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Original Article

Predictors of Difficult Laparoscopic Cholecystectomy, Scoring Systems and their Implications on the OutcomesSohag Experiences

Mahmoud Fahmy Elian, Abd El Aal Ali Saleem, Ahmed Gaber Mahmoud, Alaa Ahmad Redwan

*General Oncology and laparoscopic Surgery Department, Faculty of Medicine, Sohag University, Sohag, Egypt

Abstract

Background: Although laparoscopic cholecystectomy (LC) has become the primary surgical treatment for cholelithiasis, certain patients still require conversion to open cholecystectomy;
sometimes caused by difficulties that need special techniques and tailored to the operator to avoid more complication. We are aiming at this work to predict difficult LC preoperatively, decrease complication of LC, tailored lap chole to the operator surgeon and decrease percentage of conversion and overall morbidity and mortality.

Methods: In this prospective study, 50 patients with symptoms of gallstone disease took part. All patients were subjected to Randhawa score and Nassar grading system.

Results: In multivariate regression, age, sex, body mass index, previous acute cholecystitis, wall thickness, abdominal scar (supra umbilical), impacted gallstone and pericholycystic collection were peculiar independent indicator of difficult LC (P value <0.05) while previous abdominal infraumbilical surgery was not predictor. Preoperative score of difficulty can significantly predict difficult LC (P <0.001 and area under the curve =0.984) at cut-off >5 with 87.5% sensitivity, 90.4% specificity, 63.6% positive predictive value and 97.4% negative predictive value.

Conclusions: Both scoring systems are effective in predicting the difficulty of LC. However, Nassar scoring system, which includes both preoperative and intraoperative assessments, is superior due to its simplicity, ease of application, and ability to gather useful preoperative data, also its applicability from first look intraoperatively, and it helped us during the study in predicting difficult cases from the first look.

Keywords: Laparoscopic Cholecystectomy, Scoring Systems, Randhawa Score, Nassar Grading System

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Corresponding Author: Mahmoud Fahmy Elian **E.mail**: mahmoudfahmy@med.sohag.edu.eg

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Introduction:

Although laparoscopic cholecystectomy (LC) has become the primary surgical treatment for cholelithiasis, certain patients still require conversion to open cholecystectomy. sometimes caused by difficulties that need special techniques and tailored to the operator to avoid more complication. (1)

Identifying these individuals before surgery may lead to optimized preoperative planning and lower surgical expenses.

To determine if preoperative clinical, laboratory and radiology data can predict difficulties.

Anticipating a challenging laparoscopic cholecystectomy pre-operatively might enhance awareness for both the patient and the surgeon on intra-operative risks and the potential necessity for conversion to open cholecystectomy. (2)

Iatrogenic injuries and conversion rates may be diminished based on the surgeon's skills, specific techniques, and intraoperative ongoing maneuvers. (3)

The aim of this work was to predict difficult LC preoperatively, decrease complication of LC, tailored lap chole to the operator surgeon and decrease percentage of conversion and overall morbidity and mortality.

Patients and Methods:

This prospective study was held out on 50 patients aged from 18 to 60 years old, both sexes, with symptomatic gall stone disease.

The study was done from March 2023 to September 2023 after approval by the Ethics Committee of Faculty of Medicine, Sohag University Hospital, Egypt. An informed written consent was obtained from the patient.

Exclusion criteria were Conversion from laparoscopic to open surgery owing to equipment malfunction, pregnancy, patients with common bile duct calculus or features of obstructive jaundice, patients who refused LC, patients who were not fit for general anesthesia due to various medical illnesses and contraindications to LC like which are relative contraindications: [Cardiac and chest diseases , coagulopathies, and end-stage renal or liver disease]. **Preoperative assessment:**

Medical and surgical history of the patients was taken, clinical examination of the patients was performed, routine laboratory investigations were done, and sonographic findings were recorded. A total of patients participated in the study after prior informed written consent. This study commenced after obtaining the permission from the ethical committee of the hospital. Each patient received a preoperative score based on their history, clinical examination, and sonographic results.

The surgeon would be asked for his opinion to classify gallbladder (GB) from the first look of operation according to the scores present. Time was recorded from the 1st port site administration till the last port closure. Every intraoperative event, such as the duration of operation , bile/stone leakage, and damage to the duct/artery will be noted.. The temperature of the operating room was maintained at relative humidity to provide a compromise between the requirements of the patients and those of the surgeons.

Electrocardiograms were done for all patients. All the patients received preoperative antibiotics. On arrival at the operating room, Preanesthetic preparation and premedication, induction then maintenance anesthesia done. operative procedure began; CO2 gas was inflated through verses needle.

Each patient was instructed about preoperative and intraoperative difficulty with the Randhawa scoring system and Nassar difficulty grading scale.

Randhawa score

The Randhawa score is the total of scores, which ranges from 0 to 15. The score provides three levels for determining the difficulty.. It is easy (0-5), difficult (6-10), extremely difficult (11-15). (4)

Table 1: Preoperative Randhawa score was applied to all patients included in our study

Scoring factors	Minimum	Maximum
Age	<50 yrs (0)	>50 yrs (1)
Gender	**Female (1)**	**Male (1)**
History of Hospitaliztion of acute cholecystitis	No (0)	Yes (4)
Clinical		
BMI	<25 (0)	25-27(1) >27.5 (2)
Abdominal scar	No (0)	**Infra-umbilical** (1) **Supra umbilical** (2)
Palpable Gall bladder	No (0)	Yes (1)
Sonography		
Wall thickness	Thin (0)	Thick >4mm (2)
Pericholecystic collection	No (0)	Yes (1)
Impacted stone	No (0)	Yes (1)

Data are presented as numbers, BMI: body mass index.

All operations were done by the same operator ; The procedure was done using three abdominal ports .

Table 2: Intraoperative Randhawa system for difficult LC

GB appearance	
No adhesions	0
Adhesions	1
Adhesions < 50% and completely buried GB	2
GB is completely buried in adhesion	3
Distension/Contraction	
Distended GB (or contracted shriveled GB)	1
Unable to grasp with atraumatic laparoscopic forceps	1
Stone ≥1 cm impacted in Hartman's Pouch	1
Access	
BMI >30	1
Adhesions from previous surgery limiting access	1
Severe Sepsis/Complications	
Bile or Pus outside GB	1
Time to identify cystic artery and duct >90 minutes	1
Degree of difficulty	
Mild	<2
Moderate	2-4
Severe	5-7
Extreme	8-10

iData are presented as numbers, BMI: body mass index.

A preoperative scoring or grading system (based on age, sex, history, clinical examination, laboratory, and sonographic results), developed by Nassar et al. [5] was used, and based on scores , the patients were classified into three groups i.e., Low risk (Low risk (<2); Intermediate risk (2-6), and Hgh risk (7- 19).

Table 3: Preoperative Nassar grading system for difficult LC

Age (years)	**<40**	0
	40 and above	1
Sex	**Female**	0
	Male	1
ASA classification	**I**	0
	II	1
	III	2
	IV	7
Primary diagnosis	**Pancreatitis**	0
	Biliary colic	0
	Choledocholithiasis	1
	Cholecystitis	4
Thick-walled GB (3mm or more)	**No**	0
	Yes	2
Common biliary duct dilation (>6mm)	**No**	0
	Yes	1
Pre-operative ERCP	**No**	0
	Yes	1
Type of admission	**Elective**	0
	Delayed	1
	Emergency	2
Degree of difficulty	**Low risk**	0-1
	Intermediate risk	2-6
	High risk	7-19

Data are presented as numbers, ASA: American society of anesthesiologists, GB: Gallbladder, ERCP: Endoscopic retrograde cholangiopancreatography.

Intraoperative technique: The operative data were collected prospectively, and operators were asked to classify the difficulty of the surgery using the Nassar scale (grades 1– 4). [6] This score was published in 1995 and graded operative events from the GB, cystic pedicle, and associated adhesions. The grading system is developped to be used as an overall summary of the operative events noted , and the worst factor found in the individual aspect of either the 'GB', Cystic Pedicle' or 'Adhesions' should be used to define the final overall grade

Table 4: Intraoperative Nassar difficulty grading scale

Nassar scale	Gall bladder	Cystic pedicle	Adhesions
I	Foppy, non- adherent	Thin and clear	Simple up to the neck/Hartmann's Pouch
II	Mucocele, Packed with stones	Fat laden	Simple up to the body
III	Deep fossa, Acute cholecystitis, Contracted, Fibrosis, Hartman's adherent to CBD, Impaction	Abnormal anatomy or cystic duct— short, dilated or obscured	Dense up to fundus; Involving hepatic flexure or duodenum.
IV	Completely obscured, Empyema, Gangrene, Mass	Impossible to clarify	Dense, fibrosis, wrapping GB, Duodenum, or hepatic flexure difficult to Separate

Postoperative:

Any side effects were recorded as hypotension (systolic arterial pressure<90 mmHg), arrhythmia, bradycardia (heart rate (HR) <50 beat/min), nausea or vomiting, or any other complications. In the surgical ward, vital signs (HR, blood pressure (BP), mean BP) were assessed regularly every 2 hours during the first 6 hours post operative and then every 6 hours for 24 hours .

Assessment and validation of the scoring system:

Obviously, there were many scorings system to assess difficulty of cholecystectomy we here

trying to validate the scoring systems mentioned earlier. A preoperative score was given to the patient, then after operation assessing intraoperative score and assessing overall predictive value of difficulty scores.

Statistical analysis

The statistical analysis was performed using SPSS v26 (IBM Inc., Chicago, IL, USA). The normal distribution of data was evaluated using the Shapiro-Wilks test and histograms.. Quantitative parametric variables were provided as mean and standard deviation (SD) and compared between the two groups using the unpaired Student's T-test. Qualitative variables were provided as frequency best test performance. The significance level was set at $p<0.05$.

and percentage (%) and examined using the Chi-square test or Fisher's exact test, as applicable A two-tailed P value of <0.05 has been considered statistically significant. The overall diagnostic performance of each test was evaluated using ROC curve analysis, A curve extending from the lower left corner to the upper left corner and then to the upper right corner is considered a perfect test.. The overall test performance wass assessed using the area under the curve (AUC); an AUC of greater than 50% indicates acceptable performance, while an area of almost 100% indicates the

Results:

Table 5: Demographic data, surgical history, clinical examination, ultrasound findings and preoperative score of difficult LC of the studied patients

Demographic data		(n=50)	(%)
Age	≤ 50 years	30	60
	>50 years	20	40
Sex	Male	11	22
	Female	39	78
BMI	≤ 25 kg/m^2	23	46
	25.1-27.5 kg/m^2	18	36
	>27.5 kg/m^2	9	18
ASA physical status	II	37	74
	III	13	26
Surgical history			
Previous abdominal surgery	Supra umbilical	8	16
	Infra umbilical	17	34
Previous acute cholecystitis		8	16
Clinical examination			
Palpable GB		14	28
Ultrasound findings			
Wall thickness	≥4mm	28	56
	<4mm	22	44
Pericholecystic collection		8	16
Impacted stone		12	24
Preoperative score of difficult LC		3.9 ± 3.17	

Data is presented by frequency %, Mean SD, BMI: Body mass index, ASA: American society of anesthesiologists, LC: Laparoscopic cholecystectomy.

Table 6: Scoring system according to Randhawa and Nassar of the studied patients

		N	%
Randhawa	Mild	40	80
	Moderate	7	14
	Sever	3	6
Nassar	Low risk	41	82
	Intermediate risk	7	14
	High risk	2	4

Data is presented by frequency %.

Table 7: Relation between preoperative score of difficulty and (demographic data, surgical history, and clinical examination)

		Easy LC group (n=42)		Difficult LC group (n=6)		Very difficult LC group (n=2)		P value	Post hoc
Demographic data									
		N	**(%)**	**N**	**(%)**	**N**	**(%)**		
Age	**≤ 50 years**	28	66.67	1	16.67	1	50	0.062	---
	>50 years	14	33.33	5	83.33	1	50		
Sex	**Male**	4	9.52	5	83.33	2	100	**<0.001***	**P1<0.001*** **P2=0.015*** **P3**=1
	Female	38	90.48	1	16.67	0	0		
BMI	**≤ 25 kg/m^2**	22	52.38	1	16.67	0	0	**0.007***	**P1=0.002*** **P2**=0.144 **P3=** 0.586
	25.1-27.5 kg/m^2	16	38.1	4	57.14	1	33.33		
	>27.5 kg/m^2	4	9.52	4	66.67	1	50		
ASA physical status	**II**	33	78.57	4	66.67	0	0	**0.042***	**P1**= 0.516 **P2**= **0.012*** **P3**= 1
	III	9	21.43	2	33.33	2	100		
Surgical history									
Previous abdominal surgery	**Supra umbilical**	3	7.14	4	66.67	1	50	**0.001***	**P1<0.001*** **P2=** 0.074 **P3**=1
	Infra umbilical	14	33.33	2	28.57	1	33.33		
Previous acute cholecystitis		2	4.76	4	66.67	2	100	**<0.001***	**P1=0.001*** **P2= 0.006*** **P3**=1
Clinical examination									
Palpable GB		3	7.14	2	33.33	0	0	0.121	-

Data is presented by Frequency %, *Significantly different as P value ≤0.05, P1: P value compared to easy LC group, P2: P value compared to difficult LC group, P3: P value compared to very difficult LC group, LC: Laparoscopic cholecystectomy, BMI: Body mass index, ASA: American society of anesthesiologists.

Table 8: Relation between preoperative score of difficulty and (ultrasound findings, operation time) of the studied patients

		Easy LC Group (n=42)		Difficult LC group (n=6)		Very difficult LC group (n=2)		P value	Post hoc
Preoperative score of difficulty and ultrasound score of difficulty and ultrasound findings									
		N	**(%)**	**N**	**(%)**	**N**	**(%)**		
Wall thickness	**≥4mm**	8	19.05	6	100	2	100	**<0.001***	**P1<0.001*** **P2=0.047*** P3=---
	<4mm	34	80.95	0	0	0	0	**<0.001***	**P1=0.008*** **P2=0.022*** P3= 1
Pericholecystic collection		5	11.9	4	66.67	2	100	**<0.001***	**P1=0.008*** **P2=0.022*** P3= 1
Impacted stone		2	4.76	5	83.33	2	100	**<0.001***	**P1<0.001*** **P2=0.006*** P3=1
Preoperative score of difficulty and operation time									
Operation time (min)		36.2 ± 5.39		75 ± 19.49		95 ± 21.21		**<0.001***	***P1<0.001** ***P2<0.001** ***P3=0.019**

Data is presented by Frequency %, Mean SD, *Significantly different as P value ≤0.05, P1: P value compared to easy LC group, P2: P value compared to difficult LC group, P3: P value compared to very difficult LC group, LC: Laparoscopic cholecystectomy.

Table 9: Preoperative score of difficulty and scoring system of Randhawa and Nassar

	Easy LC group (n=42)		Difficult LC group (n=6)		Very difficult LC group (n=2)		P value	Post hoc
								Randhawa
	N	**%**	**N**	**%**	**N**	**%**		
Mild	40	95.24	0	0	0	0	**<0.001***	**P1<0.001*** **P2<0.001*** P3= 0.673
Moderate	2	4.76	4	57.14	1	33.33		
Sever	0	0	2	33.33	1	50		
								Nassar
Low risk	40	95.24	1	16.67	0	0	**<0.001***	**P1<0.001*** **P2<0.001*** P3= 0.108
Intermediate risk	2	4.76	4	57.14	0	0		
High risk	0	0	1	16.67	2	100		

Data is presented by Frequency %, *Significantly different as P value ≤ 0.05, LC: Laparoscopic cholecystectomy.

Table 10: Outcome of LC of the studied patients and multivariate regression of various variables to predict difficult LC

	n=50		
	N	**%**	
Easy LC	42	84	
Difficult LC	6	12	
Very difficult LC	2	4	
	Multivariate		
	Odds ratio	**95% CI**	**P**
Age	15.4	1.367-173.439	**0.026***
Sex	0.024	0.002-0.391	**0.008***
BMI	23.597	1.999-278.468	**0.012***
Previous abdominal surgery	4.221	0.391-45.486	0.235
Previous acute cholecystitis	29.012	2.094- 401.936	**0.012***
Abdominal scar (supra umbilical)	0.057	0.0048 - 0.6914	**0.024***
Palpable GB	0.239	0.023-2.462	0.229
Wall thickness	34.382	1.615-731.60	**0.023***
Pericholecystic collection	58.427	3.516-970.916	**0.004***
Impacted stone	67.493	5.702-798.851	**<0.001***

Data is presented by Frequency %, *Significantly different as P value ≤0.05, LC: Laparoscopic cholecystectomy, BMI: Body mass index, GB: gallbladder.

Preoperative score of difficulty can significantly predict difficult LC (P <0.001 and AUC =0.984) at cut-off >5 with 87.5% sensitivity, 90.4% specificity, 63.6% PPV and 97.4% negative predictive value (NPV).

Figure 1

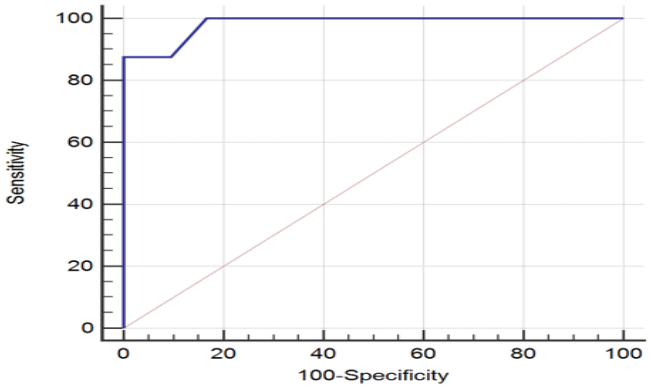

Figure 2: ROC curve of preoperative score of difficulty to predict difficult LC

Discussion

Cholecystectomy, the most common procedure in the biliary tract, is a surgical procedure to remove the GB because of a stone, inflammation, or other indication.

LC has become the recommended treatment and has been acknowledged as the gold standard for definitive care of symptomatic cholelithiasis or gall stones. [7]

In this study, regarding **abdominal surgery,** supra umbilical surgery, it was found that, they were present in 8 (16%) of patients and infra umbilical surgery was present in 17 (34%) of patients. **Palpable GB** was present in 14 (28%) of patients. [8]

In agreement with these finding , Ali et al. [9] found that previous abdominal operations were reported in 58.7% of cases (36% infra umbilical scars, 22.7% supraumbilical scars). **Distended GB** was reported in 18% of cases Several studies have investigated the impact of previous abdominal surgeries on the difficulty of LC. A study by Ghimire et al. [10] highlighted that preoperative anticipation of difficulties in such patients could reduce operative stress and postoperative morbidity.

Similarly, research involving 30 patients with prior upper abdominal incisions undergoing LC reported that while the procedure was feasible and safe in most cases, three patients required conversion to open surgery due to intra-abdominal adhesions. The study concluded that patients with previous major abdominal surgeries, especially near the laparoscopic access area, faced longer operating times, higher conversion rates, and increased adhesions. [11]

In contrast, Morsy et al. [12] found that age, gender, and history of hospitalization did not significantly affect operative difficulty. However, the presence of a supraumbilical scar was associated with increased difficulty, suggesting that the location of the scar may influence surgical outcomes.

While, ultrasound findings were, 28 (56%) of patients had thick wall ≥4mm, 22 (44%) of patients had wall thickness <4mm, 8 (16%) of patients had **pericholecystic collection** and 12 (24%) of patients had impacted stone.

Similarly, Ali et al. [9] stated that GB wall thickness was observed to be less than 4 mm in 73 individuals, accounting for 48.7% of the total, while a wall thickness of 4 mm or greater was noted in 77 individuals, representing 51.3%.

Another study by Dinkel et al. [13] found that **GB wall thickening (>4 mm)** was the most sensitive indicator of technical difficulties, with a sensitivity of 66.7% and specificity of 94.1%. **Pericholecystic fluid** was the most specific indicator, with a specificity of 100%.

The operative time in our study aligns with findings from various studies on LC. For instance, a study at Dammam Central Hospital reported a mean operative time of 99.9 minutes (range 30–290 minutes) .[14] Another study by Ferguson et al., found an average operative time of 115 minutes (range 45–238 minutes) .[15]

Conversely, some studies report shorter operative times. Bhandari et al. [16] found a mean operative time of 53.9 ± 19.9 minutes. Additionally, a study at a large municipal hospital reported a mean operative time of 2.3 hours (138 minutes).

The association of preoperative risk factors with the intraoperative outcome was described as Age ≤ 50 years was significantly higher in easy LC group than difficult and very difficult LC group. Sex and body mass index (BMI) were significantly different between both groups. Previous abdominal surgery infraumbilical was significantly higher in easy LC group than difficult and very difficult LC group. Previous acute cholecystitis was significantly lower in easy LC group than a difficult and very difficult LC group. The palpable GB was significantly lower in an easy LC group than the difficult and very difficult LC group. Wall thickness ≥ 4mm was significantly lower in easy LC group than difficult and very difficult LC group. Pericholecystic collection and impacted stone was significantly lower in easy LC group than difficult and very difficult LC group. Increasing age has been regarded a significant risk factor in predicting problematic LC in several studies since the older population tends to have a higher incidence of severe biliary tract illness, which is then overlaid by numerous comorbidities. which goes in line with our result, [9, 17] which comes in agreement with our results. Previous research has shown that gender is a key risk factor, with the male population having a greater risk of conversion and

surgical complications. However, others stated that Gender was not a major risk factor in predicting problematic LC, according to studies done by Gupta et al , [18] Gender did not influence the prediction of difficulty in LC. This might be because males make up a smaller proportion of the sample population than females.

Outcomes of this study

Our result showed that the preoperative score of difficult LC was 3.9 (±3.17) and regarding outcome of LC, 42 (84%) of patients had easy LC, 6 (12%) of patients had difficult LC and 2 (4%) of patients had very difficult LC.

So, in our study preoperative score of difficulty can significantly predict difficult LC (AUC =0.984) at cut-off >5 with 87.5% sensitivity, 90.4% specificity, 63.6% PPV and 97.4% NPV.

In this study, multivariate regression, age, sex, BMI, previous acute cholecystitis, wall thickness, abdominal scar (supra umbilical), pericholecystic collection and impacted stone were independent predictors of difficult LC while previous abdominal infraumbilical surgery was not predictor.

Fathy et al. [19] , stated that individuals with pericholecystic collection were 3.750 times more likely to have a difficult cholecystectomy than patients without pericholecystic collection, with a significant p value. Patients with palpable GB were 8.455 times more likely to have a difficult cholecystectomy than those without; the p-value was significant. Patients with GB wall thickness ≥4mm had 6.458 times higher risk for complicated cholecystectomy compared to patients with GB wall thickness < 4mm, with significant p value. Patients who had impacted stone in the neck of GB had 3.750 times more risk for difficult cholecystectomy when in comparison to patients without impacted stone with significant p value. All other factors were statistically insignificant.The multivariate analysis of intra-operative outcomes in relation to risk factors by Alponat et al. [20] demonstrated that age, gender, history of hospitalization for acute cholecystitis, presence of abdominal scars, GB wall thickness, and impacted stones in Hartmann's pouch are independent risk factors for difficult LC.

In multivariate analyses in Bhandari et al. [21], factors such as age, sex ,BMI, history of acute cholecystitis, GB wall thickness, presence of pericholecystic collection, and impacted stones have been associated with increased procedural difficulty. However, the impact of previous abdominal surgeries, including infraumbilical procedures, varies across studies.

For instance, a study published in the Egypt by SALEEM et al. [22] found that old age (over 50 years), history of hospitalization due to acute cholecystitis, BMI over 25, abdominal scar (supraumbilical), thick GB wall, and impacted stone were significant risk factors for difficult LC in females. Notably, previous infraumbilical abdominal surgery was not identified as a significant predictor in this study.

Overall we found that Nassar score helped us more in judging cases preoperatively and it was simpler comprehensive intra-operatively

Limitations were single center study that may result in different findings than elsewhere and small sample size that may produce insignificant results.

Conclusions:

Both scoring systems are effective in predicting the difficulty of LC. However, the Nassar scoring system, which includes both preoperative and intraoperative assessments, is superior due to its simplicity, ease of application, and ability to gather useful preoperative data, also its applicability from first look intraoperatively, and it helped us during the study in predicting difficult cases from the first look. This scoring system allows the surgeon to predict the level of difficulty right from the initial evaluation.

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Conflict of Interest: Nil

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