

ORIGINAL ARTICLE

The Nassar Scale as an Instrument for Predicting Conversion of Laparoscopic to Open Cholecystectomy

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ABSTRACT

Background: Difficult cholecystectomy, often associated with a heightened risk of complications, poses a significant surgical dilemma. Risk factors, such as patient age, increased body weight, the presence of gallstones, acute cholecystitis, and prior abdominal surgeries, can complicate laparoscopic cholecystectomy and necessitate conversion to an open procedure for safety. The aim of our study was to assess the applicability of the Nassar scale in predicting the need for conversion from laparoscopic to open cholecystectomy.

Material and methods: In our prospective cohort study, we included 85 patients who underwent either emergency or elective laparoscopic cholecystectomy between December 2021 and October 2023. The Nassar scale was used to assess the complexity of laparoscopic cholecystectomy, incorporating parameters such as 'Gallbladder,' 'Cystic pedicle,' and 'Adhesions' to determine a final score ranging from 1 to 5. Statistical analysis involved descriptive and analytical methods, with the significance threshold set at $p < 0.05$.

Results: ANOVA analysis revealed a statistically significant difference in the duration of operative procedures with different Nassar grades ($p < 0.001$). An increase in the Nassar grade by 1 was associated with a statistically significant 6.23-fold increase in the odds of conversion to an open procedure ($p < 0.001$). Receiver Operating Characteristic (ROC) analysis demonstrated a highly significant association ($p < 0.001$) between the Nassar grade and the conversion event, with an Area Under the Curve (AUC) of 0.881 (95% CI 0.79,0.96). The optimal cutoff value, identified as >2.5 , struck a balance between sensitivity (0.86) and 1-specificity (0.23).

Conclusion: Our study underscores the utility of the Nassar scale in surgical practice. It provides valuable insights into assessing the severity of operations, facilitating informed decision-making, and optimizing treatment outcomes for patients undergoing laparoscopic cholecystectomy at our institution.

Keywords: cholecystectomy, laparoscopy, surgical procedures, gallstones

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Introduction

Difficult cholecystectomy implies performing this surgical procedure with an increased risk of complications compared to the standard procedure, and as such represents a challenge in surgical practice¹. It is associated with risk factors such as the patient's age, increased body weight, the presence of gallstones, acute cholecystitis and previous abdominal operations².

Conversion of laparoscopic cholecystectomy to an open procedure is an important aspect of the analysis of difficult cholecystectomy, and occurs in cases when surgeons face intraoperative difficulties and complications during the laparoscopic procedure that make it difficult to complete the operation safely^{3,4}. The Nassar scale is one of the available tools for assessing the severity of laparoscopic cholecystectomy. The scale consists of five grades determined on the basis of the visual characteristics of the intraoperative finding, so that a higher grade means a more difficult (complicated) intraoperative finding^{5,6}. In grade 1, a soft gallbladder is visualized, separated from the surrounding tissue, the cystic pedicle is thin and transparent, while the adhesions are limited to the corner of the gallbladder neck (Hartman's pouch). Grade 2 is characterized by the presence of stones in the gallbladder while the cystic pedicle is covered with fatty deposits. In grade 3, the gallbladder can be "buried" in the liver, with signs of inflammation and adhesions that make access to the cystic pedicle difficult. Grade 4 represents extremely severe cases, with signs of gangrene of the gallbladder, while the adhesions are firm and make it difficult to separate the gallbladder from the surrounding structures.

Grade 5 implies a finding from grade 4 combined with the presence of Mirizzi syndrome type 2 and higher, with cholecystocutaneous or cholecystoenteric fistula⁶.

In a study conducted by Sah NP et al.⁷, it was emphasized that the Nassar scale can be used by surgeons with different experiences to evaluate the

difficulty of laparoscopic cholecystectomy. Their study indicates a significant correlation between the Nassar grade and the need for conversion to open cholecystectomy and the prolonged duration of surgery. Despite the numerically limited sample, the authors were able to confirm the applicability and consistency of the scoring method, suggesting that scoring using the Nassar scale can be used to plan operations better⁷.

The Nassar scale can be used also to assess the severity of the disease better. Despite subjectivity in the application of the scale between individual surgeons, and differences in clinical contexts, the scale is considered a valuable tool for assessing the severity of cholecystectomy⁸.

Within our current clinical practice, it is not customary to use a rating scale to assess the complexity of laparoscopic cholecystectomies or to predict conversion to open surgery. This area requires in-depth analysis, and the results of our research can help to enhance surgeon training and patient safety, contributing to a better understanding and underlining the importance of implementing the Nassar scale in our clinical department.

The aim of our study is to evaluate the application of the Nassar scale in predicting the conversion of laparoscopic cholecystectomy to an open procedure, identify the optimal rating score based on intraoperative findings for this purpose, to explore differences in ratings between emergency and elective patients, and analyze variations in the duration of surgeries among different Nassar score categories.

Material and methods

In our prospective cohort study, we included 85 patients who underwent emergency or elective laparoscopic cholecystectomy from December 2021 to October 2023. All operative procedures were performed by surgeons of the Clinic for General and Abdominal Surgery of the Clinical Center of the University of Sarajevo (CCUS). Patients were previously evaluated

by an anesthesiologist and classified according to the American Society of Anesthesiologists (ASA) physical status classification, with the inclusion of patients with an ASA score of less than or equal to 3. After the operative procedure, surgeons evaluated the complexity of the laparoscopic cholecystectomy according to the Nassar scale, using the parameters “Gallbladder”, “Cystic pedicle” and “Adhesions”, with a final score of 1 to 5. Patients were divided into two main groups according to the need for possible conversion: LC group (laparoscopically completed cholecystectomy) and OC group (need for conversion to an open approach to complete the cholecystectomy). Only patients with postoperatively confirmed benign pathohistological findings, i.e. the presence of calculous cholecystitis or gallbladder polyps, were included in the study. Pathohistological analysis of the samples was performed at the Clinic for Clinical Pathology, Cytology and Human Genetics of the Clinical Center of the University of Sarajevo. The study did not include patients with postoperative pathohistology indicating the presence of carcinoma of the gallbladder or another biliary tract, patients who underwent preoperative ultrasound-guided percutaneous cholecystostomy, or those who had laparoscopic cholecystectomy as part of other laparoscopic procedures. For statistical analysis we used the program IBM SPSS Statistics version 22.0 for Windows. The most important results of the study are presented in tables and figures. The t-test was used to examine differences in the means of continuous variables between two groups, while the ANOVA test was applied to compare the means of the continuous variables between more than two groups. To assess the predictive ability in determining the occurrence of a specific event, we used binary logistic regression. ROC analysis was performed to assess the diagnostic accuracy of the Nassar scale in predicting conversion from laparoscopic to open cholecystectomy. The area under the curve (AUC) was calculated to measure the discriminatory ability of the Nassar scale. The threshold for statistical significance was set at the conventional level ($p < 0.05$).

Results

For different Nassar grades, the duration of the operation was as follows: grade 1 - 50.75 minutes, grade 2 - 57.31 minutes, grade 3 - 73.50 minutes, grade 4 - 110.56 minutes, grade 5 - 211 minutes. The only patient with grade 5 was excluded to allow the ANOVA analysis to be performed. The results of the ANOVA analysis indicate a statistically significant difference in the duration of operative procedures among the different Nassar grades ($p < 0.001$). Post hoc analyses revealed statistically significant differences in the duration of operative interventions between the following Nassar grades: between grades 1 and 3 ($p=0.019$) and 1 and 4 ($p<0.001$); and between grades 2 and 4 ($p<0.001$) and 3 and 4 ($p=0.003$), as shown in Figure 1.

The average Nassar grade in the group of patients undergoing urgent cholecystectomy was 2.58, while in the elective cholecystectomy group it was 1.91. The difference in the average Nassar grade was 1.51. The lowest Nassar grade in the emergency patient group was 1, and the highest was 5. In the group of patients undergoing elective cholecystectomy, the lowest Nassar grade was 1, and the highest was 4. The median Nassar grade was 3 for emergency patients, and 2 for those undergoing elective surgery. An independent samples t-test revealed a statistically significant difference in the Nassar grades between patients undergoing emergency or elective cholecystectomy ($p < 0.001$), which is shown in Figure 2.

In the case of Nassar grade 1, 7.1% of patients required conversion to open cholecystectomy. In grade 2, this percentage was 10.2%, while in grade 3 it reached 22.2%. In grade 4, 66.7% of patients ended up with open cholecystectomy. In Nassar grade 5, all patients required conversion. An increase in the Nassar grade by 1 was followed by a statistically significant 6.23-fold increase in the odds of conversion to an open procedure ($p<0.001$), as shown in Figure 3.

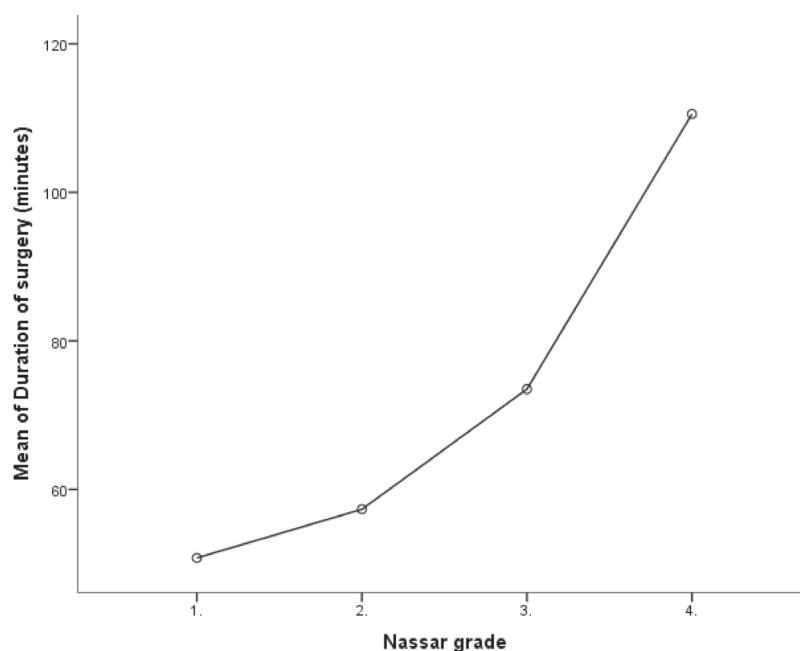


Figure 1. Duration of surgery in minutes relative to the Nassar grade.

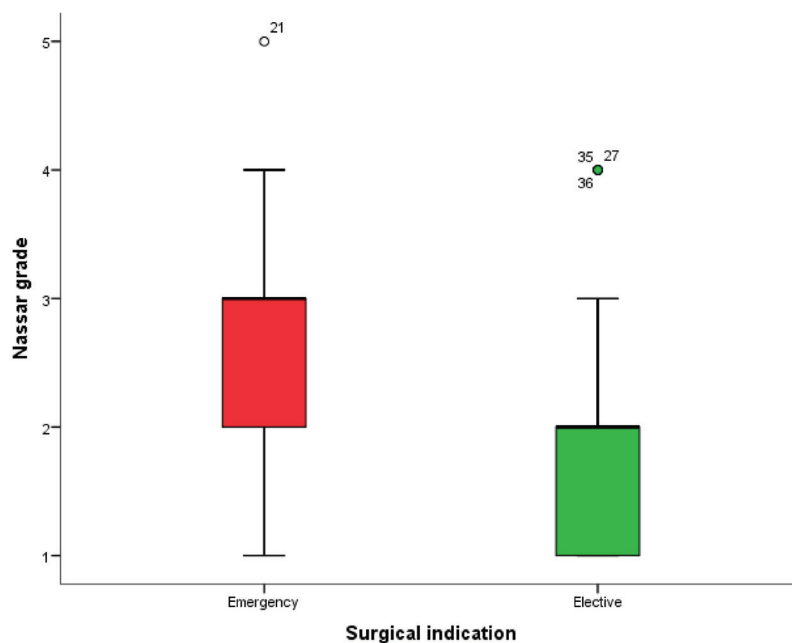


Figure 2. Nassar grade in relation to surgical indication.

ROC analysis was conducted to evaluate the diagnostic accuracy of the Nassar Score in predicting the conversion from laparoscopic to open

cholecystectomy. The Area Under the Curve (AUC) was computed to measure the model's discriminatory capacity, resulting in an AUC of 0.881 (95%

CI: 0.79-0.96). The analysis demonstrated a highly significant association ($p < 0.001$) between the Nassar grade and the conversion event. The optimal

cut-off value, identified as >2.5 , struck a balance between sensitivity (0.86) and 1-specificity (0.23), as shown in Figure 4.

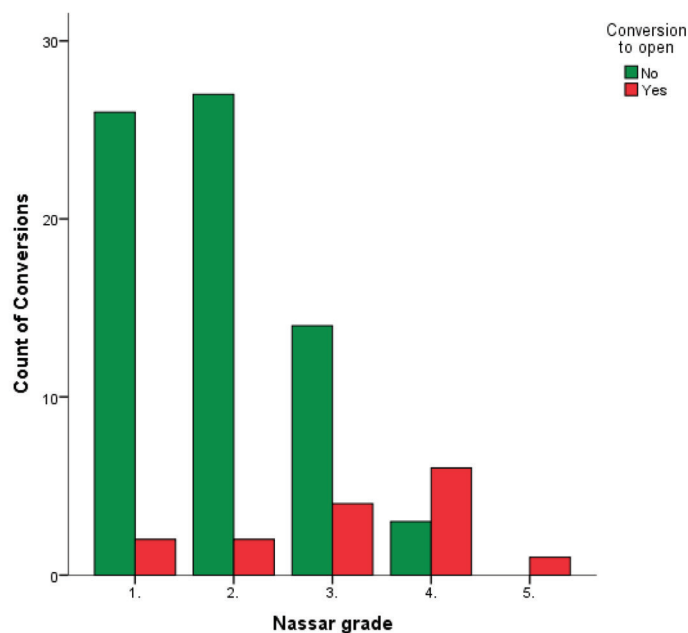


Figure 3. Conversion rates from laparoscopic to open cholecystectomy based on Nassar grade.

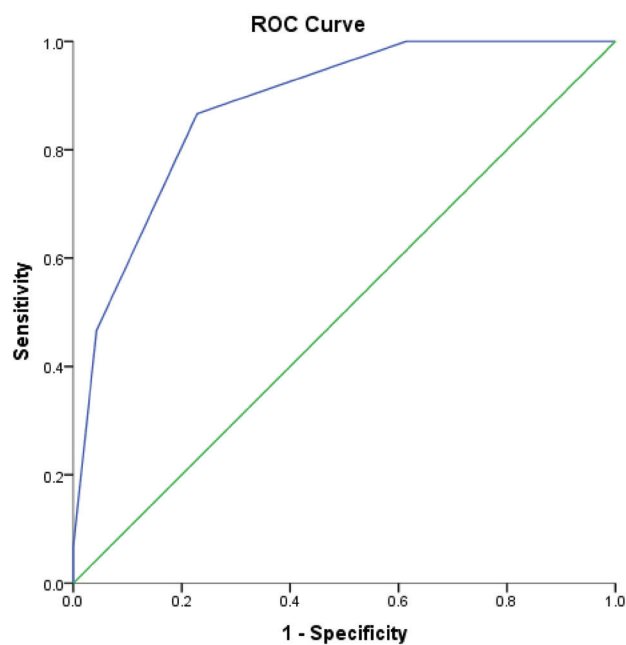


Figure 4. ROC Curve for Nassar Score with AUC Assessment.

Discussion

Our study investigated the ability of the Nassar scale to predict the conversion of laparoscopic cholecystectomy to an open procedure. We found that the risk of conversion increased significantly with an increase in the Nassar grade, with identification of the threshold value on the scale for its implementation. The significance of our finding is that it emphasizes the role of using the Nassar scale in surgical practice, and enhances risk management during this medical procedure.

Using a prospective approach to analyse all grades on the Nassar scale, we sought to achieve consistent and reliable results, in order to investigate the practical application of this scale in our clinical practice.

Gupta et al.⁹ defined surgeries as difficult if it took more than 60 minutes to complete the cholecystectomy, which is consistent with our findings, suggesting that the longer duration of surgery correlates with higher Nassar grades. Kemal et al.¹⁰ used the duration of the operation to classify the severity of cholecystectomy, dividing these operations into “difficult” and “very difficult” according to the duration of the cholecystectomy and complicating factors. Our research supports the use of the duration of surgery as a relevant indicator of the severity of laparoscopic cholecystectomy, since the longer duration of surgery correlates with higher Nassar grades. It is important to note limitations in the application of the time criterion, including differences in surgeon experience and variations in the interpretation of time thresholds. Furthermore, it is important to note that our study did not analyze intraoperative complications as a separate factor for assessing the severity of cholecystectomy, but relied solely on parameters from the Nassar scale as a measure of the difficulty of laparoscopic cholecystectomy.

Emergency patients had significantly higher Nassar grades compared to patients undergoing elective surgery. While no studies comparing Nassar grade levels based on the type of surgical indication for cholecystectomy were found, previous research indicated

a potential connection between complications during laparoscopic cholecystectomy and variations in C-reactive protein (CRP) levels, with notable discrepancies in CRP values and conversion criteria across different studies¹¹⁻¹⁴. While our study did not specifically investigate the relationship between CRP levels and conversion, this aspect warrants attention in future research to understand better how CRP may be linked to the Nassar scale. This is particularly important given that CRP is commonly used as an indicator of the severity of acute cholecystitis¹⁵.

Similar to a study conducted in 2022, our research also confirms that the highest conversion rates are observed in grade 4, with all patients in grade 5 requiring conversion⁷. Our study goes a step further by employing logistic regression, which reaffirms the statistically significant 6.23-fold increase in the conversion risk for each increment in the Nassar score. Both our study and the 2022 study stand out for their prospective approach and similar inclusion criteria, focusing primarily on patients with benign gallbladder conditions, while excluding malignant biliary tract diseases.

Although the AUC values in our study (0.881) are somewhat lower compared to the previous studies (0.903 and 0.973), all three studies confirm the high discriminating ability of the Nassar scale in predicting conversion^{7,8}. Another contribution of our study is the determination of the optimal ‘cut-off’ value for the Nassar grade to predict conversion, which, specifically, was found to be greater than 2.5.

There are significant limitations of our study that should be considered. The limited number of patients included precludes deeper analyses, including regression models to identify parameters from the Nassar scale in predicting conversion. The lack of consideration of intraoperative complications limits our understanding of the effect of the duration of the operative procedure on the Nassar scale. Also, we did not monitor long-term outcomes, such as postoperative complications and quality of life, which makes a more complete interpretation of the results difficult. The absence of a control group that would imply

cholecystectomy without the use of the Nassar scale makes it difficult to compare and prove the benefits of its use. The time limitation of the study may further limit the general applicability of the results to a wider population. It is especially important to emphasize that we did not take into account differences in the experience of surgeons in laparoscopic cholecystectomy, although all the authors of the study were either operators or first assistants.

Further investigations are needed to analyze the impact of preoperative CRP levels and intraoperative complications on the duration and conversion of laparoscopic cholecystectomy, as assessed with the Nassar score. Tracking long-term outcomes and the quality of life for patients undergoing these procedures, along with the introduction of a control group not utilizing the Nassar score, is essential for a more comprehensive assessment of its effectiveness. Additionally, comparing different surgeons, with a specific focus on the application of the Nassar score, will contribute to a better understanding of the influence of their experience on laparoscopic cholecystectomy outcomes.

In conclusion, this study identified the optimal Nassar grade for predicting conversion of laparoscopic cholecystectomy to an open procedure, confirming the reliability of this scale. Also, we found significant differences in the average Nassar scores between emergency and elective cholecystectomies, and in the duration of operative procedures among different grades. These findings confirm the importance of using the Nassar scale in surgical practice, which significantly improves our ability to assess the severity of operative findings, make correct decisions and optimize the outcome of treatment of patients undergoing laparoscopic cholecystectomy at our institution.

Conflict of interests

The authors have no relevant financial or non-financial interests to disclose.

Patient Consent Form: All participants were informed about subject of the study.

Author's Contribution: Edin Hodžić: Data curation, Visualization, Investigation, Writing-Reviewing. Sadat Pušina: Software, Investigation, Validation. Adi Mulabdić: Conceptualization, Methodology, Writing-Original draft. Adnan Kulo: Visualization, Investigation, Supervision. Salem Bajramagić: Conceptualization, Methodology, Writing-Original draft preparation, Supervision. Mirhan Salibašić: Data curation Investigation. Emsad Halilović: Data curation, Investigation. Amila Feto: Data curation, Investigation. Samir Delibegović Writing-Reviewing.

References

1. Jameel SM, Bahaddin MM, Mohammed AA. Grading operative findings at laparoscopic cholecystectomy following the new scoring system in Duhok governorate: Cross Sectional Study. *Annals of Medicine and Surgery*. 2020;60:266-70. doi:10.1016/j.amsu.2020.10.035
2. Chandio A, Timmons S, Majeed A, Twomey A, Aftab F. Factors influencing the successful completion of laparoscopic cholecystectomy. *JSLs*. 2009;13:581-6. doi:10.4293/108680809x1258998404560
3. Jethwani U, Singh G, Mohil R, Kandwal V, Razdan S, Chouhan J, et al. Prediction of difficulty and conversion in laparoscopic cholecystectomy. *OA Minimally Invasive Surgery*. 2013;1(1). doi:10.13172/2054-2666-1-1-650
4. Stanisić V, Milicević M, Kocev N, Stanisić B. A prospective cohort study for prediction of difficult laparoscopic cholecystectomy. *Annals of Medicine and Surgery*. 2020;60:728-33. doi:10.1016/j.amsu.2020.11.082
5. Mushtaque M, Kema A, Khanday S, Bacha U. Difficult laparoscopic cholecystectomy and postoperative requirement of analgesics: An observational study. *Saudi Journal of Laparoscopy*. 2019;4(1):24. doi:10.4103/sjl.sjl_7_19
6. Nassar AH, Ashkar KA, Mohamed AY, Hafiz AA. Is laparoscopic cholecystectomy possible without

- video technology? Minimally Invasive Therapy. 1995;:63-5. doi:10.3109/13645709509152757
7. Sah NP, Gupta RK, Awale L, Deo KB, Sah RP, Kumar A, et al. Operative difficulty grading scale for laparoscopic cholecystectomy at a tertiary care hospital in eastern Nepal. Journal of Kathmandu Medical College. 2022;58-67. doi:10.3126/jkmc.v11i1.45497
8. Griffiths EA, Hodson J, Vohra RS, Marriott P, Karbeh T, Zino S, et al. Utilisation of an operative difficulty grading scale for laparoscopic cholecystectomy. Surgical Endoscopy. 2018;33:110-21. doi:10.1007/s00464-018-6281-2
9. Gupta S, Anand K, Paliwal P, Baghel AS. Validation of intra-operative scoring system for difficult laparoscopic cholecystectomy. International Surgery Journal. 2022;9:1842. doi:10.18203/2349-2902.isj20222939
10. Kamal A, El-Matary M, Fadl E, Gebril N. Accuracy of randhawa and Pujahari preoperative scoring system in prediction of difficult laparoscopic cholecystectomy in Egyptian population. Ain Shams Medical Journal. 2021;72:163-71. doi:10.21608/asmj.2021.167373
11. Kaushik B, Gupta S, Bansal S, Yadav BL, Bharti D, Kalra D, et al. The role of C-reactive protein as a predictor of difficult laparoscopic cholecystectomy or its conversion. International Surgery Journal. 2018;5:2287. doi:10.18203/2349-2902.isj20182239
12. Arora BS, Sen P, Singh RK, Biswal I, Paruthy SB. HSCRP levels as predictor of difficult laparoscopic cholecystectomy- current status evaluation experience in a teaching institution. International Surgery Journal. 2017;4:1345. doi:10.18203/2349-2902.isj20171139
13. Onoe S, Maeda A, Takayama Y, Fukami Y, Kaneoka Y. A preoperative predictive scoring system to predict the ability to achieve the critical view of safety during laparoscopic cholecystectomy for acute cholecystitis. HPB. 2017;19:406-10. doi:10.1016/j.hpb.2016.12.013
14. Kutluer N. Complications during laparoscopic cholecystectomy performed due to acute cholecystitis. Laparoscopic Endoscopic Surgical Science. 2020; doi:10.14744/less.2020.25901
15. Kabul Gurbulak E, Gurbulak B, Akgun IE, Duzkoylu Y, Battal M, Fevzi Celayir M, et al. Prediction of the grade of acute cholecystitis by plasma level of C-reactive protein. Iranian Red Crescent Medical Journal. 2015;17(4). doi:10.5812/ircmj.17(4)2015.28091