

Povidone-Iodine as a Scolicidal Agent in Liver Hydatid Cyst Surgery: A Prospective Comparative Study with Hypertonic Saline

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ABSTRACT

Background: Hydatid disease caused by *Echinococcus granulosus* is endemic in Iraq and the Middle East. Surgery remains the definitive treatment for liver hydatid cysts, and the choice of scolicidal agent is critical to minimising intraoperative spillage complications and postoperative morbidity. Povidone-iodine and hypertonic saline are the most widely used scolicidal agents, yet their comparative efficacy and safety in clinical practice require further evaluation. **Objectives:** To evaluate the effectiveness and safety of 10% povidone-iodine compared with 15–20% hypertonic saline as a scolicidal agent in the surgical management of liver hydatid cysts, with respect to postoperative complications and recurrence rate.

Patients and Methods: A prospective single-centre study including 110 patients with liver hydatidosis managed surgically at Al-Nasiriyah Teaching Hospital and Al-Hussain Teaching Hospital, Nasiriyah, Iraq, from January 2022 to December 2024. Patients were divided into two groups: Group A (povidone-iodine, n=91) and Group B (hypertonic saline, n=19). All patients were followed up for up to 24 months with ultrasonography and CT, liver enzyme assays, and clinical assessment for wound infection, collection, and abscess formation. **Results:** The mean age was 33.24±13.96 years and 65.45% were female. Laparoscopic surgery was performed in 63.64% of patients. The overall recurrence rate was 12.73%. Elevated liver enzymes (9.89% vs. 42.11%, p<0.001), wound infection (8.79% vs. 26.32%, p=0.031), fluid collection (10.99% vs. 31.58%, p=0.021), and abscess formation (4.40% vs. 21.05%, p=0.029) were all significantly less frequent in the povidone-iodine group. No significant differences were found between groups in hospital stay (p=0.567) or recurrence rate (p=0.752). Prolonged hospital stay was the only factor significantly associated with recurrence (p=0.001).

Conclusions: Povidone-iodine (10%) is superior to hypertonic saline as a scolicidal agent in reducing liver enzyme elevation, wound infection, fluid collection, and abscess formation following liver hydatid cyst surgery. Both agents have comparable hospital stay and recurrence rates.

Keywords: Hydatid Cyst; Liver; Scolicidal Agent; Povidone-Iodine; Hypertonic Saline; *Echinococcus Granulosus*; Laparoscopic Surgery.

1. Introduction

Hydatid disease is a parasitic infestation caused by the larval stage of the tapeworm *Echinococcus granulosus*. It is endemic in several parts of the world, particularly in Mediterranean countries, the Middle East, South America, Australia, and New Zealand [1]. Increasing global population mobility has made

clinicians worldwide more likely to encounter this disease, necessitating full awareness of its clinical presentation, diagnosis, and management options [2].

Although hydatid disease may affect any organ, the liver is the most commonly involved, with most cysts remaining asymptomatic and discovered incidentally[3]. Symptoms arise from the mass effect of the enlarging cyst, producing abdominal pain and obstructive jaundice. Cyst rupture into the biliary tract causes biliary colic, jaundice, cholangitis, and pancreatitis [4], while rupture into the peritoneal cavity produces progressive abdominal pain and allergic reactions [5]. Sudden spontaneous rupture may precipitate a life-threatening anaphylactic reaction [6].

The life cycle of *E. granulosus* involves canines as definitive hosts and various intermediate hosts including sheep, cattle, and humans. Following ingestion of contaminated eggs, oncospheres pass through the intestinal mucosa, are transported via the portal vein to the liver, and develop into hydatid cysts. Approximately 70% of hydatid cysts occur in the liver, predominantly in the right inferior segments [7].

Four treatment modalities are currently available for liver hydatid disease: surgical resection, percutaneous aspiration-injection-reaspiration (PAIR), medical chemotherapy with albendazole, and watchful waiting for inactive calcified cysts[2]. Medical therapy with albendazole (10–15 mg/kg/day in two divided doses) is indicated in inoperable cases but is ineffective in the vast majority, with an overall success rate of only 8% as primary treatment [8-10].

PAIR is an attractive minimally invasive option with high cure rates and shorter hospital stay than surgery, though it carries a higher recurrence rate compared with laparoscopic procedures [11-13]. Surgery remains the definitive treatment, with options ranging from conservative cystectomy to radical pericystectomy and partial hepatic resection; the radical approach offers lower recurrence but higher perioperative risk [14]. Laparoscopic surgery is increasingly adopted for accessible, uncomplicated cysts in anterior liver segments, though the risk of uncontrolled intraperitoneal spillage remains a major concern [15,16].

Regardless of the surgical approach, the use of a scolicidal agent is a fundamental step to prevent intraoperative spillage of viable protoscolices and subsequent secondary hydatidosis. Numerous scolicidal agents have been studied, including albendazole and its sulphoxide, hypertonic saline, silver nitrate, cetrимide, ethyl alcohol, hydrogen peroxide, chlorhexidine gluconate, silver nanoparticles, plant extracts, fungal chitosan, and povidone-iodine [17,18].

However, no agent has achieved 100% protoscolicidal efficacy in humans, and most carry unacceptable side effects at higher concentrations.[19] Albendazole compounds exhibit protoscolicidal activity but require prolonged incubation (30 days) for full effect [20,21].Hypertonic saline in concentrations of 15–20% achieves 100% scolicide activity within 10 minutes in vitro but carries risks of hypernatraemia and sclerosing cholangitis in cases of biliary communication.[22,23] Novel agents under investigation include fungal chitosan [24,25], plant essential oils and selenium nanoparticles [26], endophytic fungal extracts [27], and cyclosporin A, which shows 100% protoscolicidal activity in vitro [28].

Povidone-iodine (polyvinylpyrrolidone-iodine) is a stable complex containing 9–12% available iodine, first developed in 1955. It is a broad-spectrum antiseptic widely used for skin and mucous membrane preparation, wound care, and surgical disinfection [29,30].Although concerns have been raised regarding potential side effects including sterile peritonitis and renal injury with high-dose intraperitoneal use, these have not been observed when povidone-iodine is used at appropriate doses followed by thorough saline irrigation [31]. The present study aimed to prospectively evaluate the effectiveness and safety of 10% povidone-iodine as a scolicidal agent compared with 15–20% hypertonic saline in the surgical management of liver hydatid cysts.

2. PATIENTS AND METHODS

2.1. Study Design and Setting

This prospective single-centre study was conducted at the Surgical Departments of Al-Nasiriyah Teaching Hospital and Al-Hussain Teaching Hospital, Nasiriyah, Thi Qar, Iraq, from January 2022 to December 2024. Ethical approval was granted by the Iraqi Board of Medical Specialization. Written informed consent was obtained from all patients prior to enrolment.

2.2. Study Population

A total of 110 consecutive patients with liver hydatidosis who underwent surgical treatment were enrolled. All patients managed with either laparoscopic or open surgery were eligible. Exclusion criteria included patients lost to follow-up or discharged against medical advice, those with small cysts (<5 cm, suitable for medical therapy), malignant or posterior cysts in close proximity to the inferior vena cava, and patients with more than three calcified cysts.

2.3. Study Groups and Surgical Technique

Patients were allocated to two groups according to the scolicalidal agent used: Group A (povidone-iodine 10%, n=91) and Group B (hypertonic saline 15–20%, n=19). All patients received pre-operative albendazole (10 mg/kg) for seven days before surgery. The surgical approach (laparoscopic or open) was determined by cyst number, size, location, and presentation. In laparoscopic surgery, a 10-mm supraumbilical trocar was placed and a 30° telescope introduced at 12 mmHg pneumoperitoneum. Additional trocars were placed according to cyst localisation. Gauze pads impregnated with the assigned scolicalidal agent were placed around the cyst, Morrison's pouch, and the subhepatic space.

The cyst was aspirated via a Veress needle, refilled with the scolicalidal agent for 5–10 minutes, and the contents were then fully aspirated. In open surgery, a subcostal incision was made, the cyst was isolated with scolicalidal-soaked gauze packs, 20 mL of cyst fluid was aspirated and replaced with 20 mL of the assigned scolicalidal agent for 5–10 minutes, after which the cyst was opened and its contents evacuated by suction. A subhepatic drain was placed and removed at 48 hours in both approaches.

2.4. Follow-up

All patients were followed for up to 24 months with regular outpatient visits. At each visit, abdominal ultrasonography and CT scan were performed to assess for recurrence in the liver or abdominal cavity. Liver enzyme levels were measured according to standard protocols. Patients were clinically examined for wound infection, fluid collection, and abscess formation.

2.5. Statistical Analysis

Data were analysed using SPSS version 25.0. Continuous variables were expressed as mean \pm SD and compared using the independent samples t-test. Categorical variables were expressed as frequencies and percentages and analysed with the chi-square test or Fisher's exact test. A p-value <0.05 was considered statistically significant.

3. RESULTS

3.1 Patient Characteristics

The mean age was 33.24 \pm 13.96 years (range: 9–75 years). The majority were female (65.45%), yielding a male-to-female ratio of approximately 1:2. Rural residents comprised 67.27% of the cohort. In 43.64% of patients the cyst was discovered incidentally; 20.91% had a disease duration of \leq 12 months and 35.45%

had >12 months. The right lobe of the liver was affected in 79.09% of patients, the left lobe in 10.91%, and both lobes in 10.00%. Demographic and clinical characteristics are presented in Table 1.

Table 1. Demographic and clinical characteristics of the patients (n=110)

Variable	Value
Age, years (Mean±SD)	33.24±13.96 (range: 9–75)
Female sex, n (%)	72 (65.45%)
Rural residence, n (%)	74 (67.27%)
Accidental discovery, n (%)	48 (43.64%)
Disease duration ≤12 months, n (%)	23 (20.91%)
Disease duration >12 months, n (%)	39 (35.45%)
Right lobe involvement, n (%)	87 (79.09%)
Left lobe involvement, n (%)	12 (10.91%)
Bilateral involvement, n (%)	11 (10.00%)
Laparoscopic surgery, n (%)	70 (63.64%)
Open surgery, n (%)	40 (36.36%)
Hospital stay, days (Mean±SD)	3.88±3.15 (range: 1–20)
Follow-up, months (Mean±SD)	12.26±6.16 (range: 2–24)

4. Surgical Approach and Postoperative Findings

Laparoscopic surgery was performed in 70 patients (63.64%) and open surgery in 40 patients (36.36%). Overall, elevated liver enzymes were detected in 17 patients (15.45%), wound infection in 13 (11.82%), fluid collection in 16 (14.55%), and abscess formation in 8 (7.27%). The mean hospital stay was 3.88±3.15 days (range: 1–20) and the mean follow-up period was 12.26±6.16 months (range: 2–24).

4.1 Scolicidal Agent Comparison

Povidone-iodine was used in 91 patients (82.73%) and hypertonic saline in 19 patients (17.27%). As shown in Table 2, elevated liver enzymes (9.89% vs. 42.11%, $p<0.001$), wound infection (8.79% vs. 26.32%, $p=0.031$), fluid collection (10.99% vs. 31.58%, $p=0.021$), and abscess formation (4.40% vs. 21.05%, $p=0.029$) were all significantly less frequent in the povidone-iodine group. No significant difference was found between the two groups in terms of hospital stay (3.68±2.18 vs. 4.21±4.35 days, $p=0.567$) or recurrence rate (13.19% vs. 10.53%, $p=0.752$).

Table 2. Comparison of postoperative outcomes between scolical agent groups

Complication	Povidone-Iodine (n=91)	Hypertonic Solution (n=19)
	n (%)	n (%) p-value
Elevated liver enzymes	9 (9.89%)	8 (42.11%) <0.001
Wound infection	8 (8.79%)	5 (26.32%) 0.031
Fluid collection	10 (10.99%)	6 (31.58%) 0.021
Abscess formation	4 (4.40%)	4 (21.05%) 0.029
Recurrence	12 (13.19%)	2 (10.53%) 0.752
Hospital stay, days (Mean±SD)	3.68±2.18	4.21±4.35 0.567

5. Recurrence Rate and Associated Factors

After the follow-up period, 14 patients (12.73%) experienced hydatid cyst recurrence. The only variable significantly associated with recurrence was prolonged hospital stay (mean 7.67±6.25 days in the recurrence group vs. 3.36±2.13 days in the non-recurrence group, $p=0.001$). Age, sex, disease duration, cyst location, type of surgery, and follow-up duration were not significantly associated with recurrence (Table 3).

Table 3. Association of demographic and clinical characteristics with recurrence

Variable	No Recurrence (n=96)	Recurrence (n=14)	p-value
Age, years (Mean±SD)	34.52±13.89	23.83±11.43	0.078
Female sex, n (%)	58 (60.42%)	12 (85.71%)	0.066
Right lobe, n (%)	75 (78.13%)	12 (85.71%)	0.344
Laparoscopic surgery, n (%)	32 (33.33%)	8 (57.14%)	0.084
Hospital stay, days (Mean±SD)	3.36±2.13	7.67±6.25	0.001
Follow-up, months (Mean±SD)	12.16±6.29	13.0±5.6	0.757

6. DISCUSSION

This prospective study evaluated 110 patients with liver hydatidosis managed surgically with either 10% povidone-iodine or 15–20% hypertonic saline as the scolical agent. Hydatid disease remains a significant health burden in endemic regions; it occurs most commonly in the liver (50–70% of cases) and carries potentially lethal complications if untreated [32,33]. Four treatment options are currently available – surgery, PAIR, medical chemotherapy, and watchful waiting – with surgical intervention remaining the most widely applied definitive approach [34].

The mean patient age in this series was 33.24 years, consistent with reports from Saudi Arabia by

Jastaniah et al.[35] and Nepal by Hazra et al.[36], reflecting the predominance of this disease among economically active adults involved in agriculture and livestock rearing. The female predominance (65.45%) and male-to-female ratio of approximately 1:2 are in agreement with findings from Iran by Ahmadi and Hamidi [37] and Ethiopia by Abebe et al.[38], and may be attributed to the greater exposure of Iraqi rural women to the parasite through their roles in agriculture and animal husbandry.

The right lobe of the liver was affected in 79.09% of cases, consistent with studies from Greece [39,40], and Nepal,[36,41] and attributable to the greater portal blood flow to the right lobe, which provides oncospores greater access to this segment [42]. High proportions of incidentally discovered cysts (43.64%) reflect the largely asymptomatic natural history of hepatic hydatidosis until cysts become large or complicated.

Elevated liver enzymes, wound infection, fluid collection, and abscess formation were the principal postoperative complications, consistent with the known tendency of hepatic hydatid cysts toward superadded bacterial infection [43-45].

The wound infection rate in the present series (11.82%) was higher than that reported by Ghannouchi et al. from Tunisia (1.9%) [46], and Hosseini Shabanan et al. from Iran (1.8%) [47], likely reflecting differences in patient case mix and operative complexity. Mean hospital stay in the present series (3.88±3.15 days) was shorter than that reported in Greece (median 18 days) [48], reflecting the higher proportion of laparoscopic procedures and less complicated cases in our cohort.

The overall recurrence rate of 12.73% falls within the range of 0–22% reported in the literature [49,50], despite advances in surgical technique and perioperative albendazole prophylaxis. Recurrence in hydatid surgery is multifactorial and is influenced by the completeness of cyst elimination, the type of surgical procedure, and surgeon experience [51]. In the present study, prolonged hospital stay was the only factor significantly associated with recurrence, likely as a surrogate marker for complicated cases in which complete cyst elimination was not achieved.

Povidone-iodine (10%) was associated with significantly lower rates of liver enzyme elevation, wound infection, fluid collection, and abscess formation. Bosanac and Lisanin reported no recurrences during 2–3 years of follow-up in 52 patients treated percutaneously with 10% povidone-iodine and no major complications [52]. Experimental evidence also supports that 10% povidone-iodine is more effective than saline in intraperitoneal hydatidosis [53]. These findings are corroborated by comparative studies from Iraq and internationally [54-56]. The lower hepatocellular toxicity of povidone-iodine compared with hypertonic saline, particularly when followed by thorough saline irrigation, may explain the significantly lower rate of enzyme elevation in the povidone-iodine group [31].

No significant difference was found between the two groups in hospital stay or recurrence rate, which is in contrast to the national study by Assi [55], a difference likely attributable to the larger sample size in that study (120 patients) and possible differences in baseline case complexity. Hypertonic saline remains the most widely used scolicidal agent worldwide, with effectiveness varying by concentration and exposure time. At 20%, it achieves 100% protoscolicidal activity within 10 minutes *in vitro*, though efficacy diminishes at lower concentrations [57].

However, its use is associated with a risk of hypernatraemia and sclerosing cholangitis in cases of biliary communication [22]. In the present study, the hypertonic saline group had significantly higher rates of all measured postoperative complications compared with the povidone-iodine group. This study has limitations. The unequal group sizes (91 vs. 19 patients) may reduce the statistical power of inter-group comparisons. The single-centre design and relatively short mean follow-up (12.26 months) may underestimate true recurrence rates. Randomised controlled trials with larger, balanced cohorts and standardised follow-up are warranted.

7. CONCLUSIONS

Liver hydatid cyst disease predominantly affects young adults in endemic regions, with many cases discovered incidentally. Both laparoscopic and open surgical approaches are effective management strategies. Povidone-iodine (10%) is superior to hypertonic saline (15–20%) as a scolicial agent in reducing postoperative liver enzyme elevation, wound infection, fluid collection, and abscess formation, without adversely affecting hospital stay or recurrence rate. Povidone-iodine is therefore recommended as the scolicial agent of choice in the surgical management of liver hydatidosis, given its efficacy, low cost, and wide availability.

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