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OUTCOMES OF MINIMALLY INVASIVE INTERVENTIONS FOR SEVERE ACUTE PANCREATITIS DEPENDING ON SURGICAL TIMING AND TECHNIQUE IN A CENTRAL ASIAN COHORT

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Background

Despite broad acceptance of the step-up approach for necrotising pancreatitis, the precise timing of minimally invasive intervention and the criteria for selecting between ultrasound-guided percutaneous drainage (PTBD), video-assisted retroperitoneal necrosectomy (VARD) and open necrosectomy remain subjects of ongoing debate. The 2019 WSES guidelines [1] recommend deferring intervention beyond 12 days when feasible, yet this guidance is largely based on cohorts from high-resource settings where CT-guided follow-up is readily available. In Central Asian emergency centres, late hospital presentation and limited imaging availability frequently make a prolonged conservative phase impractical. Moreover, published data on conversion rates and complication profiles by intervention type are almost exclusively derived from European and North American series, leaving a significant evidence gap for our region [2]. A critical unanswered question is whether the benefit of earlier intervention - guided by molecular-genetic risk stratification rather than clinical deterioration alone - outweighs the theoretical risk of operating on immature necrosis.

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Aim

To evaluate the clinical outcomes of minimally invasive surgical interventions for severe acute pancreatitis according to type of procedure (PTBD, VARD, open necrosectomy) and timing of operation, and to identify independent predictors of conversion to open surgery.

Patients and methods

A retrospective-prospective cohort study enrolled 210 patients with severe AP (Revised Atlanta Classification 2012 [3]) treated at three branches of the Republican Research Centre for Emergency Medicine, Uzbekistan (2016-2025). The control group (n=98, 2016-2020) received conventional step-up surgery without genetic risk assessment. The study group (n=112, 2021-2025) was managed by a personalised algorithm based on a validated 12-criterion prognostic score incorporating clinical, laboratory, CT and molecular-genetic parameters. A total of 111 surgical interventions were analysed: PTBD under ultrasound guidance (n=29), VARD via retroperitoneal lumbotomy approach (n=29) and open necrosectomy (n=35) in the two cohorts combined. Timing was categorised as early (<24 h), intermediate (24-72 h) or late (>72 h) from admission. Primary outcomes: in-hospital mortality, postoperative complications, conversion to open surgery. Secondary outcomes: ICU stay, hospital length of stay. Categorical variables were compared by chi-square test with Yates correction or Fisher exact test; continuous variables by Mann-Whitney U test. Independent predictors of conversion were identified by multivariate binary logistic regression. All ORs and RRs are presented with 95% confidence intervals; $p<0.05$.

Results

The personalised algorithm shifted the composition of surgical activity substantially: the proportion of minimally invasive procedures increased from 20.7% to 73.8% (PTBD 17.9%, VARD 5.4%), while open necrosectomy fell from 22.4% to 8.0% (chi-square=9.4; p<0.001).

Outcomes differed markedly by intervention type. Open necrosectomy carried the highest complication burden (74.3%) and mortality (17.1%). VARD occupied an intermediate position: complication rate 27.6%, mortality 3.4%, with VARD significantly outperforming open necrosectomy for mortality (OR=6.0; 95% CI 1.3-28.1; p=0.018) and ICU stay (median 5 vs. 9 days; p<0.001). PTBD in appropriately selected patients (walled-off collections without solid sequestra) produced zero mortality and a complication rate of 20.7%, with 86.2% of patients avoiding conversion to open surgery [4].

Surgical timing exerted a decisive influence on outcomes in high-risk patients (score >=13 points). Among those who underwent intervention within 24 hours, mortality was 0% (0/23); among those operated at 24-72 hours, it was 12.5%; and beyond 72 hours, 50.0% (trend chi-square=7.4; df=1; p=0.003). The odds ratio for in-hospital death when intervention was delayed beyond 48 hours relative to the first 24 hours was 9.2 (95% CI 2.1-40.6; p=0.001). Conversion to open surgery increased in parallel: 6.7-12.5% for early interventions versus 25.0% for late (p=0.03), reflecting the technical difficulties posed by mature fibrotic infiltrate [5].

Multivariate logistic regression identified four independent predictors of conversion to open surgery: pancreatic necrosis exceeding 50% on CT (OR=8.4; 95% CI 1.9-36.8; p=0.004), MMP9 Arg risk allele (OR=5.1; 95% CI 1.3-19.7; p=0.017), intra-abdominal pressure >15 mmHg at admission (OR=4.8; 95% CI 1.2-19.3; p=0.026) and delay to intervention beyond 48 hours (OR=6.3; 95% CI

1.4-27.9; p=0.015). Early identification of this subgroup allows pre-operative planning of a primary open approach or a hybrid strategy, avoiding the morbidity of failed minimally invasive access [6].

Conclusion

Minimally invasive step-up interventions for severe AP produce significantly lower mortality and complication rates than open necrosectomy, provided patient selection and timing are appropriate. In genetically high-risk patients, intervention within 24 hours from admission is associated with zero mortality versus 50% when delayed beyond 72 hours (OR=9.2; 95% CI 2.1-40.6). Four independent predictors of conversion to open surgery - CT necrosis >50%, MMP9 Arg allele, intra-abdominal pressure >15 mmHg and delay >48 hours - can be established at the time of admission, enabling individualised pre-operative planning. These findings support the integration of molecular-genetic risk stratification into surgical decision-making protocols for severe AP.

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