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Risk Factors and Strategies for Reducing Postoperative Complications in Hepatic Echinococcosis in an Endemic Region

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ABSTRACT: Hepatic echinococcosis remains a significant surgical problem in endemic regions and is associated with a high rate of postoperative complications, partly due to cyst-related anatomical features and insufficient consideration of metabolic and nutritional disorders. This study aimed to evaluate the effectiveness of an algorithm-based surgical strategy incorporating preoperative nutritional support and optimized residual cavity management.

A retrospective-prospective analysis included 246 patients with hepatic echinococcosis. The comparison group consisted of 127 patients treated using conventional surgical approaches, while 119 patients in the main group underwent an optimized diagnostic and therapeutic algorithm. Energy and nutritional status, postoperative complications, and long-term outcomes were assessed. Statistical analysis included Pearson's χ^2 test and multivariate logistic regression.

Most patients demonstrated significant preoperative energy and protein deficiency, with actual intake reaching only 70–80% of physiological requirements. In the main group, the overall postoperative complication rate decreased from 27.6% to 6.7% ($p < 0.001$), with no postoperative mortality observed. No disease recurrence was detected during long-term follow-up.

An algorithm-based surgical approach combined with mandatory preoperative nutritional optimization and standardized residual cavity management is an effective and safe strategy for improving short- and long-term outcomes in patients with hepatic echinococcosis.

INTRODUCTION

Hepatic echinococcosis holds a leading position among parasitic diseases in endemic regions, significantly impacting the structure of surgical morbidity [1,8,14,9,20]. The high prevalence is attributed to persistent natural foci of infection, close association with livestock farming, and insufficient effectiveness of preventive and screening measures, often leading to late detection and surgical intervention at complicated stages [1,3,13,14,15,18]. Despite advances in imaging and minimally invasive techniques, echinococectomy remains the primary radical treatment for hepatic echinococcosis [2,4,6,8,12,16]. However, the frequency of postoperative complications is 25-30%, reaching 35% or more in some clinical series, while disease recurrence is reported in 4-10% of cases and up to 12-15% in complicated forms [5,7,10,11,19]. This high rate of adverse outcomes is due to the combined influence of echinococcal cyst morphological characteristics, segmental localization, size, multiplicity of lesions, and the condition of the residual cavity, necessitating a comprehensive and differentiated approach to surgical strategy.

OBJECTIVE

To identify key epidemiological and surgical risk factors for postoperative complications in hepatic echinococcosis and to substantiate pathways for their prevention.

MATERIALS AND METHODS

A retrospective-prospective analysis was conducted of 246 patients with hepatic echinococcosis hospitalized at clinics of the Andijan State Medical Institute from 2016 to 2025. Epidemiological data, cyst morphological characteristics, surgical methods, residual cavity management techniques, and postoperative outcomes were evaluated.

The diagnosis was established based on clinical-laboratory data, mandatory use of imaging (ultrasound, computed tomography), and serological tests. Based on the therapeutic-diagnostic approach, patients were divided into two groups. The comparison group included 127 patients operated on between 2016-2020, receiving surgical treatment using traditional approaches without algorithmic strategy or standardized residual cavity management. The main group comprised 119 patients operated on between 2021-2025, who underwent an optimized, algorithmic surgical strategy with a differentiated approach and elements of nutritional support. Among the patients, males predominated (192, 78.0%), with 54 females (22.0%), reflecting the professional and epidemiological structure of the disease in the endemic region. Comparative analysis of sex distribution between groups showed no statistically significant difference (Pearson's $\chi^2 = 0.41$; $p > 0.05$), indicating group comparability.

Age analysis showed most patients were of working age: 18–45 years (189, 76.8%), ≥ 46 years (44, 17.9%), and < 18 years (13, 5.3%) (Table 1).

Table 1

Distribution of Patients with Hepatic Echinococcosis by Sex and Age

Indicator	Total (n = 246)	Comparison group (n = 127)		Main group (n = 119)		Pearson's χ^2	p
Gender		n	%	n	%		
Male	192 (78,0%)	100	78,7	92	77,3	0,41	>0,05
Female	54 (22,0%)	27	21,3	2	22,7		
Age							
< 18	13 (5,3%)	7	5,5	6	5,0	1,12	>0,05
18–45	189 (76,8%)	99	78,0	90	75,6		
≥ 46	44 (17,9%)	21	16,5	23	19,4		

Correlation analysis revealed no significant link between patient sex and treatment group ($r=0.04$; $p>0.05$) or between age groups and surgical strategy type ($r=0.06$; $p>0.05$). The odds ratio for working-age patients (18–45 years) was OR=1.08 (95% CI: 0.61–1.89). The absence of significant differences confirms sample representativeness.

Epidemiological analysis in the Andijan region (2021–2023) showed marked territorial heterogeneity (Table 2).

Table 2

Territorial Variability of Echinococcosis Incidence (Andijan Region)

Territory	Risk Category	Intensity Rate (per 100,000)	Note
Asaka District	High	8.37–12.09	Regional average: 2.5
Shahrikhan District	Medium	4.65–8.36	
Kurgantepa / Jalalquduq / Pakhtaabad Districts	Low	(below specified)	Ranking based on observation data

Risk factor analysis revealed typical patterns for endemic agricultural regions, with rural residents comprising 57.6%. High-risk professions included shepherds (27.3%), butchers (22.8%), cattle farmers (19.3%), milkmaids and tanners (11.3% each) (Table 3). Additional determinants were low participation in preventive screening (40.6% had no preventive ultrasound) and poor disease awareness (84.1–86.3%).

Table 3

Occupational Structure of the Risk Group (n=88)

Occupational Group	n	%
Shepherds	24	27.3
Butchers	20	22.8
Cattle Farmers	17	19.3
Tanners	10	11.3
Milkmaids	10	11.3
Zoo Workers	2	2.3

Occupational Group	n	%
Pet Store Workers	2	2.3
Others (including anemic individuals)	3	3.4

Analysis of sanitary-hygienic risk factors in the main group (Table 4) identified significant associations between lack of preventive ultrasound and late detection ($\chi^2=6.84$; $p=0.009$), and between poor hygiene standards and complicated forms ($\chi^2=7.31$; $p=0.007$). Weak but significant positive correlations were found between rural residence and complicated forms ($r=0.21$; $p<0.01$), and between animal contact and multiple liver lesions ($r=0.19$; $p=0.02$).

Table 4

Markers of Sanitary-Hygienic Risk in Patients with Hepatic Echinococcosis

Indicator	Yes	No
	n	%
Regular contact with domestic animals (dogs, cattle, sheep/goats)	83	69.7
Rural residence	70	58.8
Participation in agricultural work	76	63.9
Adherence to sanitary-hygienic norms in animal care	30	25.2

Multivariate logistic regression (Table 5) identified non-adherence to sanitary-hygienic norms as the most significant independent predictor of complicated disease (OR=2.41; 95% CI: 1.32–4.39; $p=0.004$), followed by lack of preventive ultrasound screening (OR=1.87; 95% CI: 1.05–3.32; $p=0.031$).

Table 5

Multivariate Logistic Regression Analysis

Factor	OR	95% CI	p
Non-adherence to sanitary-hygienic norms	2.41	1.32–4.39	0.004
Absence of preventive ultrasound screening	1.87	1.05–3.32	0.031

Factor	OR	95% CI	p
Regular contact with animals	1.56	0.89–2.74	0.118
Rural residence	1.34	0.76–2.37	0.314

Preoperative nutritional assessment revealed significant energy and nutrient deficiency (Table 6). Most patients' dietary energy value was 70–80% of physiological needs.

Table 6

Energy and Nutritional Status of Patients Before and After Preoperative Nutritional Support

Indicator	Before Support	After Support	p
Daily energy value, % of requirement	74.6 ± 8.3	96.8 ± 5.9	<0.001
Proteins, g/day	58.2 ± 7.4	84.6 ± 6.9	<0.001
Animal protein proportion, %	47.1 ± 6.2	61.3 ± 5.4	<0.001
Fats, g/day	61.8 ± 8.1	78.4 ± 7.2	<0.001
Vegetable fat proportion, %	28.6 ± 5.7	41.9 ± 6.1	<0.001
Carbohydrates, g/day	342 ± 38	298 ± 34	0.002
Protein energy contribution, %	11.2 ± 1.8	16.1 ± 1.6	<0.001
Fat energy contribution, %	29.4 ± 3.2	33.6 ± 2.9	<0.001
Carbohydrate energy contribution, %	59.4 ± 4.1	50.3 ± 3.8	<0.001
B:K:V Ratio	1:1:4.2	1:1.0:3.5	-
Amino acid balance	Impaired	Satisfactory	-
B-vitamin adequacy, %	62.4 ± 9.1	92.1 ± 6.8	<0.001

Indicator	Before Support	After Support	p
Ca / P ratio	0.78 ± 0.09	1.02 ± 0.07	<0.001
Mg, mg/day	238 ± 34	326 ± 29	<0.001

Preoperative nutritional deficiency was significantly associated with increased complication risk (Table 7). Key predictors were energy insufficiency (<80%, OR=2.68) and hypoalbuminemia (<35 g/l, OR=3.12).

Table 7

Association Between Preoperative Nutritional Deficiency and Postoperative Complications

Nutritional Deficiency Factor	OR	95% CI	p
Energy insufficiency (<80%)	2.68	1.45–4.94	0.002
Albumin <35 g/l	3.12	1.66–5.86	<0.001
Animal protein <50%	2.04	1.12–3.72	0.019
B-vitamin deficiency	1.89	1.01–3.53	0.046
Ca/P ratio imbalance	1.67	0.92–3.02	0.091

Optimized Surgical Algorithm

Based on shortcomings identified in the comparison group (2016–2020), an optimized therapeutic-diagnostic algorithm was implemented for the main group (2021–2025), featuring three stages:

1. *Preoperative:* Comprehensive assessment, biliary tract sanitation if indicated, targeted nutritional support, vitamin complexes, immunocorrection, and albendazole prophylaxis (10 mg/kg/day).
2. *Operative:* Differentiated surgical access and echinococcectomy method based on cyst characteristics. A key element was a developed four-stage residual cavity processing scheme (Patent № IAP 2025 7902): a) Aspiration and sanitation with 20% NaCl; b) Mechanical cleaning of the fibrous capsule; c) Chemical antisepsis (0.1% chlorhexidine in ethanol, 0.5% metronidazole, 10% betadine, 2 min each); d) Placement of a dual-conduit (active/passive) drainage system. Omentoplasty was added for large/giant cysts.
3. *Postoperative:* Complication prevention measures, supportive antiparasitic therapy, dynamic monitoring, and follow-up at 3, 6, 12, 24, and 36 months.

RESULTS AND DISCUSSION

Comparative analysis showed significant outcome improvement in the main group. The overall postoperative complication rate decreased from 27.6% to 6.7% ($\chi^2=24.8$; $p<0.001$). Specific complications also decreased: residual cavity suppuration (14.9% vs. 3.3%, $p<0.01$) and biliary fistula formation (9.5% vs. 2.5%, $p<0.05$). No lethal outcomes occurred in the main group (0% vs. 2.3%). Hospital stay decreased from 12.4 ± 2.8 to 8.7 ± 1.9 bed-days ($p<0.001$). No recurrences were observed in the main group during up to 36 months of follow-up.

The effectiveness is attributed to the comprehensive impact on key pathogenetic links: algorithmic access minimized technical errors, multi-stage cavity processing ensured proper sanitation and drainage, and preoperative nutritional support enhanced liver regeneration potential and reduced susceptibility to infection.

CONCLUSION

Traditional surgical approaches for hepatic echinococcosis, lacking systematic assessment of anatomical, morphological, and metabolic factors, are associated with high complication rates. The introduction of an optimized strategy incorporating preoperative nutritional support, individualized surgical method selection, and standardized multi-stage antiparasitic residual cavity management significantly improved both immediate and long-term outcomes, confirming its pathogenetic rationale and high clinical efficacy in an endemic setting.

SUMMARY OF FINDINGS

1. Patients exhibit significant preoperative energy and nutritional deficiencies associated with increased complication risk.
2. The algorithmic strategy reduced the overall postoperative complication rate from 27.6% to 6.7% ($p<0.001$) with zero mortality.
3. Standardized multi-stage residual cavity management with dual-conduit drainage (and omentoplasty if needed) is key to preventing suppuration and biliary fistulas.
4. Preoperative nutritional support corrects energy deficit, enhances liver regeneration, and reduces the likelihood of adverse postoperative outcomes.
5. The optimized patient management algorithm is clinically effective, safe, reproducible, and recommended for widespread implementation in surgical hospitals of endemic regions.

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