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Navigator nurse implementation within a fast track program of liver resections: How to improve the healthcare service and perioperative results

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Abstract

Background: The introduction into the clinical practice of the navigator nurse (NaNu) to address the task of counseling and short term follow-up help the effective implementation of the fast track protocol. The aim of the present study was to investigate the impact of the standardization of the NaNu's role in patients undergoing liver surgery.

Methods: Patients undergoing elective liver surgery for all diagnosis and approach, from 2015, received counseling and postoperative follow-up by NaNu and constituted the study group ($n = 890$). This group was compared with the control group ($n = 712$) including patients treated in the era before the implementation of the NaNu role (2011–2014). Outcome was evaluated in terms of discrepancy between functional recovery and discharge, number of ER accesses, number of readmissions.

Results: Preoperative characteristics of patients and disease, as well as type of resection and postoperative outcomes were similar between the two groups. The proportion of laparoscopic cases was higher in the study group (51.2% vs. 32% in the control). Time for discharge, interval between functional recovery and discharge, number of ER accesses and number of readmissions were reduced in the study group. Benign diagnosis, absence of complications, laparoscopic approach and presence of NaNu were independent predictors of shorter length of stay. The positive effect of NaNu's activation was recorded in patients with complications and undergoing open surgery.

Conclusion: The implementation of NaNu's role has allowed to us optimize the level of healthcare service offered to patients. The wider benefit was offered in the setting of complex patients.

KEYWORDS

eras, fast track, laparoscopy, liver surgery, navigator nurse

Abbreviations: CI, interval of confidence; CRLM, colon rectal liver methastasis; CV, urinary catheter; DI, difficult scoring system; ERAS, enhanced recovery after surgery; FNH, focal nodal hyperplasia; HCC, hepatocarcinoma; iCCA, intrahepatic cholangiocarcinoma; LOS, length of hospital stay; LPS, laparoscopy; LPT, laparotomy; NaNu, navigator nurse; POD, postoperative day; PONV, postoperative nausea and vomiting; RR, risk ratio; SVV, stroke volume variation.

Francesca Fermi and Francesca Ratti share the first authorship.

1 | INTRODUCTION

Hepatic surgery has acquired a profile of increasing safety and efficacy in recent years, thanks to outstanding advances in the surgical, anesthesiological, radiological and oncological fields. The capillary diffusion of laparoscopic approach, promoted by well documented short-term benefits, has allowed to reduce the biological impact of surgery, optimizing intra- and postoperative results.[1–7] In parallel with the attention to minimal invasiveness, the focus was also on the definition and implementation of specific perioperative management protocols. The rationale was to target factors that potentially delay postoperative recovery, in order to optimize and reduce the time required for functional recovery,[8–10] hence shortening the length of stay. This advantage has been specifically described even in groups of high-risk patients as those with cirrhosis[11–14] or candidates to procedures with high degree of technical complexity.[15–17] The fast-track perioperative protocol targets specific aspects of management and its flagship core is the multidisciplinary approach of the hepatobiliary team, with each professional figure being in charge of specific tasks and competences. Some critical aspects of the ERAS protocol primarily concerned the potential risk of readmission after discharge and more generally the increase in the use of first aid and emergency departments by patients. Furthermore, a discrepancy was described between the functional recovery of the patient and the moment of actual discharge, linked both to logistic factors and to the lack of a reference figure and direct contact with health personnel after discharge. Finally, patient compliance is recognized as one of the most factors impacting adherence to items and therefore success of the protocol. Within this background, Navigator Nurse (NaNu) plays a fundamental role. However, while the surgical and anesthesiological roles have been specifically analyzed, little has been investigated about the nurse's profile and consequently about the impact of this figure in improving adherence and effectiveness of the protocol. This study is the first to analyze the impact of NaNu's figure in the setting of hepatic surgery. The main purpose of the study is to evaluate the trend of accesses in the emergency room (ER) before and after the implementation of the NaNu figure, with specific attention to the improper accesses, and those that occurred for the “late” management of a complication. Secondary endpoint is to evaluate the length of hospitalization (LOS) and the discrepancy between functional recovery and discharge before and after the introduction of this figure, underling patients that could gain more advantages than others.

2 | MATERIAL AND METHODS

2.1 | Study design

All consecutive liver resections performed at San Raffaele Hospital, Milan, from 2011 to 2019 were included in this retrospective study. Inclusion criteria considered elective liver surgery, all types of surgical procedures conducted for benign and malign tumors with both open and minimally-invasive approaches. All patients operated after February 2020 were excluded from the study because of different postoperative management related to the Sars-Cov2 pandemic. Patients with NaNu counseling, introduced in 2015 as part of fast-track protocol (*Study group*), were compared with patients that underwent surgery before the introduction of NaNu (*Control group*). This study was conducted following the STrengthening the Reporting of Observational Studies in Epidemiology Statement (STROBE) guidelines.

2.2 | Variables

Perioperative features were included in the descriptive analysis. Preoperative variables included demographics (age and sex) and comorbidities, focusing on liver impairment. Child-Pugh score[18] is used to score it. Malignant tumors were hepatocarcinoma (HCC), intrahepatic cholangiocarcinoma (iCCA), colon rectal liver metastasis (CRLM) while, benign lesions were hemangioma, adenoma, focal nodal hyperplasia (FNH). Intraoperative parameters included surgical approaches (laparoscopic and laparotomic), extension of liver resection, time of surgery (min), intraoperative blood loss (ml). Postoperative complications, such as liver failure, hemorrhage, biliary fistula, ascites, abdominal collection were classified according to Dindo-Clavien et al.[19] LOS (days) and time for functional recovery were analyzed. Time for functional recovery was defined as the time needed by the patient to reach all discharge criteria. Moreover, the rate of readmission, readmission in ER, and inappropriate access were recorded. Inappropriate access was defined as access to ER without the need of radiological exams, interventional procedures or prolonged hospitalization. In a sub-analysis, patients were classified considering difficult scoring system (DI) parameters[15]: lesion $\geq$3 cm, proximity to major vessels, liver impairment, extensions of surgery, site of lesion in non-laparoscopic liver segments. One of these parameters defined high-risk patients for a laparoscopic approach.

2.3 | Role of navigator nurse (NaNu)

The role of NaNu was introduced in 2015 in clinical practice in the Liver Unit at San Raphael Hospital. A nurse with more than 10-years' experience in surgical patients was selected and was trained focusing on liver surgery.

The role of the NaNu took different timing (Figure 1):

1. *Preoperative*: NaNu met each patient for a preoperative counseling in order to verify the patient's information and solve medical doubts. Each patient could consider NaNu as a referential point for any preoperative problems.
2. *Perioperative*: NaNu was involved in patient hospitalization management. NaNu conducted two daily bedside visits to identify early postoperative complications. Patients could communicate concerns and discomfort to NaNu, who selected relevant medical information. Psychological support could be provided if patients needed it. Additionally, many patients came from different geographic areas, so NaNu recommended the best discharge plans considering type of surgery, postoperative complications, and the patient's medical condition. If necessary, NaNu could arrange for home nursing assistance or devices (enteral nutrition). Family education was conducted before discharge to involve them in the patient's healthcare. The main purpose is to avoid unnecessary hospitalization days.
3. *Postoperative*: NaNu maintained daily phone contact with patients during the first weeks after discharge. This approach allowed NaNu to address patient concerns and discomfort effectively, reducing postdischarge feelings of abandonment and associated anxiety. Furthermore, NaNu could provide medical contact or direct patients to a hospital setting if delayed postoperative complications arose, ensuring early identification and prompt problem resolution. If necessary, rapid in-hospital readmission or outpatients visits could be arranged.

2.4 | ERAS protocol for liver resection

All hepatic resections conducted, at San Raphael Hospital, for every surgical approach underwent ERAS protocol, as known in literature[11,16]:

1. *Preoperative* counseling and education, performed by anesthesiologist, surgeon and, after 2015, from NaNu. Preoperative carbohydrate intake, thromboembolism and antibiotic prophylaxis.
2. *Perioperative* gold directed fluid management, with *intraoperative* stroke volume variation monitoring.[20] Intraoperative pain control avoiding the usage of opioids and nausea management. Avoidance of naso-gastric tube and drain placement.
3. *Postoperative* liquid intake and mobilization performed on postoperative day (POD) 0–1. Fluid dismission, urinary catheter removal, oral pain control, and a normal diet reach in POD 2.
4. *Discharge* in POD3-4.

2.5 | Statistical analysis

Categorial variables were reported as frequencies and percentages. The X^2 and Fischer exact test were performed, as appropriate. Continuous variables were reported as mean and standard deviation with Mann-Whitney test or *t*-test application as appropriate. Univariate and multivariate logistic regression were used to identify independent predictors of longer length of hospital stay. Risk ratio and 95% confidence interval

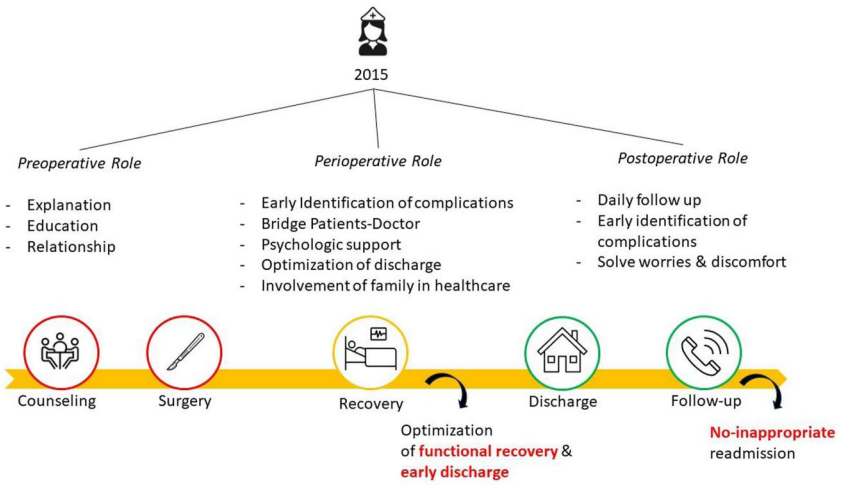

FIGURE 1 Role of navigator nurse (NaNu) in liver surgery department at San Raphael Hospital, Milan. [Colour figure can be viewed at wileyonlinelibrary.com]

reported the results. Statistical significance was defined as $p < 0.05$. All analyses were performed using SPSS software (Version 26.0, IBM Inc).

3 | RESULTS

Overall, 1602 liver resections were performed at San Raphael Hospital, during the study period. Surgical procedures performed after 2015 were 890 (55%), receiving NaNu counseling, while 712 (45%) patients were subjected to surgery before the introduction of NaNu figure.

Comparing the study group with the control one, no difference in terms of preoperative, intraoperative features and morbidity and mortality was observed (Table 1).

Laparoscopic surgery was more performed in the study group (51% vs. 32%; $p = 0.026$) with a lower LOS than the control group (4 vs. 6; $p = 0.041$). The functional recovery and the ratio between functional recovery/discharge were significantly different in the two groups, respectively 3 (2–10) compared to 4 (4–15) days ($p = 0.040$) and 1 (0–2) compared to 2 (1–5) days ($p = 0.034$). Finally, the rate of readmission was higher in the control group (3% vs. 4%) with a major number of inappropriate accesses compared with the study group (1% vs. 3.5%, $p = 0.033$) (Table 1).

The factors potentially associated with a longer LOS were analyzed, including: age, ASA score, comorbidities, presence of liver cirrhosis, portal hypertension, previous surgeries, malignancy diagnosis, surgical approach, conversion to laparotomy, blood transfusions, blood loss >700 mL, postoperative complications, activation of the NaNu, adherence to protocol items exceeding 80%. The factors that showed significance in the univariate analysis and multivariable analysis were reported in Table 2. Malignant diseases (RR 1.54; CI 95% 1.06–2.31; $p = 0.031$), open approach (RR 1.95; CI 1.24–2.41; $p = 0.041$), postoperative complications (RR 1.44; CI 95% 1.06–2.01; $p = 0.041$), the absence of NaNu were independent predictor of a longer LOS (Table 2).

Considering ERAS parameters, a major agreement in terms of preoperative counseling, avoid of abdominal placement, early mobilization within POD 0–1, with a complete mobilization in POD 3, intravenous fluid stop prescription within POD 2, optimal pain control orally within POD 2, early remotion of urinary catheter in POD 2 and discharge in POD 3-4, was observed in study group (Figure 2). Moreover, as reported in Figure 3, an early functional recovery and agreement for discharge was underlined in the study group instead of the control one.

Finally, in the sub-analysis, the laparoscopic group of patients with lesions ≥3 cm had a lower rate of postoperative complications, in particular postoperative liver failure (1% vs. 5%, $p = 0.031$), ascites (5% vs. 15%, $p = 0.017$), abdominal collection (5% vs. 18%, $p = 0.032$), a shorter time of hospitalization (5 vs. 7 days, $p = 0.041$) and a shorter time of functional recovery (4 vs. 6, $p = 0.04$) instead of laparotomic one. The same results were recorded considering specifically patients undergoing major hepatectomies, with lesions close to major vessels, with impaired liver function and surgery performed for non-laparoscopic segments, as reported in Figure 4.

4 | DISCUSSION

In this study, the role of NaNu for patients subjected to liver surgery was underlined. The preoperative education of patients and the perioperative support (Figure 1) allowed an easier adherence to fast-track protocol with a shorter LOS (4 vs. 6 days, $p = 0.041$) and a lower discrepancy between functional recovery and discharge (1 vs. 2, $p = 0.034$). Moreover, the postoperative role of telephonic follow-up, with distant support of patients and medical advice guaranteed, reduced the number of inappropriate access to ER (6% vs. 11%; $p = 0.028$). This study, first, discovered benign lesions, laparoscopic approach, no-postoperative complications, and NaNu role (RR 2.19; CI 95% 1.31–2.62; $p = 0.023$) as independent factors of shorter LOS.

Overall, NaNu has been introduced in the oncology field, showing benefits like simplified management of chemotherapy complications, enhanced psychological support and improved patient education on diagnosis and treatment.[21–23] The strong patient-NaNu relationship fosters compliance and agreement with chemotherapy, crucial for overcoming pharmacological toxicity and ensuring effective oncological therapy.[24]

Nowadays, this clinical role has been introduced in surgical activities, including cardiac[25,26] and gastrointestinal surgery.[27] Adequate nursing guidance played a significant role in colorectal surgery[28] leading to shorter LOS, fewer complications and readmission in patients requiring stoma management.[29]

NaNu was introduced at San Raphael hospital in 2015, according to the increasing laparoscopic approach in liver surgery and the fast-track protocol adhesion. The rate of laparoscopic liver surgery after 2015 was 51%, significantly higher than the previous years (32%). The ERAS protocol at San Raphael Hospital was introduced in 2011 and it underwent a dynamic evolution over time, based on literature and guidelines. However, the only distinguishing factor in the protocol was the introduction of NaNu, not present previous than 2015. Consequently, the improvement in outcomes can be correlated to NaNu interventions (Table 2). Indeed, as reported in Figures 2 and 3, an early oral feeding, mobilization, orally pain control, and a shorter LOS were observed in the study group. A fast discharge could be a source of anxiety for the patient, because of some worries about pain domiciliary management and the inability to know what postoperative

TABLE 1 Preoperative, intraoperative and postoperative features comparing the study group ($n = 890$) and the control group ($n = 712$).

Variables	Study group $n = 890$ (%)	Control group $n = 712$ (%)	p
Preoperative features			
Age[a], year	62 ± 6	63 ± 8	0.83
Sex, Male	532 (60)	384 (54)	0.23
ASA			0.187
1	105 (12)	56 (8)	
2	427 (48)	370 (52)	
3	323 (36)	266 (37)	
4	35 (4)	21 (3)	
BMI[a], kg/m^2	23.8 ± 2.1	22.7 ± 3.2	0.29
Comorbidities, Yes	594 (67)	516 (72)	0.34
Cardiocirculatory comorbidities, yes	332 (37)	244 (34)	0.55
Pulmonary comorbidities, yes	149 (17)	132 (19)	0.61
Renal comorbidities, yes	78 (9)	84 (12)	0.437
Diabetes, yes	183 (21)	167 (23)	0.75
Underlying liver impairment			0.39
Healthy liver	296 (33)	202 (28)	
Mild impairment	347 (39)	419 (59)	
Cirrhosis	157 (18)	90 (13)	
Child class (18)			0.033
A	837 (94)	698 (98)	
B	53 (6)	14 (2)	
Portal hypertension, yes	113 (13)	49 (7)	0.041
Previous chemotherapy, yes	218 (24)	209 (29)	0.28
Previous surgery, yes	436 (49)	384 (54)	0.19
Previous supramesocolic surgery, yes	200 822)	147 (21)	0.26
Previous hepatic surgery, yes	69 (8)	56 (8)	0.38
Previous interventional procedures, yes	61 (7)	42 (6)	0.89
Diagnosis			0.55
Malignant	767 (86)	620 (87)	
HCC	294 (33)	179 (25)	
iCCA	111 (12)	124 (17)	
CRLM	251 (28)	236 (33)	
Other	111 (12)	54 (8)	
Benign	123 (14)	92 (13)	
Hemangioma	46 (5)	30 (4)	
Adenoma	26 (3)	25 (3)	
FNH	31 (3)	7 (1)	
Other	35 (4)	30 (4)	
Tumor size[a], cm[a]	3.8 ± 1.5	4.5 ± 2.6	0.47
Nodularity			0.57
Single	628 (71)	441 (62)	
Multiple	262 (29)	271 (38)	

(Continues)

TABLE 1 (Continued)

Variables	Study group $n = 890$ (%)	Control group $n = 712$ (%)	p
Intraoperative features			
Approach			0.026
Laparoscopic	456 (51)	228 (32)	
Open	434 (49)	484 (68)	
Extension of resection			
Minor	376 (42)	328 (46)	
Major	507 (57)	384 (54)	
Multiple resection, Yes	301 (34)	263 (37)	
Operative time[a], min	230 ± 53	210 ± 60	0.56
Blood loss[a], ml	350 ± 100	450 ± 200	0.28
Conversion to laparotomy, Yes	53 (12)	23 (10)	0.189
Pringle maneuver, Yes	855 (96)	698 (98)	0.45
Resection margin			0.16
R0	872 (98)	677 (95)	
R1	18 (2)	35 (5)	
Total RPBC transfusion, Yes	183 (21)	154 (22)	0.92
Total frozen plasma transfusion, Yes	113 (13)	140 (20)	0.201
Nasogastric tube removed in OR, Yes	890 (100)	705 (99)	0.94
Drainage placement, Yes	323 (36)	286 (40)	0.48
Need for ICU, Yes	9 (1)	14 (2)	
Postoperative features			
Postoperative mortality, yes	7 (0.8)	6 (0.9)	0.34
Postoperative morbidity, yes	21 (24)	180 (25)	0.47
Clavien Dindo score (19)			0.27
I-II	147 (16)	125 (17)	
III-V	71 (8)	56 (8)	
Postoperative liver failure, Yes	18 (2)	42 (6)	0.16
Ascites, Yes	53 (6)	62 (9)	0.09
Hemorrhage, Yes	18 (2)	21 (3)	0.67
Biliary fistula, Yes	44 (5)	42 (6)	0.72
Pleural effusion, Yes	78 (9)	66 (9)	1
Abdominal collection, Yes	44 (5)	42 (6)	0.78
Fever, Yes	92 (10)	91 (13)	0.31
Need of reoperation, Yes	15 (2)	15 (2)	1
LOS[a], days	4 (3–34)	6 (4–36)	0.041
Time for functional recovery, days	3 (2–10)	4 (4–15)	0.040
Discrepancy functional recovery/discharge	1 (0–2)	2 (1–5)	0.034
Access to ER, yes	56 (6)	78 (11)	0.028
Inappropriate access to ER, yes	9 (1)	25 (3)	0.033
Rate of readmission, yes	29 (3)	30 (4)	0.56

Abbreviations: ASA, American society of Anesthesiology; BMI, body mass index; ER, emergency room; ICU, intensive care unit; LOS, length of hospital stay; NS, not significant; OR, operating room; PRBC, packet red blood cells.

[a]Mean ± Standard deviation.

complication could develop. On one side, a preoperative explanation of in-hospital goals was needed to gain compliance and protocol agreement. On the other hand, NaNu had the role of teaching how to recognize postoperative complications at home, with a fast way to communicate with the doctor and NaNu. Useless early access in ER was avoided.

TABLE 2 Univariate and multivariate analysis of variables predicting a longer length of hospital stay after liver resection.

Variable	Univariable *p*	Multivariable Or (95% CI)	*p*
Diagnosis			
Benign		1	
Malignant	0.019	1.54 (1.06–2.31)	0.031
Approach			
Open		1.95 (1.24–2.41)	
Laparoscopic	0.031	1	0.041
Complication			
No		1	
Yes	0.029	1.44 (1.06–2.01)	0.041
Nanu activation			
Yes		1	
No	0.015	2.19 (1.31–2.62)	0.023

Abbreviation: NaNu, navigator nurse.

As known in literature, the combination of minimally invasive approach and ERAS protocol in liver surgery allowed less postoperative morbidity and faster recovery than open surgery.[30,31] This association permitted the extension of surgical indications to high risk patients. Indeed, an higher rate of cirrhotic patients (C.P score B: 6% vs. 2%, $p = 0.033$) and with portal hypertension (13% vs. 7%, $p = 0.041$) benefitted more of laparoscopic surgery than laparotomic one, according to the literature.[13,14,17] Otherwise, high risk patients, defined considering age, comorbidities and extension of surgery, were less confident in application of fast-track protocol, also related to a higher rate of clinical relevant postoperative complications, medical and surgical ones. These patients benefited more from NaNu influence.[32,33] Consequently, the role of NaNu gained importance with increase of patients' and surgical procedures complexity. As known, highly difficult surgical technical procedures were extremely difficult to identify, because of the influence of more factors. The DI index[15] combined lesions ≥3 cm, difficult liver segments approaching laparoscopically, major hepatectomy, close lesion relation to major vessels and liver impairment. It allowed the creation of a preoperative score able to define high risk procedures. In the present study, postoperative outcomes were compared between laparoscopic and laparotomic surgery, divided for each single DI parameter. Laparotomy was associated with a major rate of postoperative liver failure (lesion ≥3 cm, major hepatectomy, liver impairment)

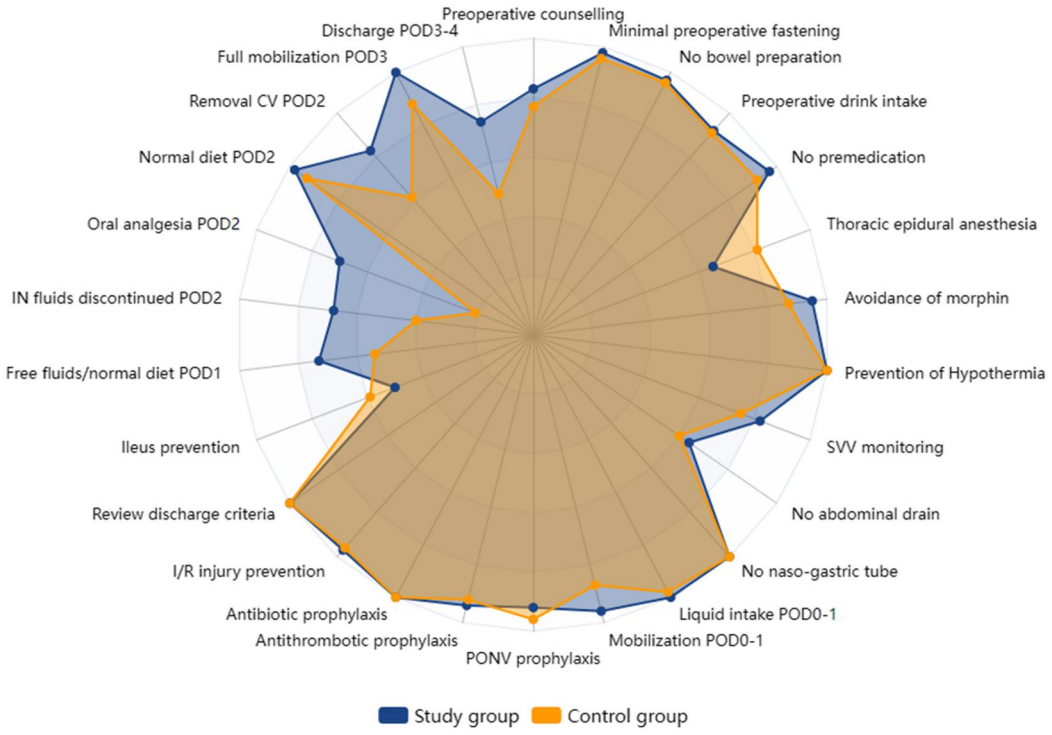

FIGURE 2 Fast-track protocol agreement comparing the study group with control one. CV, urinary catheter; POD, postoperative day; PONV, post-operative nausea and vomiting; SVV, stroke volume variation. *Source*: This figure was created by Visual-Paradigm Online free program. [Colour figure can be viewed at wileyonlinelibrary.com]

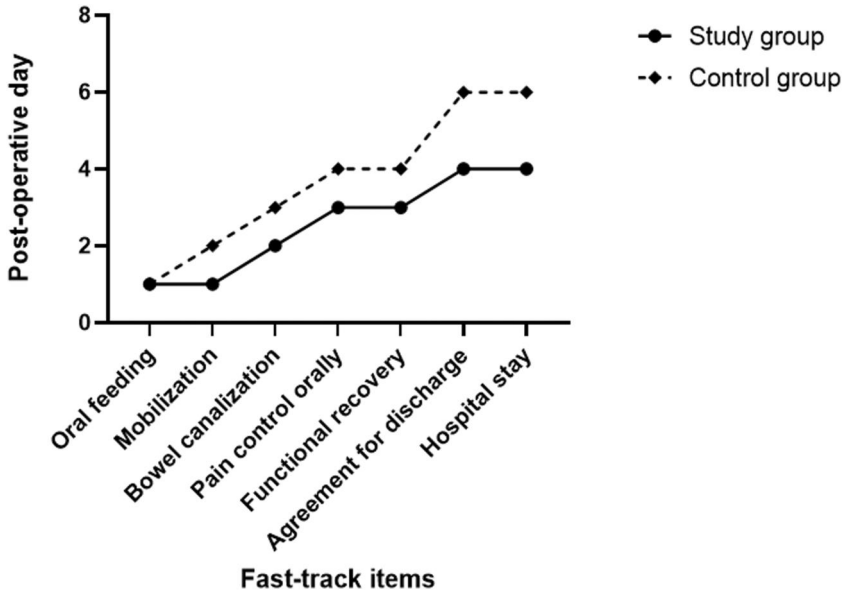

FIGURE 3 Functional recovery compared between study and control groups. *Source*: This figure was created by GraphPad-Prism.

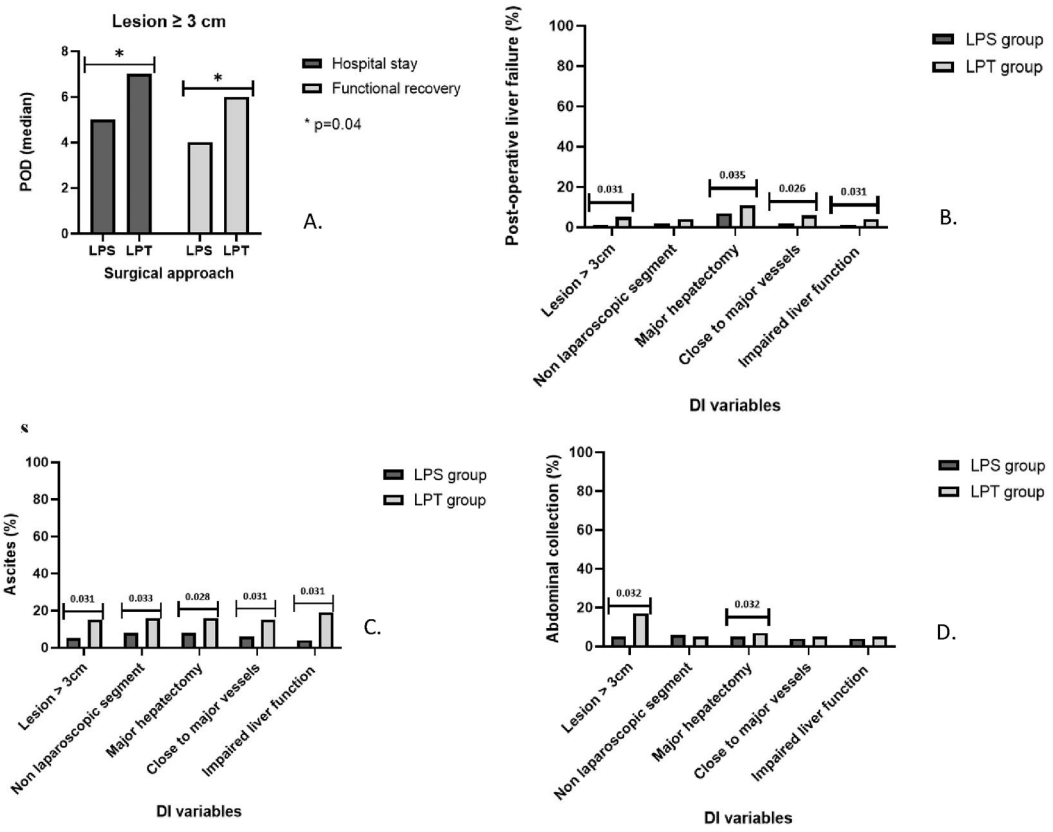

FIGURE 4 (A) *Length of hospital stay and time of functional recovery* comparing laparoscopic and laparotomic approach for *lesion ≥ 3 cm.* (B) Percentage of *postoperative liver failure* comparing laparoscopic and laparotomic group for each DI parameters (C) Percentage of postoperative *ascites* comparing laparoscopic and laparotomic group for each DI parameters (D) Percentage of *intrabdominal collection* comparing laparoscopic and laparotomic group for each DI parameters. DI, difficult scoring system; LPS, laparoscopic; LPT, laparotomic; POD, postoperative day. *Source*: This figure was created by GraphPad-Prism.

and to a longer LOS (Figure 4). NaNu introduction facilitated the discharge of complex patients contemporary to reduction of well-known risk of early readmission after fast-track protocol.

The role of NaNu was assessed in a high-volume liver disease surgical center, but it should also be introduced in low-volume centers with workload distribution based on patients and disease complexity. Reducing hospital stays and preventing inappropriate readmissions could lower healthcare costs, improve care and reduce surgical waiting times, especially for cancer patients. Additionally, the potential impact of implementing NaNu on optimizing surgeons' and nurses' work time is beyond this study's scope, although it is conceivable. Finally, Nanu conducted nutritional, physical and psychological assessments as part of preoperative evaluations. The study did not focus on the potential for other professionals to intervene, as this considered a period before the introduction of these figures. However, all these aspects may be subjects of future research.

This study has several limitations. Firstly, it has a retrospective design. Additionally, it's challenging to isolate the independent impact of NaNu due to simultaneous advancements in laparoscopic surgery and the ERAS protocol. The study lacks patients-reported outcomes and doesn't assess NaNu's influence on quality of life. Furthermore, it includes an older patient cohort, excluding surgical patients post-2020, which doesn't account for changes in patient management and the role of NaNu during the COVID-19 pandemic. However, telemedicine and technological advancements could provide valuable resources for remote patient follow-up and efficient medical documentation transmission.

In conclusion, this study underlined the important role of NaNu as an integral part of the fast-track protocol. A preoperative counseling, perioperative and postoperative role gained a shorter functional recovery and a lower rate of inappropriate readmission. The positive effect of NaNu was mainly observed after complex liver resection, with laparotomic approach and the development of postoperative complications.

AUTHOR CONTRIBUTIONS

Manuscript drafting: Francesca Fermi, Diletta Corallino. Design conception: Raffaella Reineke, Sara Ingallinella. Data collection: Francesca Fermi, Perthshanush Stepanyan. Statistical Analysis: Francesca Ratti. Supervision: Luigi Beretta, Luca Aldrighetti. Manuscript revision: Francesca Ratti, Luca Aldrighetti.

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CONFLICT OF INTEREST STATEMENT

The authors of this manuscript have no conflicts of interest to disclose and further disclose any commercial interest that they may have in the subject of study and the source of any financial or material support.

ETHICS STATEMENT

Approval to perform this retrospective study was obtained from the Institutional Review Board of enrolling institution and the requirement for consents from subjects was waived.

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