

Weekend endoscopic retrograde cholangiopancreatography has similar outcomes as weekday procedures—a propensity score match analysis of the Hungarian ERCP Registry

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Abstract

Background: Endoscopic retrograde cholangiopancreatography (ERCP) is essential for the minimally invasive management of biliary and pancreatic disorders. Under certain indications, performing ERCP without delay during the weekend can be important for improving outcomes.

Objectives: To compare the outcomes of ERCP performed on weekends and holidays with those of regular weekday ERCPs.

Design: Propensity score match analysis of the data from the Hungarian ERCP Registry.

Methods: A total of 116 ERCPs were performed during weekends or holidays, and 3144 during weekday working hours. The analyses were performed on 1:2 propensity-matched groups (116 weekend and 232 weekday cases).

Results: Weekend ERCPs were mostly performed for acute cholangitis and acute biliary pancreatitis (70% of cases), whereas in the weekday group, only 32% of cases were performed for these indications. No significant difference was found between weekday and weekend ERCPs in terms of the rates of successful (91.38% vs 93.1%, $p=0.565$) and difficult (33.62% vs 36.64%, $p=0.511$) biliary cannulations. We found no significant differences in the number of adverse events (bleeding, post-ERCP pancreatitis, and 30-day mortality) in ERCPs performed during weekends or weekdays. Moreover, no significant differences in the aforementioned outcomes were detected between the propensity-matched groups.

Conclusion: In this propensity-matched study, no significant differences were found in the outcomes of weekend and weekday ERCPs.

Keywords: advanced cannulation, adverse events, cannulation, endoscopic retrograde cholangiopancreatography, outcome, weekend

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Introduction

Endoscopic retrograde cholangiopancreatography (ERCP) is a widely used, minimally invasive procedure that is invaluable for the management of various pancreatobiliary disorders and requires a highly qualified healthcare team.

In some cases, urgent ERCP is required to achieve the best outcomes. For example, in cases of severe acute cholangitis, according to the 2018 Tokyo guidelines, ERCP should be performed as soon as possible, even during the weekend, to avoid deterioration of the patient's condition.¹

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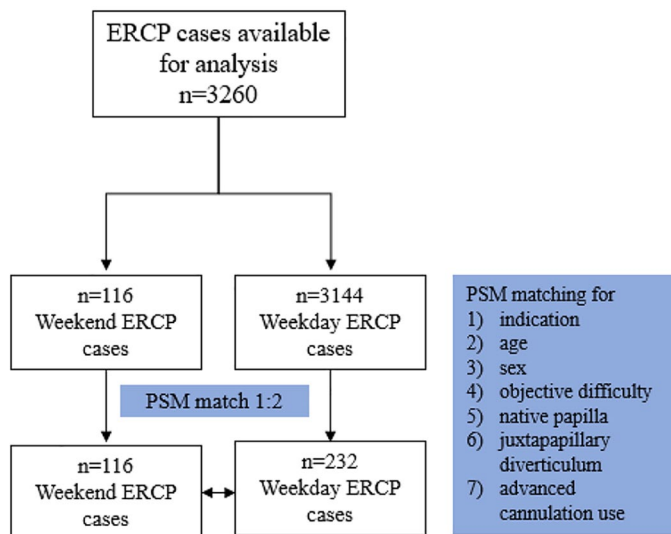


Figure 1. Flowchart of case selection.

During weekends and off-hours, personnel (e.g. ERCPists and endoscopy assistants) and supportive backgrounds (e.g. surgeons and interventional radiologists) are not optimally available, which could lead to worse outcomes.

Multiple studies have shed light on the financial aspect of performing ERCPs during the weekend: by performing the procedure earlier, the length of stay could be shorter, and the cost of care could potentially be lower.^{2,3} For example, personnel can perform multiple urgent procedures during off-hours. However, the outcomes of ERCP performed on weekends are unknown.

Therefore, in this study, we analyzed data from the Hungarian ERCP Registry (H-ERCP) to compare the outcomes of weekend and weekday ERCPs.

Methods

General considerations

In this cohort study, data from the H-ERCP, initiated by the Hungarian Endoscopy Study Group in 2016, were analyzed to compare weekend and weekday ERCPs. The Registry included 3260 cases from 7 tertiary referral centers and 15 endoscopists at the time of analysis. All participating endoscopists were experienced practitioners with high yearly case numbers. Participating endoscopists uploaded all ERCP procedures

performed consecutively and a 30-day telephone follow-up was conducted to detect late adverse events. As previously discussed, the Registry has a four-step checking system to ensure data quality (1, local check from administrator; 2, endoscopist; 3, central check by chief administrator; 4, registry coordinator (ÁV, DP)).⁴ This cohort study conforms with the STrengthening the Reporting of OBservational studies in Epidemiology guidelines.⁵

Inclusion and exclusion criteria

All the cases available for analysis were included. A total of 116 ERCP procedures were performed during weekends or holidays, and 3144 ERCP procedures were performed during weekday working hours. Patients with missing data were excluded from the analysis (Figure 1).

Outcomes and definitions

The primary outcome of this study was the success rate of biliary cannulation. The secondary outcomes were difficult cannulation, adverse event rates (post-ERCP pancreatitis (PEP), bleeding, and 30-day mortality), and cannulation and fluoroscopy time.

Indications for ERCP were included in the registry protocol and were based on current guidelines.⁶ The cannulation algorithm established by the European Society of Gastrointestinal

Endoscopy (ESGE) was implemented in all centers.⁷ Adverse events such as bleeding and PEP were defined according to the current ESGE guidelines.⁸

Propensity score matching analysis with a 1:2 ratio was performed to minimize confounding factors that could influence the outcomes.

Analyzed dataset

Demographic data and patient characteristics (sex, age, American Society of Anesthesiology status) as well as procedural data were analyzed: the presence of juxtapapillary diverticulum (JPD), the success rate of biliary access, use of advanced cannulation techniques, PEP prophylaxis measures such as the use of non-steroid suppositories and prophylactic pancreatic stent (PPS) placement, adverse event rates (bleeding, PEP), and cannulation and fluoroscopy time.

Statistical analysis

To compare weekend and weekday ERCP outcomes, we performed nearest-neighbor matching using propensity scores as a distance measure. The use of matched data was necessary because the weekend and weekday groups differed in many aspects that could also affect the outcome variables; therefore, bias could have been introduced. We selected covariates for matching for which we thought a balance was required for comparison: indication, age, sex, objective difficulty, native papilla, JPD, and advanced cannulation use. We assessed the balance of the matched variables using density and distribution plots to compare the distributions of the matched variables between the two groups before and after matching. We also compared the standardized mean differences between the groups before and after matching to assess the matching success. Based on these plots and measures, the matching procedure was successful, and the distribution of the matched variables was very similar between the two groups after matching. We had 116 weekend and 3144 weekday ERCP procedures in the raw dataset, which made it possible to perform 1:2 matching while maintaining good matching quality. In the matched sample, 116 weekend and 232 weekday ERCPs were performed. To calculate the differences in outcome variables, we fitted a simple linear model

for continuous variables and a logistic model for binary variables, with weekends as the only covariate. To calculate the standard error of the difference between the groups in the outcome variables, we used cluster-robust standard errors that considered the dependence between matched observations, as recommended by Ho *et al.*⁹ To assess the differences, we created summary plots in which we visualized the estimated mean differences of continuous variables and the risk differences of binary variables with their corresponding 95% confidence intervals. For the statistical evaluation, R version 4.1.0 was used. For the matching, we used the “MatchIt” version 4.5.3 and “marginaleffects” version 0.12.0 packages.

Results

General characteristics of the cohort

The weekend and weekday procedures were matched in a 1:2 ratio according to the parameters that could influence the outcomes (Supplemental Table 1).

Indications of ERCP

Most cases were performed for acute cholangitis (40.5%) and acute biliary pancreatitis (29.3%) during the weekend, although obstructive jaundice (18.1%) and diseases of the bile ducts (10.3%) were also frequent non-urgent indications.

During working hours, most procedures were performed for obstructive jaundice (31.5%) and diseases of the bile ducts (33.0%), whereas cholangitis and pancreatitis were rare (Figure 2).

Biliary cannulation success rates

No significant differences were found in the biliary cannulation success rates between weekend and weekday ERCPs (91.38% vs 93.1%, $p=0.565$). The rate of difficult biliary cannulations was not higher on weekends (33.62% vs 36.64%, $p=0.511$; Figure 3).

Adverse event rates

Relatively low PEP rates were observed in the weekend and weekday groups (1.72% vs 0.86%,

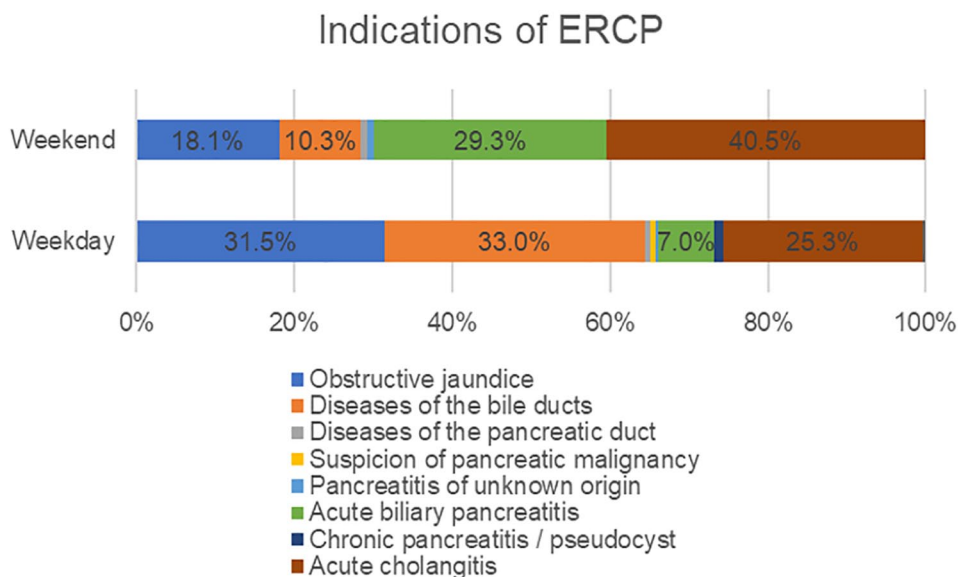


Figure 2. Distribution of ERCP indications. ERCP, endoscopic retrograde cholangiopancreatography.

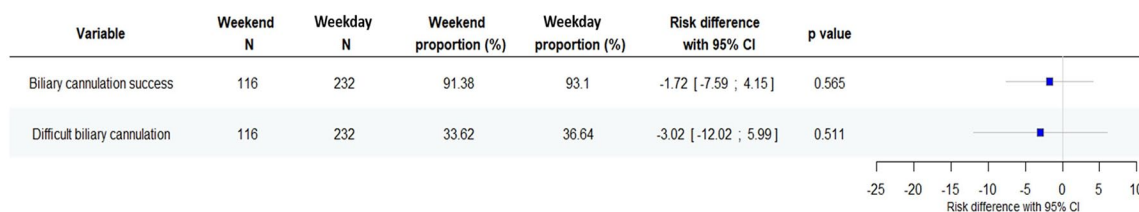


Figure 3. Comparison of biliary cannulation success rates and difficult biliary cannulation rates in the propensity score matched groups.

$p=0.528$). No difference in the bleeding rate was observed between the groups (0.86% vs 0.43%, $p=0.656$). The 30-day mortality rates were similar between the two groups (16.9% vs 14.71%, $p=0.661$; Figure 4).

PEP prophylaxis

Indomethacin suppository use was lower on weekends (43.1% vs 56.03%, $p=0.019$). No difference was found between the PPS insertion rates (13.04% vs 10.78%, $p=0.523$; Figure 5).

Cannulation and fluoroscopy time

The average cannulation time was similar in weekend and weekday procedures (166.6 vs

194.4 s, $p=0.371$). In addition, no difference was observed in fluoroscopy time between weekend and weekday ERCPs (151.5 vs 132.4 s, $p=0.42$; Figure 6).

Discussion

Based on our data, weekend ERCP outcomes were not worse than those of weekday working hours. The biliary cannulation success and adverse event rates were similar; only indomethacin suppository use was lower on weekends.

The suboptimal use of PEP prophylaxis with below 50% use of indomethacin suppositories was unexpected, although it is possible and understandable that suppository placement could

Variable	Weekend N	Weekday N	Weekend proportion (%)	Weekday proportion (%)	Risk difference with 95% CI	p value
PEP	116	232	1.72	0.86	0.86 [-1.82 ; 3.54]	0.528
Bleeding	116	232	0.86	0.43	0.43 [-1.46 ; 2.33]	0.656
30-day mortality	71	170	16.9	14.71	2.2 [-7.61 ; 12]	0.661

Figure 4. Comparison of adverse event rates and 30-day mortality in the propensity score matched groups (PEP). Thirty-day mortality was collected prospectively, not in all cases could have been ascertained this outcome, these cases were left out of analysis.

ERCP, endoscopic retrograde cholangiopancreatography; PEP, post-ERCP pancreatitis.

Variable	Weekend N	Weekday N	Weekend proportion (%)	Weekday proportion (%)	Risk difference with 95% CI	p value
Indomethacin supp.	116	232	43.1	56.03	-12.93 [-23.74 ; -2.12]	0.019
Prophylactic pancreatic stent impl.	115	232	13.04	10.78	2.27 [-4.68 ; 9.22]	0.523

Figure 5. Analysis of post-ERCP pancreatitis prophylaxis use in the propensity score matched groups (supp., impl.). One weekend ERCP case was excluded from analysis because a pancreatic stent was already in place.

ERCP, endoscopic retrograde cholangiopancreatography; impl., implantation; supp., suppository.

Variable	Weekend N	Weekday N	Weekend Mean (SE)	Weekday Mean (SE)	Mean difference with 95% CI	p value
Average cannulation time	86	179	166.6 (25.3)	194.4 (20)	-27.8 [-88.8 ; 33.1]	0.371
Average fluoroscopy time	66	166	151.5 (21.5)	132.4 (10.7)	19 [-27.2 ; 65.2]	0.42

Figure 6. Comparison of cannulation and fluoroscopy time in the propensity score matched groups (SE). Only cases with data of cannulation and fluoroscopy time were analyzed.

SE, standard error.

be forgotten and left out during weekends in a hurry. However, a very low rate of PEP was observed, which is unexpected in urgent procedures involving substandard PEP prophylaxis. This could be explained by the fact that all cases were handled at tertiary centers by expert endoscopists, and 25% of the ERCPs were non-native papilla cases, which lowers the risk of adverse events.

Our findings are consistent with those of previous studies that reported similar rates of adverse events in off-hours ERCPs.¹⁰

Several studies have addressed the financial aspects of weekend ERCP.^{2,3,11} Based on the registry data, we could not analyze the length of hospital stay (LOS) because it was not included in the questionnaire. However, it is desirable to reduce the financial burden and, possibly, antibiotic use. The availability of expert endoscopists during weekends is limited; therefore, the feasibility of performing non-urgent procedures is currently questionable.

In their retrospective study, Kruit *et al.*¹² showed that higher radiation doses were measured in

ERCPs performed during weekends. In contrast, we found no significant difference in fluoroscopy time between the two groups.

The main strength of our study was that the data were prospectively gathered from the H-ERCP, which includes seven high-volume centers. Good data quality was achieved for most outcomes. Quality control and multiple checks by different personnel improved data quality. We used propensity score matching to reduce confounding biases by balancing the factors in the two groups that could alter outcomes.

A limitation of our study is that this analysis was performed using post hoc questions raised in prospectively collected data, which could have included confounding factors. The generalizability of the findings is hindered by the fact that all cases were obtained from high-volume tertiary centers by expert endoscopists. The case distribution varied between the centers. The possibility of selection bias cannot be excluded, as this was an observational study.

Recommendations for clinical practice: Weekend ERCP has similar outcomes in tertiary centers performed by expert endoscopists. These procedures should not be delayed if strongly indicated.

Recommendations for research: A feasibility study of performing weekend non-urgent ERCPs to lower LOS and cost of care should be conducted.

Conclusion

In this propensity-matched study, no significant differences were found in outcomes between weekend and weekday ERCPs.

Declarations

Ethics approval and consent to participate

All patients in the prospective data collection consented to participating in the study. The Scientific and Research Ethics Committee of the Medical Research Council approved this H-ERCP study (TUKÉB-35523/2016/EKU and BMEÜ/714-1/2022/EKU).

Consent for publication

All patients in the prospective data collection consented to the publication of their anonymized data.

Author contributions

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Competing interests

The authors declare that there is no conflict of interest.

Availability of data and materials

All relevant data are presented in the paper and the Supporting Information files. Additional data are available upon request.

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Supplemental material

Supplemental material for this article is available online.

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