



How does the COVID-19 pandemic affect the preoperative evaluation and anesthesia applied for urinary stones? EULIS eCORE–IAU multicenter collaborative cohort study

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Received: 22 April 2020 / Accepted: 4 May 2020 / Published online: 20 May 2020
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Abstract

Stone disease is a unique condition that requires appropriate management in a timely manner as it can result in both emergent conditions and long term effects on kidney functions. In this study it is aimed to identify the up-to-date practice patterns related to preoperative evaluation and anesthesia for stone disease interventions during COVID-19 pandemic. The data of 473 patients from 11 centers in 5 different countries underwent interventions for urinary stones during the Covid-19 pandemic was collected and analyzed retrospectively. Information on the type of the stone related conditions, management strategies, anesthesiologic evaluation, anesthesia methods, and any alterations related to COVID-19 pandemic was collected. During the preoperative anesthesia evaluation thorax CT was performed in 268 (56.7%) and PCR from nasopharyngeal swab was performed in 31 (6.6%) patients. General anesthesia was applied in 337 (71.2%) patients and alteration in the method of anesthesia was recorded in 45 (9.5%) patients. A cut-off value of 21 days was detected for the hospitals to adapt changes related to COVID-19. Rate of preoperative testing, emergency procedures, conservative approaches and topical/regional anesthesia increased after 21 days. The preoperative evaluation for management of urinary stone disease is significantly affected by COVID-19 pandemic. There is significant alteration in anesthesia methods and interventions. The optimal methods for preoperative evaluation are still unknown and there is discordance between different centers. It takes 21 days for hospitals and surgeons to adapt and develop new strategies for preoperative evaluation and management of stones.

Keywords COVID-19 · SARS-CoV-2 · Pandemic · Urolithiasis · Kidney stones · Nephrolithiasis · Anesthesia

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Introduction

The coronavirus disease 2019 (COVID-19) emerged from Wuhan, China in December 2019 and became a global health problem [1]. This viral infection mainly affects the pulmonary system and due to the highly contagious nature of the disease certain considerations raised regarding the anesthesiology procedures in the era of pandemic [2–4]. As the asymptomatic patients can spread the virus even during the incubation period [5], the perioperative evaluation of all cases is of upmost importance for both the patients and the health care professionals.

Limited experience accumulated during the Covid-19 pandemic era demonstrated that the management of all medical conditions including surgical procedures were altered to a certain extent. In a recent publication, Ficarra et al. advised the suspension of non-emergency urological interventions and the expert panel suggested recommendations for the organization of surgical cases [6]. Stone disease is a unique condition which can cause emergency conditions and also adverse effects on the kidney function during long-term follow-up. Therefore, appropriate management in a timely manner is crucial. Approach to urinary stones and related conditions can vary from major surgeries under general anesthesia (i.e. percutaneous nephrolithotomy) to less invasive applications under local anesthesia (i.e. nephrostomy placement). It has been recently shown that the practice patterns for stone disease also were altered due to COVID-19 pandemic [7].

Clinical decision making for urinary stone cases not only depends on the patient and stone related factors but also on the other disciplines and health care resources including anesthesiologists, hospital beds, mechanical ventilators and intensive care units. During the extraordinary conditions of Covid-19 pandemic, the ideal strategies for management of stone disease in an individualized manner is unknown and also there is no information in the published literature regarding the anesthesiology perspectives.

The aims of this study are: a. to identify the up-to-date practice patterns related to preoperative evaluation and anesthesia applied for the management of stones and b. assess the possible different approaches among centers from different parts of the world.

Materials and methods

The data of 473 patients from 11 centers in 5 different countries underwent interventions for urinary stones during the Covid-19 pandemic was collected and analyzed retrospectively. Six of the centers (Ankara University School

of Medicine Department of Urology, Ankara ($n = 29$), Necmettin Erbakan University, Meram School of Medicine Department of Urology, Konya ($n = 48$), Health Sciences University, Dr. Lütfi Kırdar Training and Research Hospital, Istanbul ($n = 42$), Medipol University School of Medicine Department of Urology, Istanbul ($n = 17$), Koç University School of Medicine Department of Urology, Istanbul ($n = 13$), and Istanbul University School of Medicine Department of Urology, Istanbul ($n = 5$)) were from Turkey and there were two center from Italy [Università Vita-Salute San Raffaele, Division of Experimental Oncology/Unit of Urology ($n = 4$) and Department of Urology Foundation IRCCS Ca' Granda Ospedale Maggiore Policlinico ($n = 5$)]. There were also single centers from China [The First Affiliated Hospital of Guangzhou Medical University, Guangzhou ($n = 250$)], Greece [University of Patras School of Medicine Department of Urology, Patras ($n = 38$)], and Bulgaria [Military Medical Academy, Department of Urology and Nephrology, Sofia ($n = 22$)]. Among the patients, 223 of them were from European centers whereas 250 patients were from China.

The recorded data included patient demographics, preoperative symptoms and history of exposure to Covid-19. Also data related to presence of urinary stones, type of the intervention, emergency status of the intervention together with if there is any alteration in the type of intervention related to Covid-19 was questioned. The type of the tests during preoperative anesthesiology assessment together with their results were recorded. The method of anesthesia for each intervention was recorded and any alteration in the anesthesia method related to Covid-19 was also questioned. Further information on follow-up of the patients in terms of both stone disease related status and Covid-19 related status was also collected.

The primary end point of the study was to collect information on the type of the stone related conditions, management strategies, anesthesiologic evaluation, anesthesia methods, and any alterations related to COVID-19 pandemic. The secondary end point was to determine if there is any difference in practice patterns between the European centers and Chinese center which would indicate a time related alteration in practice patterns.

Statistics

The Statistical analysis was performed using the IBM Statistical Package for the Social Sciences version 20.0 (IBM SPSS Statistics for Windows, Version 20.0. Armonk, NY, USA) The normal distribution of the continuous variables was tested using the Kolmogorov–Smirnov test. The data was mainly presented as descriptive statistics. To evaluate the effect of time on practice patterns, Receiver Observer Characteristics (ROC) analysis was performed. The patients

were grouped with respect to the cut-off date from the observation of the first case in a country. The chi-squared test was used to compare categorical variables, and Student’s *t*-test was applied to compare continuous variables among groups. A *p*-value < 0.05 was accepted as statistically significant.

Results

The main age of the population was 51.4 ± 14.1 years and mean days from the report of the first case in the particular country to the stone related intervention was 35.5 ± 24.2 days. Regarding gender, 296 (62.6%) of the patients were males and 177 (37.4%) of the patients were females. Suspicious history of exposure to COVID-19 (+) patients was not present in any of the patients and no symptoms were present in 468 (98.9%) of the patients. During first presentation fever was positive in three patients, myalgia was positive in one patient and fatigue with fever was present in one patient. Positive test result related to COVID-19 was not reported in any of these symptomatic patients. The demographic and stone disease related data of the entire population is summarized in Table 1.

Kidney stone was the most common stone related situation (38.5%) while ureteral stone was present in 23.9% of the patients. Multiple stones located both in kidney and ureter was also present 21.9% of the cases and obstructive pyelonephritis was present in 9.8% of the patients. An emergency intervention was performed in 109 (23%) patients and the most common procedure performed was ureteroscopic stone extraction (34.5%). Any alteration in the choice of stone related procedure was reported in 33 (7%) of the patients. The data on location of stones in the collecting system and preoperative stone related clinical conditions together with the performed interventions is summarized in Table 2.

During the preoperative anesthesia evaluation, additional testing was performed in 282 (59.6%) patients. The most commonly performed additional test was computerized tomography (CT) scan of the chest and was performed in

Table 1 The demographic and stone disease related data of the entire population

| Parameter | Outcome |
|---|-------------|
| Mean age ± SD (years) | 51.4 ± 14.1 |
| Mean days to intervention ± SD (days) | 35.5 ± 24.2 |
| Preoperative COVID-19 related symptom, <i>n</i> (%) | |
| No symptom | 468 (98.9) |
| Fever | 3 (0.6%) |
| Myalgia | 1 (0.2%) |
| Fatigue and fever | 1 (0.2%) |
| Suspicious exposure to COVID-19, <i>n</i> (%) | 0 (0%) |

Table 2 The stone related situation and the interventions of the entire population

| Parameter | Outcome <i>n</i> (%) |
|---|----------------------|
| Stone related situation <i>n</i> (%) | <i>N</i> = 473 |
| Kidney stone | 182 (38.5) |
| Ureter stone | 113 (23.9) |
| Kidney and ureter stone | 104 (21.9) |
| Obstructed pyelonephritis | 46 (9.8) |
| Previously placed JJ stent | 28 (5.9) |
| Emergency intervention <i>n</i> (%) | <i>N</i> = 473 |
| Yes | 109 (23) |
| No | 364 (77) |
| Type of intervention | <i>N</i> = 460 |
| Nephrostomy placement | 12 (2.6) |
| JJ stent insertion | 82 (17.8) |
| Ureteroscopic stone extraction | 163 (35.4) |
| Retrograde intrarenal surgery | 26 (5.7) |
| Percutaneous nephrolithotomy | 139 (30.2) |
| Endoscopy Combined intrarenal surgery | 9 (2) |
| JJ stent extraction (auxiliary procedure) | 28 (6.1) |
| Laparoscopic ureterolithotomy | – |
| Open surgery | 1 (0.2) |
| SWL | – |
| Altered management due to COVID-19 | <i>N</i> = 473 |
| Yes | 33 (7) |
| No | 440 (93) |

268 (56.7%) patients. PCR from the nasopharyngeal swab was performed in 31 (6.6%) patients and rapid antigen/antibody testing was performed in only one patient. A positive test result in any of the tests was not reported in any of the patients. Regarding the anesthesia methods, general anesthesia either by intra-tracheal general anesthesia or laryngeal mask airway was applied in 337 (71.2%) patients. Spinal/epidural anesthesia was performed in 76 (16.1%) and topical/local anesthesia was performed in 52 (11%) patients. Any alteration in the method of anesthesia was recorded in 45 (9.5%) of the patients. The data related to anesthesia evaluation and practice is summarized in Table 3.

To evaluate the effect of time (from the first reported COVID-19 case to stone related intervention) on the anesthesia evaluation, ROC analysis was performed. A cut-off value of 21 days (sensitivity: 90.8% and specificity:82.2%) was detected for performing an additional diagnostic test for COVID-19 preoperatively. Additional tests were performed preoperatively in 14.2% of the patients operated within ≤ 21 days and in 88.3% of the patients operated after 21 days (*p* < 0.0001). PCR from nasopharynx swabs was performed in 3.8% and 8.3% of the patients in the ≤ 21 days and > 21 days groups respectively and the difference was not statistically significant (*p* = 0.059). However, the rate of

Table 3 The data related to anesthesia evaluation and practice of the entire population

| Parameter | Outcome n(%) |
|--|--------------|
| Additional testing during anesthesia evaluation n(%) | 282 (59.6) |
| PCR test from nasopharyngeal swab | 31 (6.6) |
| Rapid antigen/antibody test | 1 (0.2) |
| Thorax CT scan | 268 (56.7) |
| Anesthesia method n(%) | |
| Topical/local anesthesia | 52 (11) |
| Spinal/epidural anesthesia | 76 (16.1%) |
| Laryngeal mask airway | 167 (35.3) |
| Intra-tracheal intubation | 170 (35.9) |
| Sedation | 8 (1.7) |
| Alteration in anesthesia method n(%) | |
| Yes | 45 (9.5) |
| No | 428 (90.5) |

chest CT scan was significantly higher in the latter group (84.5% vs. 12.6%, $p < 0.0001$). The rates of alterations in the anesthesia method were also similar (11.5% vs. 8.3%, $p = 0.263$). The rates of emergency procedures were 35% vs. 15.5% in the ≤ 21 days and > 21 days groups respectively and the difference was statistically significant ($p < 0.001$). The rates of alteration of stone related procedures were similar (7.1% vs. 6.9%, $p = 1.000$). The results are summarized in Fig. 1.

The cohorts from European centers and Chinese center were also evaluated separately. As expected, the mean time to stone related intervention was significantly longer in the Chinese cohort (53.3 ± 16.8 days vs. 15.5 ± 13.2 days, $p < 0.0001$). During preoperative evaluation, all of the

patients in the Chinese cohort underwent chest CT and any other testing was not performed. Also no alterations in method of anesthesia or stone related intervention was reported related to COVID-19 pandemic.

However, in the European cohort, chest CT was performed in 18 (8.1%) and PCR from nasopharyngeal swabs was performed in 31 (13.9%) of the 223 patients. Alteration in the anesthesia method and stone related interventions were reported in 32 (14.3%) and 33 (14.8%) patients respectively. Additionally, the alterations in the European cohort became prominent with the cut-off value of 21 days. Additional testing during preoperative anesthesia evaluation was performed in 24 of the 58 (41.4%) patients and 8 of the 165 patients (4.8%) in the > 21 days and ≤ 21 days groups respectively ($p < 0.0001$). Similarly, the rate of alteration in the anesthesia method was significantly higher in the > 21 days group (41.4% vs. 12.7%, $p < 0.0001$) and rate of alteration in the stone related procedure was also significantly higher in the > 21 days group (34.5% vs. 7.9%, $p < 0.0001$). Results are summarized in Fig. 2. In the European cohort the rate of the patients underwent an emergency intervention increased significantly after the cut-off value of 21 days (38.8% vs. 76.6%, $p < 0.0001$). Also regarding the applied anesthesia method, 53.5% of the patients underwent topical or regional anesthesia in the > 21 days group, while the rate was 41.2% among patients operated in ≤ 21 days group ($p = 0.0001$).

In the European cohort the type of interventions also shifted to more conservative options. In the ≤ 21 days group, the rate of definitive surgical options such as ureteroscopic stone extraction, retrograde intrarenal surgery, and percutaneous nephrolithotomy was 61.8% and rate of conservative approaches such as nephrostomy placement, JJ stent placement or JJ stent extraction as an ancillary procedure

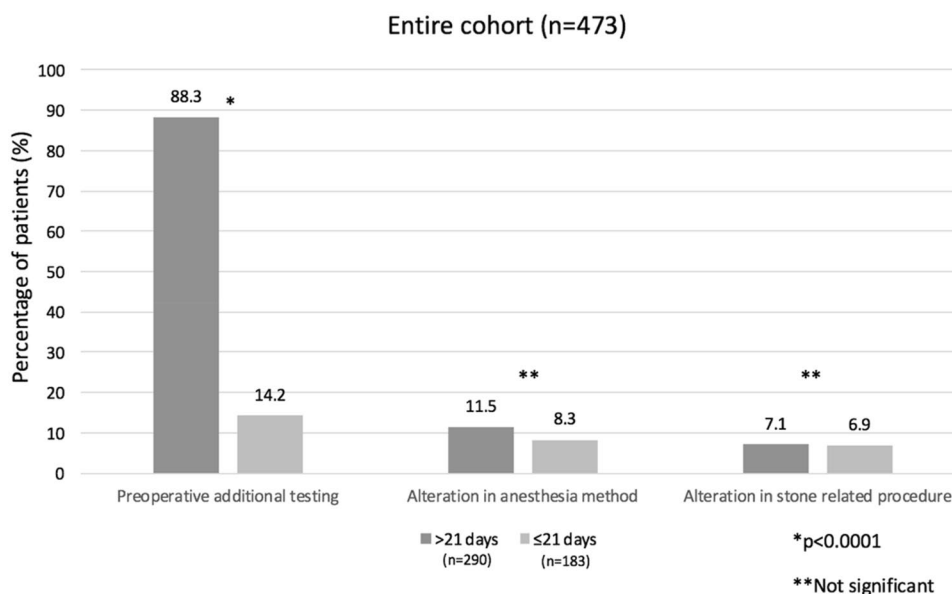
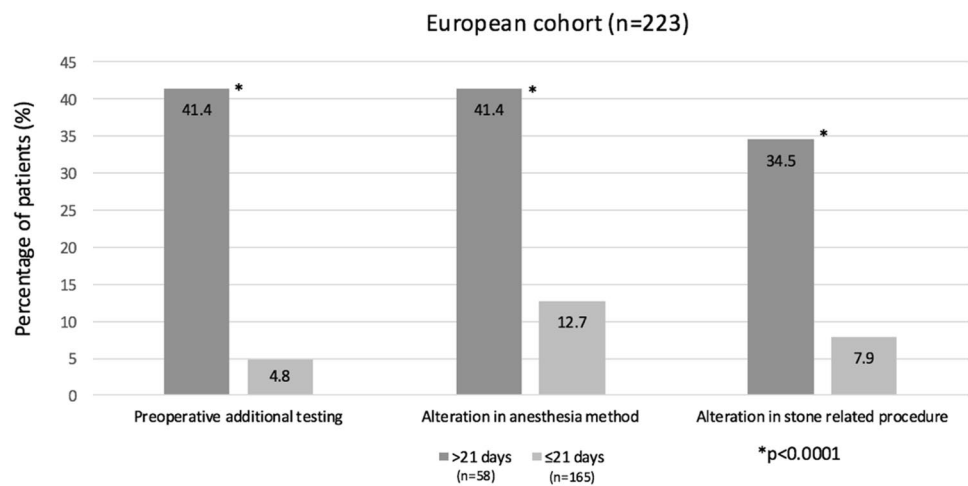
Fig. 1 Summary of preoperative additional testing, alteration in anesthesia method and stone related procedures in the entire cohort

Fig. 2 Summary of preoperative additional testing, alteration in anesthesia method and stone related procedures in the European cohort



was 38.2%. However, in the > 21 days group, there was a significantly higher tendency for conservative or ancillary procedures (81%) compared to definitive treatments (19%) ($p < 0.0001$). This shifting to more conservative approaches was parallel with higher rate of patient admissions for emergent conditions after 21 days. In the ≤ 21 days group, kidney stones were the leading clinical condition (37.6%) with previously scheduled definitive treatments. However, the leading cause of hospital admissions was obstructive pyelonephritis in 37.9% of the cases in > 21 days group, which required nephrostomy tube or JJ stent placement.

During the follow up two patients developed fever post-operatively. The nasopharyngeal swab PCR and chest CT studies revealed COVID-19 (+) results. Elongated hospitalization related to stone disease was observed in 15 (3.2%) of the patients.

Discussion

As a pulmonary infection causing lethal conditions, COVID-19 pandemic affected not only the infected patients but its consequences has also altered the entire health care system. While the cases with an elective surgery plan were postponed in the majority of the centers; emergency cases together with oncological surgeries are advised to be performed with precautions [6]. Among other non-oncological urological disorders, as a common pathology stone disease carries the risk of potential to become an emergency condition and also obstructing calculi may cause detrimental effects on kidney functions if not treated on time with an appropriate management plan. Therefore, successful removal of such stones on time is highly crucial.

Regarding the unexpected and underestimated involvement of the world as well as modern medicine with COVID-19 pandemic in a truly unprepared status; many questions arose with respect to preoperative patient evaluation, as there

was no standard approach and/or recommendations during problematic days. For this reason, surgeons were obliged to make their own decisions during the preoperative evaluation at the beginning of the pandemic and then began to act according to internal regulations of their institutions and internal guidelines of their countries. Related with this issue, although some national and international organizations began to report their recommendations based on their limited experience obtained; there is still no consensus between such organizations to give reliable, established guidance to practicing surgeons [8].

In addition to the patient evaluation, challenges are being faced also during preoperative anesthesia preparation process in this controversial situation. Aside from the cases with a positive COVID-19 diagnosis, the asymptomatic patients or the ones within the incubation period may cause transmission of the viral infection to the healthcare professionals and other patients. On the other hand again, due to the direct exposure to the airway of the patients, anesthesiologists are at great risk for being infected during interventions [9]. In a recent study, Lie et al. stated that regional anesthesia on this aspect could provide a successful anesthesia for the patient and be helpful in the protection for the anesthesiology team [10]. However, Baig et al. also reported that COVID-19 virus can involve the central nervous system [11] and viral transmission could be possible during regional anesthesia as well. Therefore, it is obvious that relying on the safety of regional anesthesia does not provide complete protection for the health care professionals and principles for optimal preoperative evaluation during the pandemic need to be determined.

The two prominent tests performed to screen COVID-19 virus during preoperative evaluation are PCR from a nasopharyngeal swab and chest CT scan [12, 13]. While some guidelines suggest PCR testing in suspicious cases, the guidelines for sections with a high likelihood of virus load, such as otolaryngology, suggest that it can be performed

in all patients [14]. The rate of PCR testing was 6.6% in our cohort without any positive result preoperatively. Chest CT was commonly applied in preoperative evaluation during the pandemic due to the fact that it can demonstrate relevant objective, indicative changes in the affected lungs even in the PCR false-negative patients [13]. In our cohort, a CT scan was applied in 268 (56.7%) patients in the absence of a positive result detected by any means. Among these 268 patients, 250 of them were operated in China and this result is concordant with the result of a recent meta-analysis indicating the low prevalence of screening with chest CT outside of China [15]. Also Chinese national guidelines advocate chest CT examination in every admitted patient for surgery [16]. However, taking the reported respective sensitivity and specificity of chest CT as 94% and 37% into account, some long term detrimental consequences of radiation exposure necessitates its application with caution as well [15]. In our cohort two patients without a preoperative adequate screening were diagnosed postoperatively with positive test results for COVID-19 in both PCR and CT scan evaluations.

The Chinese perspective for preoperative screening was performing a CT scan in all patients without PCR testing. Interestingly, neither anesthesia method, nor treatment strategy was altered in the Chinese center. This could be due to the fact that the Chinese authorities had a better COVID-19 control or the recommendations on this aspect were published a while later from the beginning of the COVID-19 in China [17]. In our trial, we also investigated the change in practice patterns related to time and the ROC analysis revealed 21 days as the cut-off. Among patients operated in Europe the rate of additional testing significantly increased after 21 days (4.8% vs. 41.4%). Therefore we believe that it took at least 21 days for the hospital regulations to be evolved and surgeons to get adapted to the pandemic situation. This is also in accordance with the increased rate of emergency procedures (38.8% vs. 76.6%) and decreased rate of general anesthesia (58.8% vs. 46.5%) after 21 days in the European cohort.

In the entire cohort, the rate of alteration in the stone related interventions was found to be only 7%. However, this rate was also higher in European cohort (14.8%) and significantly increased from 7.9 to 34.5% after 21 days. Also, there was a tendency to perform more conservative approaches such as nephrostomy tube or JJ stent placement rather than definitive treatment options namely ureterorenoscopy or percutaneous nephrolithotomy in the > 21 days group. Therefore, our findings indicate well that after 21 days of time period following the diagnosis of first case, the rate of testing performed for preoperative screening, number of cases treated in an emergency basis and also the alterations in type of interventions were all increased. While conservative approaches became preferred alternatives in the same period, number of cases treated under general anesthesia did

decrease to a certain extent. This shift after 21 days may be explained by increased COVID-19 workload in the urology departments of hospitals and also avoidance of definitive treatment options requiring general anesthesia and mechanical ventilation.

Conclusions

The preoperative evaluation prior to the management of urinary stones has been found to be affected well by the COVID-19 pandemic. Significant alterations in preferred anesthesia methods and stone related interventions were also noted. However, the optimal methods for preoperative evaluation are still unknown and there is discordance between different centers. It took 21 days for hospitals and surgeons to adapt and develop new strategies for preoperative evaluation and management of stones.

Funding There is no funding for the study.

Compliance with ethical standards

Conflict of interest None of the authors have any conflict of interest.

Ethical approval The study was approved by Medipol University Ethics Committee (approval number: 311).

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