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Comparative analysis of treatment outcomes in chronic pancreatitis complicated by pancreatolithiasis

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ABSTRACT: **To evaluate the outcomes of a modified Puestow-type pancreaticojejunostomy in patients with chronic pancreatitis complicated by pancreatolithiasis. The study included 32 patients who underwent surgical treatment for pancreatolithiasis. The main group consisted of 20 patients who received the authors' modification of the anastomosis, while the comparison group included 12 patients treated using the standard technique. Parameters assessed included operation duration, mechanical ventilation time, length of hospital stay, complication rates, and recurrence rates. Statistical analysis involved the t-test, χ^2 test, and Kaplan-Meier survival analysis. The results showed showed a significant reduction in operation time (113.5±6.8 vs. 134.4±5.7 minutes; p=0.025), mechanical ventilation duration (3.0±0.3 vs. 4.25±0.5 hours; p=0.04), and hospital stay (6.3±0.5 vs. 8.4±0.8 days; p=0.033) in the main group. Postoperative complications occurred less frequently, and no reinterventions were required. The recurrence rate of stone formation was reduced from 33.3% in the comparison group to 5.0% in the main group (p=0.033), with cumulative recurrence-free survival of 91.7% versus 78.3%. The modified pancreaticojejunostomy technique provides superior surgical and clinical outcomes in pancreatolithiasis, significantly reducing the risk of recurrence and complications. The study recommended that the modified technique should be considered the preferred surgical option for patients with chronic pancreatitis and pancreatolithiasis.**

KEYWORDS: **Chronic pancreatitis, pancreatolithiasis, pancreaticojejunostomy, Puestow modification, stone recurrence.**

INTRODUCTION

Chronic pancreatitis (CP) remains one of the most challenging pathologies in modern gastroenterology and surgery, posing not only a medical but also a socioeconomic problem. According to the WHO, the global prevalence of CP continues to rise, with the disease often leading to severe complications, including pancreatic duct lithiasis (pancreatolithiasis), pancreatic duct strictures, pseudocyst formation, and pancreatic cancer [1].

Epidemiological studies indicate a significant increase in CP incidence over the past 30 years, particularly in Asian countries, where rates are 2–3 times higher than in Europe and North America [2]. Approximately 50–60% of patients who experience acute pancreatitis develop chronic disease, substantially increasing the risk of disability and mortality [3]. The five-year mortality rate among CP patients reaches 20–30%, with the highest rates observed in cases of non-alcoholic etiology [4]. The leading causes of death include progressive exocrine and endocrine insufficiency, infectious complications, and malignant transformation of pancreatic tissue [5-7].

Currently, two main strategies dominate the treatment of complicated chronic pancreatitis: resectional procedures (pancreatoduodenectomy, Frey procedure) and drainage procedures (lateral pancreaticojejunostomy, endoscopic lithotripsy) [8]. The choice of method depends on the location of the pathological process, the degree of parenchymal calcification, and the condition of the ductal system [9].

Despite significant advances in pancreatic surgery, many issues remain unresolved. In particular, long-term outcomes of different surgical interventions are insufficiently studied, and clear criteria for choosing between open and minimally invasive techniques are lacking [10]. Additionally, the role of combined approaches integrating endoscopic and surgical methods requires further clarification.

Recent evidence suggests that ductal drainage procedures yield superior outcomes compared to resectional techniques in patients with dilated pancreatic ducts (>5 mm) and multiple calculi [11]. The modified Puestow technique, incorporating a side-to-side Roux-en-Y pancreaticojejunostomy, offers theoretical advantages including complete ductal clearance, sustained pain reduction (reported in 70-85% of cases), and lower endocrine insufficiency rates (15-25% at 5 years) versus pancreatic resections [12]. However, contemporary studies report conflicting data regarding optimal patient selection, with particular controversy surrounding: the minimum required ductal diameter; the impact of concurrent parenchymal calcification on outcomes; the role of combined endoscopic and surgical approaches in complex cases.

Therefore, this study aims to evaluate the modified pancreaticojejuno-astomosis for patients with chronic pancreatitis complicated by pancreatolithiasis.

MATERIALS AND METHODS

Out of a total of 32 patients who underwent open surgery for pancreatolithiasis, the authors' modifications of the Puestow-type pancreaticojejunostomy were applied in 20 cases (7 procedures with a rigid duct wall, 5 with a flaccid wall, and 8 with a normal duct wall). These 20 patients were included in the main study group.

A comprehensive examination was performed: collection of complaints, analysis of anamnesis, physical examination, laboratory tests (general and biochemical blood tests, urine analysis), and instrumental diagnostics (ultrasound, MRI, CT, ERCP). Ultrasound examination was performed on GE Logiq S8 devices; MRI, on 3T Siemens Magneton Vida; CT, on 640-slice Toshiba Aquilion One. If necessary, ERCP and functional tests were used to assess pancreatic function. Complications were classified according to Clavien-Dindo; anastomotic leakage was assessed according to Strasberg criteria [1, 2].

Statistical analysis was performed using SPSS, Statistica and Excel: descriptive statistics, t-test, Mann-Whitney, χ^2, Fisher test, correlation analysis, logistic regression, Kaplan-Meier methods and ROC analysis (AUC). Statistical significance was accepted at $p<0.05$.

RESULTS

Analysis of baseline data revealed both differences and similarities between the comparison group (n=12) and the main group (n=20), as well as allowed for the assessment of key patient characteristics. Males predominated in both groups (58.3% in the comparison group and 60.0% in the main group), with no statistically significant difference (p=0.781). Patients in the main group were slightly younger (51.4±1.2 years vs. 52.2±1.9 years, p=0.524). Body mass index was also comparable between groups (23.8±1.7 in the comparison group and 24.9±1.3 in the main group, p=0.569), excluding the influence of obesity on outcomes. The causes of chronic pancreatitis (alcoholic-nutritional, idiopathic, or biliary etiology) were similarly distributed across groups, with minimal differences (p>0.7), confirming their etiological comparability (Table 1).

The number of pancreatic duct stones (single or multiple) and their sizes (6–10 mm and ≥10 mm) were similar between the groups, without statistically significant differences. The stone location (head, tail, or body of the pancreas) also showed no significant differences. The degree of main pancreatic duct dilation (ranging from 4–5 mm to ≥10 mm) was comparable, with minor variations (p>0.5). The presence of ductal strictures likewise did not differ significantly between the groups.

In the main group, patients had a shorter hospital stay (6.3±0.5 days vs. 8.4±0.8 days, p=0.033), indicating a faster recovery. The duration of surgery was also significantly shorter in the main group (113.5±6.8 minutes vs. 134.4±5.7 minutes, p=0.025), which may be attributed to improved surgical technique (Figure 1). Additionally, the duration of mechanical ventilation was lower in the main group (3.0±0.3 hours vs. 4.25±0.5 hours, p=0.04), suggesting a lower level of invasiveness or clinical severity.

In the comparison group, pancreaticojejunostomy insufficiency with leakage, requiring reoperations and prolonged drainage, was observed in 16.7% of cases (Figure 2), whereas it did not occur in the main group (p=0.06). Resolved fistulas (Clavien-Dindo grade II) following pancreaticojejunostomy insufficiency, performed with a rigid Wirsung duct wall, were noted in 2 (10.0%) patients in the main group, but the differences were not statistically significant (p=0.26).

In the comparison group, stone formation recurrence was observed more frequently (33.3%) compared to the main group (5.0%). Comparative analysis of Kaplan-Meier curves and evaluation of cumulative freedom from stone formation in the pancreas and symptom recurrence in the study groups showed that the use of the authors' modifications of pancreaticojejunostomy formation according to Puestow reduces the frequency of stone

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formation recurrence, increasing the freedom rate from 78.3% to 91.7% (p=0.033) in the long-term period (Figure 3).

As evident, the main group demonstrated better clinical and surgical outcomes, including shorter surgery duration, reduced hospital stay, and a significantly lower rate of stone recurrence. The absence of serious complications, such as pancreaticojejunostomy insufficiency, further highlights the success of the applied surgical tactics and techniques.

Thus, the use of the proposed modifications of the Puestow-type pancreaticojejunostomy in patients with pancreatolithiasis allowed for a reduction in the risk of specific early complications from 16.7% to 10.0%, the need for reinterventions from 16.7% to 0% (p=0.06), a decrease in the postoperative hospital stay from 8.4±0.8 to 6.3±0.5 days (p=0.03), and within a follow-up period of up to three years, a reduction in the recurrence rate of pancreatic duct stones and pain symptoms from 33.3% to 5.0% (p=0.033).

Table 1. Comparison of baseline characteristics of patients with Pancreatolithiasis who underwent surgical interventions.

Characteristic		Comparison Group (n=12)	Main Group (n=20)	χ^2	p
Gender	Male	7 (58.3%)	12 (60.0%)	0.078	0.781
	Female	5 (41.7%)	8 (40.0%)		
	Mean age, years (range)	52.2±1.9 (45–66)	51.4±1.2 (34–72)	0.58	0.524
Etiology of chronic pancreatitis	Alcohol-related/alimentary	4 (33.3%)	6 (30.0%)	0.039	0.844
	Idiopathic (undefined)	4 (33.3%)	8 (40.0%)	0.142	0.707
	Biliary	4 (33.3%)	6 (30.0%)	0.039	0.844
Number of stones	Single	7 (58.3%)	11 (55.0%)	0.034	0.854
	Multiple	5 (41.7%)	9 (45.0%)		
Stone size	6–10 mm	5 (41.7%)	10 (50.0%)	0.209	0.648
	≥10 mm	7 (58.3%)	10 (50.0%)		
Stone location	Head of pancreas	4 (33.3%)	9 (45.0%)	0.423	0.516
	Tail	3 (25.0%)	6 (30.0%)	0.093	0.761
	Body	5 (41.7%)	5 (25.0%)	0.97	0.325
Main pancreatic duct diameter	4–5 mm	2 (16.7%)	3 (15.0%)	0.016	0.900
	5–7 mm	4 (33.3%)	6 (30.0%)	0.039	0.844
	8–9 mm	2 (16.7%)	5 (25.0%)	0.305	0.581
	≥10 mm	4 (33.3%)	6 (30.0%)	0.039	0.844
Presence of strictures	No stricture	9 (75.0%)	13 (65.0%)	0.349	0.555
	Stricture at duct orifice	2 (16.7%)	4 (20.0%)	0.055	0.816
	Stricture of the main duct	1 (8.3%)	3 (15.0%)	0.305	0.581

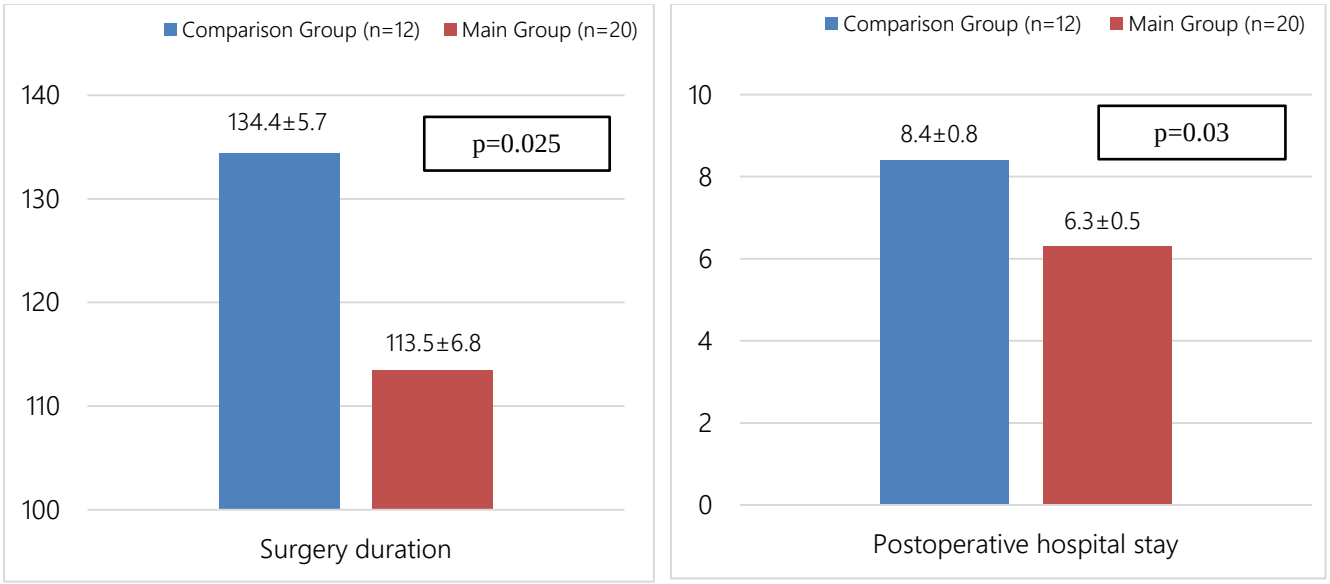


Figure 1. Indicators of operation duration and hospital stay in the study groups.

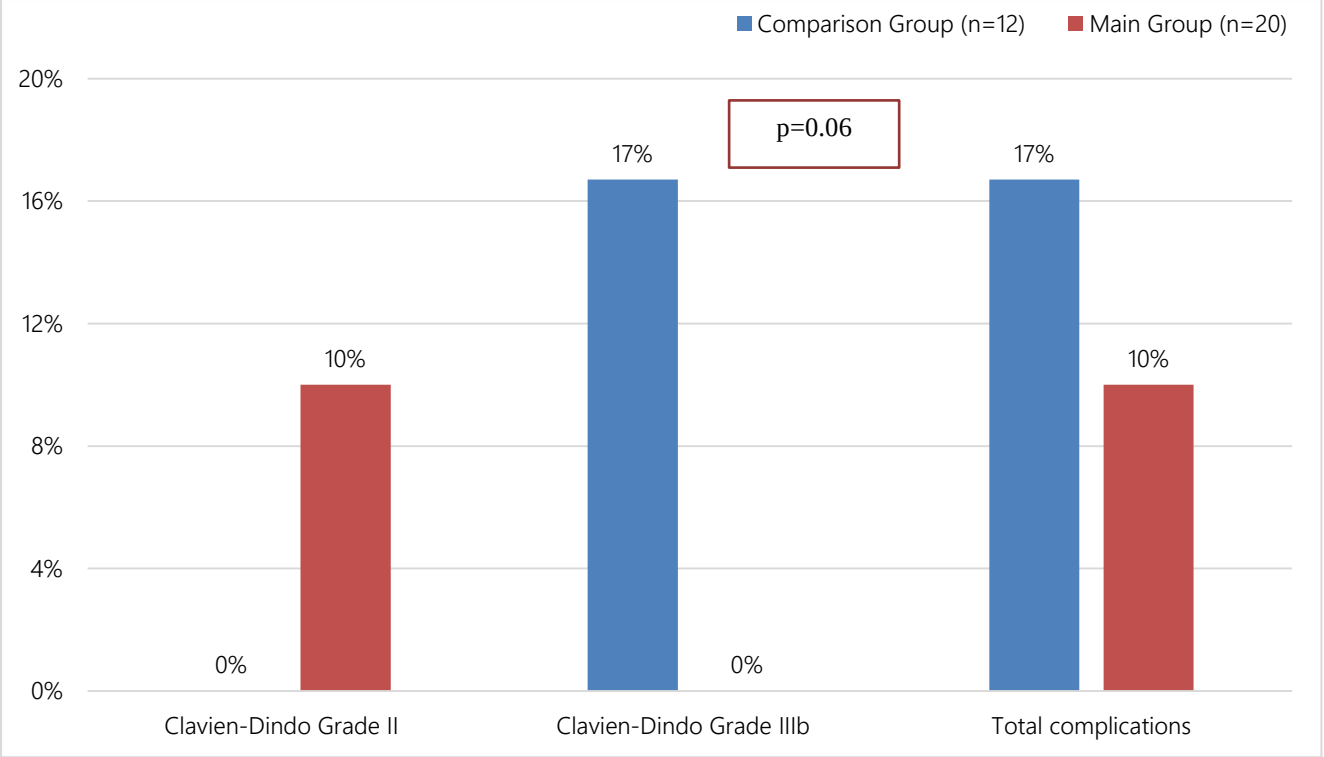
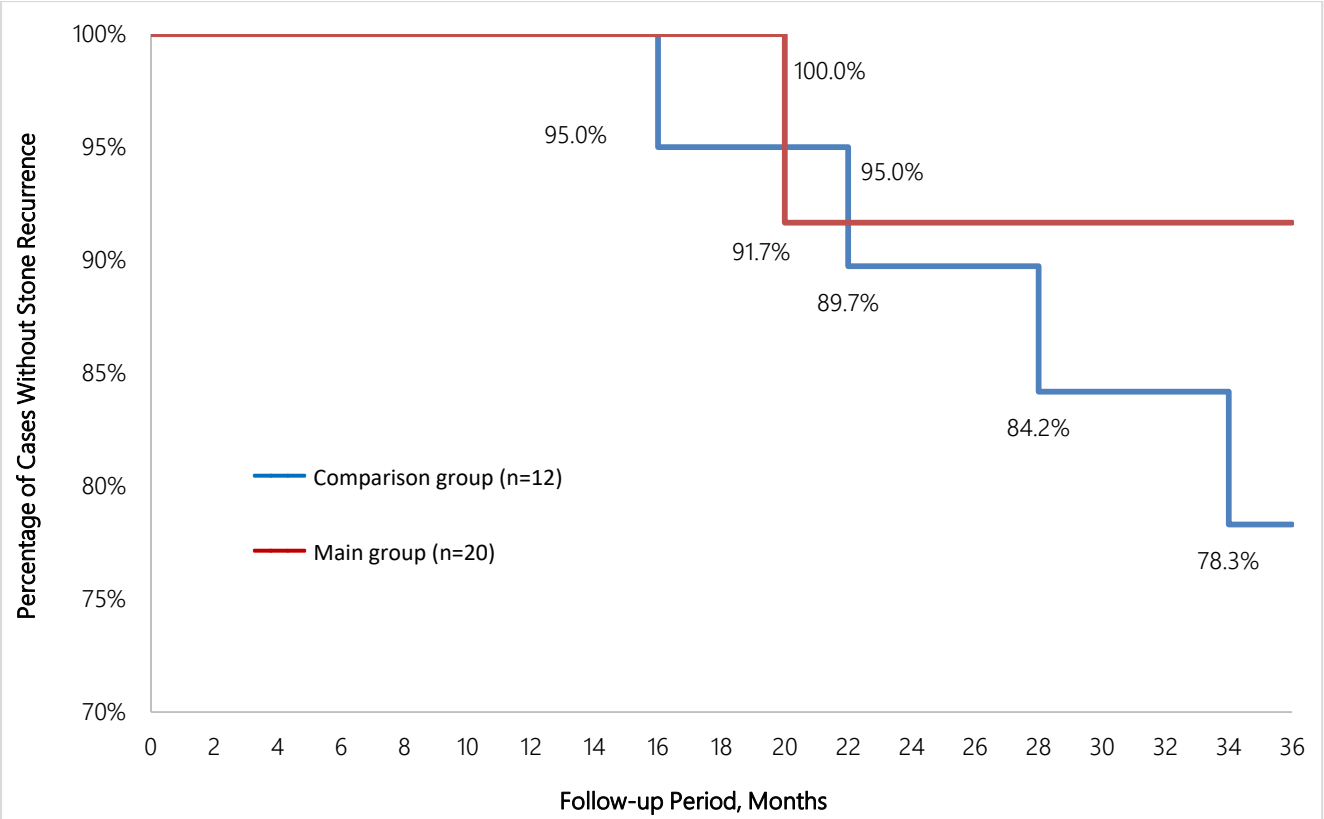


Figure 2. Frequency of specific postoperative complications



		Comparison Group (n=12)		Main Group (n=20)		χ^2	p
Stone formation recurrence		4	33,3%	1	5,0%	4,6	0,033

Figure 3. Cumulative freedom from pancreatic stone formation and symptom recurrence (Kaplan-Meier curve analysis).

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DISCUSSION

The present study demonstrates that the authors' modification of Puestow-type pancreaticojejunostomy in patients with chronic pancreatitis complicated by pancreatolithiasis yields superior perioperative and long-term outcomes compared to the standard technique. In our cohort, operative time, mechanical ventilation duration, and length of postoperative hospital stay were significantly reduced, while the rates of postoperative complications and stone recurrence were notably lower. These results are in agreement with previously published evidence supporting the role of tailored ductal drainage procedures in improving surgical efficiency and recovery parameters in patients with dilated pancreatic ducts.

Historically, the Puestow procedure and its Partington–Rochelle modification were developed to achieve adequate decompression of the main pancreatic duct in chronic pancreatitis while preserving pancreatic parenchyma [14]. In a retrospective review of 116 patients, lateral pancreaticojejunostomy achieved sustained pain relief in 83.1% of cases and maintained exocrine and endocrine function in the majority [13]. Similarly, Nealon et al. [14] reported that extended ductotomy with meticulous mucosa-to-mucosa anastomosis shortened operative time and reduced hospital stay without compromising long-term outcomes. Our data confirm these observations, showing shorter operative time (113.5±6.8 min) and shorter hospitalization (6.3±0.5 days) in the modified technique group.

Pain control and recurrence-free survival rates observed in our series (91.7% freedom from recurrence) exceed those reported in multicenter series of conventional Puestow-type procedures, where recurrence rates ranged from 14% to 28% [15, 16]. Palanivelu et al. [17] demonstrated that complete ductal clearance and optimized anastomotic configuration could reduce recurrence to below 10% at five years, findings closely aligned with our recurrence rate of 5.0%. Importantly, no anastomotic leaks were observed in our main group, whereas leak rates up to 8% have been reported even in high-volume centers [18, 19].

Our results further support the evidence from Keck et al. [18] and Sutton et al. indicating that drainage procedures outperform resection in patients with dilated ducts (>5 mm) and multiple calculi, providing better pain control, lower endocrine insufficiency rates, and reduced morbidity [18, 20]. Endoscopic approaches, although less invasive, have shown higher recurrence and reintervention rates in long-term follow-up, with meta-analyses by Cahen et al. and Issa et al. reporting recurrence rates of 20–35% within 2–3 years [21, 22]. This highlights the superiority of our modified surgical approach in durable disease control.

Several factors may explain the improved outcomes observed in our series. The modified technique allows for extended ductotomy, ensuring complete clearance of calculi and strictures, while preserving pancreatic tissue and minimizing trauma to adjacent structures. Additionally, optimized mucosa-to-mucosa approximation reduces the risk of anastomotic leak and stricture formation. These technical refinements likely contributed to the reduced rates of complications and reinterventions in our main group.

Overall, our findings confirm that a carefully executed and technically optimized modification of the Puestow-type pancreaticojejunostomy provides significant clinical advantages over both standard surgical drainage and purely endoscopic approaches, particularly in patients with multiple or large calculi, rigid duct walls, or complex strictures.

CONCLUSIONS AND RECOMMENDATIONS

The conducted study demonstrated that the use of the authors' modifications of the Puestow procedure in patients with chronic pancreatitis complicated by pancreatolithiasis significantly reduces the recurrence rate of stone formation, shortens the duration of surgery and hospital stay, and decreases the risk of reinterventions and postoperative complications. The obtained data confirm the clinical effectiveness and safety of the proposed surgical approach, particularly in cases with a dilated main pancreatic duct and multiple calculi, and support its recommendation as the preferred treatment method for this patient population.

DECLARATIONS

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Data availability

The datasets used and/or analysed during the current study available from the corresponding author on reasonable request.

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Authors' contributions

M. Mirolimov designed the study, searched the database, extracted the data, and did the quality assessment. MMM did the statistical analysis and wrote the results section and assessed the quality of studies. M. Mirolimov wrote the initial draft and S. Ismailov revised and edited the paper.

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Ethical approval

The review board and ethics committee of the Republican Specialized Scientific Practical Medical Center of Surgery named after acad. V.Vakhidov, Ministry of Health of the Republic of Uzbekistan approved the study protocol. All methods were performed in accordance with the relevant guidelines and regulations. For ethical approval, the authors confirm compliance with the ARRIVE guidelines and with the Interdisciplinary Principles and Guidelines for the Use of Animals in Research, Testing, and Education issued by the New York Academy of Sciences, Ad Hoc Animal Research Committee.

Competing interests

All authors declare that they have no conflict of interest.

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