 MORITOH, Aich, Japan), and the maximum value was used as the result. The Fried Frailty Phenotype Questionnaire, which includes five domains (fatigue, resistance, ambulation, inactivity and weight loss) with a total score ranging from 0 to 5 points, was used to assess preoperative frailty[12]. Nutritional status was assessed using the MNA-SF, with a total score ranging from 0 to 14 points (normal, 12–14 points; at-risk, 8–11 points; and malnourished, 0–7 points). In this study, patients with a total score of less than 12 points, that is, at-risk and malnourished, were defined as having a poor nutritional status. Intraoperative data, including anaesthetic agents, surgical field, postoperative analgesia, surgical duration, and blood loss volume, were also collected.

Outcomes

The primary outcome of this study was the QoR-15 score on POD 2. The secondary outcomes were the QoR-15 scores on POD 4 and 7 and the length of stay post-operation.

Statistical analysis

Continuous data are presented as medians (1st quartile, 3rd quartile), and categorical variables are presented as numbers (%). Univariate analysis was performed using the Mann–Whitney *U* test or Fisher's exact test, as appropriate, comparing the normal and poor nutrition groups. The primary outcome of this study, the QoR-15 score, had a normal distribution and is presented as mean and standard deviation[10,11] and compared using an unpaired *t* test. Additionally, repeated QoR-15 scores were analysed using linear mixed models with restricted maximum likelihood. Preoperative poor nutritional status, categorical time, and the interaction between poor preoperative nutritional status and categorical time were included in this model. The QoR-15 score is influenced by some factors; thus, we adjusted for the following clinically prominent covariates: age, sex, physical status by the criteria of the American Society of Anaesthesiologists (ASA-PS), surgical field, surgical procedure, surgical duration, blood-loss volume and postoperative analgesia. The scores for each QoR-15 item on POD 2 were also compared using an unpaired *t* test. The partial regression coefficient of the preoperative poor nutritional status to the QoR-15 score on POD 2 was calculated using multiple regression analysis with and without adjusting for the above prominent factors. Before performing the multiple regression analysis, multicollinearity among the above variables was assessed, and variables with a variance inflation factor of > 5 were excluded. Because the MNA-SF score is a continuous variable, a multiple regression analysis was used in the secondary analysis and was performed with and without adjustment for the prominent factors listed above. In the sensitivity analysis, the MNA-SF score was treated as a continuous variable. Because we analysed an existing dataset, the sample size used in this study was determined by that of our original study (*n* 230). As an alternative to an *a priori* sample size determination, we calculated the study power (1-β) using G*power v3·1 (Faul, Erdfelder, Lang, & Buchner, 2007) with the requirements: type I error probability (α) = 0·05 and effect size = 0·5 (large effect size). With these parameters and the number of existing patients (normal group = 152 and poor nutrition group = 78), the power was 93·7 % to show a difference. Missing data points were not imputed. All data were analysed using IBM SPSS Statistics (version 25.0; IBM Corp.), and statistical significance was set at $P < 0·05$.

Results

Baseline data

In the 230 included patients, the median age was 73 years and men predominated (70·0 %). Based on the MNA-SF scores, 66 %, 26·9 % and 6·9 % of patients were classified as normal, at-risk and malnourished, respectively. Consequently, 33·9 % of the patients were included in the poor nutrition group. We observed significant intergroup differences in the following variables: sex, weight, serum albumin, serum creatinine, frailty score, grip strength, preoperative QoR-15 score, anaesthetic agents, surgical field, surgical procedure and surgical duration (Table 1).

Outcome data

Table 2 and Fig. 1 show the mean values of QoR-15 after surgery. The QoR-15 score increased with the postoperative course in both groups; however, the mean QoR-15 was significantly lower in the poor nutritional group than in the normal group at all

Table 1. Patient demographics, surgical parameters and anaesthetics administered

	Total (*n* 230)		Normal (*n* 152)		At-risk and malnutrition (*n* 78)		*P*
	n	%	*n*	%	*n*	%	
Age (years)							
Median	73		74		72		0·17
1st quartile, 3rd quartile	69, 77		70, 77		69, 77		
Male	161	70·0	119	78·3	42	53·8	< 0·001
Height (cm)							
Median	163		163		160		0·08
1st quartile, 3rd quartile	156, 167		156, 168		153, 167		
Weight (kg)							
Median	60·8		65·0		53·6		< 0·001
1st quartile, 3rd quartile	53·1, 67·2		56·4, 70·0		48·2, 60·3		
ASA-PS							0·03
1	9	3·9	3	2·0	6	7·7	
2	178	77·4	117	77·0	61	78·2	
3	42	18·3	32	21·1	10	12·8	
4	1	0·4	0	0·0	1	1·3	
Co-morbidity							
Symptomatic cerebral vascular disease	12	5·2	10	6·6	2	2·6	0·34
Hypertension	130	56·5	92	60·5	38	48·7	0·09
Ischaemic heart disease	18	7·8	14	9·2	4	5·1	0·31
Atrial fibrillation	18	7·8	15	9·9	3	3·8	0·12
Peripheral arterial disease	1	0·4	1	0·7	0	0·0	1
Diabetes	60	26·1	41	27·0	19	24·4	0·75
Medication							
β-blocker	13	5·7	9	5·9	4	5·1	1
Steroid	4	1·7	3	2·0	1	1·3	1
Statin	63	27·4	49	32·2	14	17·9	0·02
	Median	1st quartile, 3rd quartile	Median	1st quartile, 3rd quartile	Median	1st quartile, 3rd quartile	
Laboratory data							
Serum albumin (g/dl)	4·2	4·0, 4·4	4·3	4·1, 4·5	4·1	3·9, 4·3	0·001
Serum creatinine (mg/dl)	0·80	0·68, 0·97	0·84	0·73, 0·99	0·75	0·63, 0·93	0·004
Frailty score	1·0	0·0, 2·0	1·0	0·0, 2·0	2·0	1·0, 3·0	< 0·001
Preoperative handgrip strength (kgf)	30·8	23·1, 38·5	34·3	26·8, 39·9	26·5	20·1, 34·0	< 0·001
Mini Nutritional Assessment Short-Form	13	11, 14	13	13, 14	10	8, 11	< 0·001
	n	%	*n*	%	*n*	%	
Number (%)							
Normal	152	66·0	152	100	0	0	
At-risk	62	26·9	0	0	62	79·5	
Malnutrition	16	6·9	0	0	16	20·5	
Preoperative Quality of Recovery-15 score							
Mean	139		141		135		< 0·001
SD	12		9·9		16		
Intraoperative covariate							
Anaesthetics agents							1
Inhalation agents	223	97·0	147	96·7	76	97·4	
Intravenous agents	7	3·0	5	3·3	2	2·6	
Surgical field							< 0·001
General	167	72·6	102	67·1	65	83·3	
Urologic	57	24·8	49	32·2	8	10·3	
Gynaecologic	6	2·6	1	0·7	5	6·4	
Surgical procedure							0·003
Laparoscopy	168	73·1	121	79·6	47	60·3	
Laparotomy	62	26·9	31	20·4	31	39·7	
Postoperative analgesia							0·12
None	4	1·7	2	1·3	2	2·5	
PCEA	101	43·9	62	40·8	39	50·0	
IV-PCA	125	54·3	88	57·9	37	47·4	
Surgical duration (min)							
Median	290		272		323		0·02
1st quartile, 3rd quartile	217, 374		215, 354		229, 401		
Intraoperative blood loss volume (ml)							
Median	66		60		72		0·29
1st quartile, 3rd quartile	16, 261		15, 223		19, 321		

ASA-PS, American Society of Anesthesiologists physical status; PCEA, patient-controlled epidural analgesia; IV-PCA, intravenous patient-controlled analgesia.

Table 2. Outcome data

	Total		Normal		At-risk and mal-nutrition		*P*
Mean QoR-15 score							
	Mean	SD	Mean	SD	Mean	SD	
Postoperative day 2	(*n* 230)		(*n* 152)		(*n* 78)		
	106	24	110	24	99	24	0·002
Postoperative day 4	(*n* 226)		(*n* 150)		(*n* 76)		
	118	22	122	19	110	25	< 0·001
Postoperative day 7	(*n* 229)		(*n* 151)		(*n* 78)		
	124	21	128	19	116	23	< 0·001
Median length of postoperative hospital stay (days)							
Median	9		9		10		< 0·001
1st quartile, 3rd quartile	8, 12		7, 10		8, 14		

QoR-15, Quality of Recovery-15.
Mean and standard deviation or Median (1st quartile, 3rd quartile).

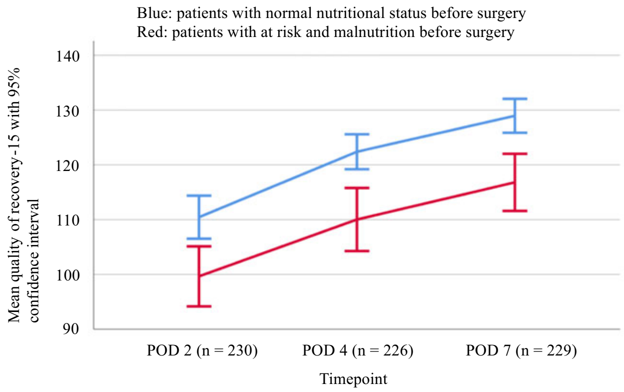

Fig. 1. Mean scores on Quality of Recovery-15 (QoR-15) *v.* preoperative nutritional status. POD, postoperative day. The test for significance was an unpaired *t* test.

postoperative time points. The linear mixed models showed statistically significant intergroup differences in the QoR-15 scores over time in both the unadjusted ($P < 0·001$) and adjusted models ($P = 0·007$).

At POD 2, the unpaired *t* test revealed significant differences in the following QoR-15 items: food, rest, hygiene, communication, return to work, feeling in control, well-being, anxiety and depression. However, at this time point, the mean values of the other items, including pain and nausea/vomiting, were not significantly different between the two groups (Table 3).

The variance inflation factors between patient-controlled epidural analgesia and intravenous patient-controlled analgesia were 15·8 and 15·5, respectively; thus, intravenous patient-controlled analgesia was excluded from a multiple regression analysis, which decreased the variance inflation factor of patient-controlled epidural analgesia to 1·37. Multiple regression analysis showed that poor preoperative nutritional status was associated with the QoR-15 score on POD 2 (adjusted partial regression coefficient, −7·8; 95 % CI, −14·9, −0·72) even after adjusting for prominent factors (Table 4). A sensitivity analysis treating the MNA-SF score as a continuous variable revealed that a higher MNA-SF score increased the QoR-15 score on POD 2 (adjusted partial regression coefficient, 1·6; 95 % CI, 0·1, 3·0; online Supplementary Table 1). The poor nutrition group had a longer postoperative stay than did the normal nutritional group ($P < 0·001$; Table 2).

Discussion

We found that the QoR-15 score increased with time post-surgery, but patients with poor nutritional status before surgery had significantly lower postoperative QoR-15 scores than did those with normal nutritional status. In our cohort, the preoperative QoR-15 score was statistically different between the two groups at $P < 0·001$; however, the mean difference taking into account the first decimal point was 6·2 (141·8 minus 135·6), which was below both the traditional minimal clinically important difference of 8·0 and an updated minimal clinically important difference of 6·8[13,14]; thus, the observed difference is not clinically significant. Furthermore, because the QoR-15 was developed as a measure of postoperative recovery and therefore does not necessarily reflect the baseline value if administered preoperatively, the preoperative QoR-15 should be considered a reference value only[15,16]. Patients with poor preoperative nutritional status had lower QoR-15 scores at any postoperative measurement point (POD 2, 4 and 7), and poor preoperative nutritional status was also a significant factor at POD 2. The exact reasons are unclear, but they could be explained by the fact that patients with poor nutritional status might be vulnerable to surgical stress and anaesthetics, and that malnutrition increases the risk of developing muscle weakness, impaired immune function, depression, and functional impairment[17–20]. Moreover, the MNA-SF can be used to assess physical frailty as well as serving as a comprehensive screening tool for nutritional status[21]. Physical frailty is also linked to vulnerability to surgical stress and is known to have a negative impact on postoperative outcomes[22]. These facts provide an alternative explanation of the results of this study.

The fact that the preoperative nutritional status affected the QoR-15 score on POD 2 is of interest. Previous studies have investigated the influence of patient factors such as age and sex on postoperative recovery; however, these are fixed factors[9,23–25]. By contrast, poor preoperative nutritional status could be a potentially modifiable factor if detected

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Table 3. Mean QoR-15 score on postoperative day 2 based on preoperative nutritional status

QoR-15 item	Total (*n* 230)		Normal (*n* 152)		At-risk and malnutrition (*n* 78)		
	Mean	SD	Mean	SD	Mean	SD	*P*
1. Breathing	8·2	2·1	8·3	2·0	7·8	2·3	0·08
2. Food	3·9	3·6	4·5	3·7	2·7	3·2	0·001
3. Rest	6·6	2·7	7·0	2·6	6·0	2·7	0·007
4. Sleep	6·2	3·0	6·1	3·1	6·2	2·7	0·83
5. Hygiene	6·8	3·5	7·1	3·3	6·1	3·8	0·04
6. Communication	8·4	2·3	8·6	2·0	8·0	2·7	0·03
7. Support	9·4	1·5	9·4	1·3	9·3	1·7	0·62
8. Return to work	7·2	2·7	7·5	2·7	6·7	2·8	0·04
9. Feeling in control	6·0	2·8	6·3	2·8	5·2	2·6	0·004
10. Well-being	6·7	2·6	7·0	2·6	6·0	2·5	0·005
11. Moderate pain	5·8	2·8	5·9	2·7	5·4	3·0	0·20
12. Severe pain	7·2	3·1	7·4	3·0	6·9	3·2	0·27
13. Nausea/vomiting	8·2	2·6	8·2	2·6	8·1	2·6	0·75
14. Anxiety	7·3	2·7	7·6	2·5	6·7	2·8	0·01
15. Depress	8·3	2·3	8·6	2·1	7·7	2·5	0·01

QoR, Quality of Recovery-15.
Mean and standard deviation.

Table 4. Results of multiple regression analysis, treating the Mini Nutritional Assessment Short-Form score as a category variable

	Unadjusted estimate			Adjusted estimate		
	Partial regression coefficient	95 % CI	*P*	Partial regression coefficient	95 % CI	*P*
Preoperative poor nutritional status	−10·7	−17·4, −4·0	0·002	−7·8	−14·9, −0·72	0·03

In the adjusted model, age, sex, American Society of Anesthesiologists physical status, surgical field, surgical procedure (laparotomy), surgical duration, blood loss volume and postoperative analgesia (patient-controlled epidural analgesia) were adjusted.

before surgery. Furthermore, on POD 2, patients in the poor nutrition group had relatively low QoR-15 scores on items other than pain and nausea/vomiting. Although care givers are attentive to reducing postoperative pain and nausea/vomiting, which are frequent complications after surgery, our findings in this study suggest new targets for enhancing postoperative recovery.

This study had some limitations. First, we included only patients with cancer who underwent major abdominal surgeries at a single university hospital. Therefore, it cannot be generalised to other populations. Second, the sample size of this study was not calculated to support a secondary analysis. Therefore, the number of patients categorised as at-risk or malnourished was too small to provide sufficient power to analyse our primary outcome based on the three groups defined by the MNA-SF. This is mitigated by the fact that a multiple regression model that included the MNA-SF score as a continuous variable also showed a negative association between preoperative nutritional status and the POD 2 QoR-15. Third, this study did not present a causal relationship between preoperative nutritional status and postoperative QoR-15 scores; however, our findings did further emphasise the importance of preoperative nutritional assessment.

In conclusion, we find that cancer patients with poor preoperative nutritional status are more likely to have lower QoR-15 scores after abdominal surgery. Further studies are needed to investigate whether optimisation of preoperative nutritional status contributes to improved postoperative recovery.

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There are no conflicts of interest.

Supplementary material

For supplementary material/s referred to in this article, please visit https://doi.org/10.1017/S0007114523001046

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