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Surgical Management of Urolithiasis in France from 2016 to 2022: Epidemiological Data from the National PMSI Database

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Abstract

Purpose

The incidence of lithiasis is increasing in France; in the general population, the prevalence is close to 10%. The advent of minimally invasive endoscopic techniques has profoundly changed surgical management in recent decades. According to the guidelines, the choice among methods, including Extracorporeal Shock Wave Lithotripsy (ESWL), Ureteroscopy (URS), and Percutaneous Nephrolithotomy (PCNL), remains open. The objective of this study is to describe practices in recent years.

Methods

Using the French national database of the Program for the Medicalization of Information Systems (PMSI), we collected data from 2016 to 2022 on the number of interventions using the three methods, their distribution by healthcare facility type (public, private, university hospitals), the average length of stay, and the epidemiological characteristics of patients treated for upper urinary tract stones.

Results

Between 2016 and 2022 in France, the total number of procedures for upper urinary tract stones increased by 12%, with a 37% increase in URS procedures. ESWL procedures decreased by 36%, and PCNL procedures by 5%. The number of procedures steadily increased, except in 2020. The male-to-female sex ratio was close to 2:1, except for PCNL, where it was 1:1. Age profiles are similar across techniques, with a larger proportion of patients aged 51 to 60. 75% of ESWL and 70% of ureteroscopies are performed in private hospitals, 60% of PCNL procedures in public hospitals, and nearly 50% in university hospitals. The average length of stay decreased by 56% for ESWL, 32% for URS, and 22% for PCNL, with the shortest durations in private facilities.

Conclusion

The total number of procedures for treating upper urinary tract stones has been increasing in France over the years, with a growing proportion of URS procedures at the expense of ESWL and increasingly shorter hospital stays. These results should be compared with medico-economic data to better guide care provision.

Introduction

Upper urinary tract (UUT) stones are increasing steadily in developed countries [1] The prevalence of urolithiasis in the general population of France is estimated at 10% [2]. Renal colic accounts for 1 to 2% of emergency department visits, with an estimated 170,000 visits per year [3].

The reasons for the increased incidence of UUT stones are multiple: changes in dietary habits, health conditions, environmental factors, and the prevalence of conditions that predispose to stone formation (obesity, diabetes, metabolic syndrome).

Although some UUT stones resolve on their own and 50% of patients with UUT will have only one episode during their lifetime, many require surgical intervention, and 10% will experience frequent recurrences.

The surgical procedures for treating upper tract stones include extracorporeal shockwave lithotripsy (ESWL), ureteroscopy (URS), percutaneous nephrolithotomy (PCNL), and open surgery (OS). Surgical indications depend on stone size, location, composition, and clinical context, with some overlap in possible surgical techniques. [4] Open surgery for UUT stones has been completely abandoned in recent years in France, with only a few hundred interventions per year. Meanwhile, improvements in laser technology have been a game-changer for URS treatment, and the management of stones is evolving accordingly. There is limited data to monitor the evolution of practice.

In France, all procedures performed during hospitalization must be reported and recorded in the database of the “Programme de Médicalisation des Systèmes d’Information” (PMSI). This enables reimbursement for establishments and ensures an exhaustive collection of all surgical interventions performed on French territory.

Our study aims to examine surgical management practices for stone disease in France from 2016 to 2022.

Materials and Methods

Data collection

All hospitalizations in France between January 1st, 2016, and December 31st, 2022, with one of the codes from the Classification Communes des Actes Médicaux (CCAM) for the three main surgical procedures for Upper Urinary Tract (UUT) stones (ESWL, URS, and PCNL) were extracted retrospectively from the PMSI. We restricted the population to adults 18 years and older, with no upper age limit.

We used additional filters to diagnose UUT stone as the primary hospitalization diagnosis, using the corresponding codes from the International Classification of Diseases, 10th edition (ICD-10).

Through the national database, we obtained data including the number of procedures, patient age and sex, and the average Length of Stay (LOS) in days.

We also studied the distribution of procedures across the different medical establishments: University Hospital Centers, Public Hospital Centers, Private Health Establishments of Collective Interest (PHECI), and Private Hospitals.

Technical procedure

The three available procedures for stone management were identified with respective codes for surgical and interventional procedures from CCAM:

- ESWL had four codes: JANM001/JANM002 for ESWL of the kidney with radiological guidance or with ultrasound guidance, and JANM001/JANM002 for ESWL of the ureter with radiological guidance or with ultrasound guidance.
- PCNL had six codes: JAGF001 for multiple kidney stones, JAGF002 for a simple kidney stone, JAGF003 for a staghorn or complex renal stone, and three codes (JAGD001, JAGD002, and JANJ002) when the procedure was performed with an existing nephrostomy.
- URS had five codes based on the location of the stone: JCGE001 for the pelvic ureter, JCGE005 for the iliac ureter, JCGE006 for the lumbar ureter, JANE002 for the renal pelvis, and JANE005 for the lower calyx.

Results

Between 2016 and 2022, 783,955 procedures were performed in French hospitals for UUT stones. URS accounted for 73,91%, ESWL for 25,16%, and PCNL for 0,94% of the procedures.

During this period, the total number of procedures increased by 12,19%. This increase has been consistent over the years, except in 2020, when the number of procedures decreased by 5,69% (Fig. 1).

In detail, the number of URS increased by 37,14%, decreased by 35,99%, and decreased by 4,82% for ESWL and PCNL, respectively.

The patient profile by age and sex didn’t differ between 2016 and 2022. We summarized each surgical technique's patient profile in 2022 in Table 1. The sex ratio (M/F) was 1,94 for ESWL, and 1,78 for URS, whereas it was 1,04 for PCNL. Most patients were over 50 across the three procedures, with the largest proportion in the 51- to 60-year-old age group.

Table 1: Patient’s demographic profile in 2022 for ESWL, PCNL, and URS

	ESWL		PCNL		URS	
Mean age (median)	55.4	(56)	53.6	(55)	56.2	(57)
Age groups, n (%)						
< 21	253	(1)	27	(3)	803	(1)
21 to 30	937	(6)	65	(7)	3 791	(6)
31to 40	1 995	(12)	117	(12)	7 654	(12)
41 to 50	3 074	(18)	180	(18)	11 214	(17)
51 to 60	4 109	(24)	231	(23)	15 185	(23)
61 to 70	3 862	(23)	217	(22)	14 750	(22)
> 70	2 729	(16)	160	(16)	13 105	(20)
Sex, n (%)						
Men	11 263	(66)	507	(51)	42 590	(64)
Women	5 689	(34)	490	(49)	23 898	(36)
Unknown	7	(0)	0	(0)	14	(0)

In Table 2, we reported the distribution of UUT stone surgeries by type of medical establishment from 2016 to 2022. Almost ¾ of ESWLs were performed in private hospitals, and this proportion has tended to decline over time (78% in 2016 vs. 73% in 2022).

For URS, 70% of procedures were performed in private hospitals, and this proportion did not change over the study period.

Most PCNLs were performed in public hospitals, especially UHCs, and this share increased over time (55% in 2016, including 43% in UHCs, vs 62% in 2022, including 46% in UHCs).

Table 2: Distribution of surgeries by type of establishment during the years 2016-2022

	2016		2022	
ESWL				
Total public hospital	7845	22%	6 254	27%
UHC	3 545	10%	3 798	12%
HC	4 300	12%	3 456	15%
Private hospital	24 942	71%	15 031	67%
PHECI	2 526	7%	1 310	6%
PCNL				
Total public hospital	624	55%	676	62%
UHC	486	43%	504	46%
HC	138	12%	172	16%
Private hospital	433	38%	321	30%
PHECI	86	7%	89	8%
URS				
Total public hospital	21 175	31%	28 930	30%
UHC	8 061	12%	8 722	9%
HC	13 114	19%	20 208	21%
Private hospital	42 056	61%	57 088	60%
PHECI	6 018	8%	8 992	10%

PHECI = Private Health Establishments of collective interest, UHC = University Hospital Center, HC = Hospital Center

Between 2016 and 2022, the average LOS for ESWL across all French hospitals decreased by 56%. Likewise, LOS decreased by 32% for URS and 22% for PCNL.

In Figure 2, we showed the evolution of LOS for the three surgical procedures by hospital type. The shortest hospital stays were observed in private hospitals.

Discussion

This study highlighted a significant increase in the number of interventions for lithiasis in France between 2016 and 2022, from 105,264 to 118,098, representing a 12.19% increase. We also showed an evident decline in ESWL in favor of ureteroscopy and a slight decrease in PCNL.

This is the first study to comprehensively address the surgical management of lithiasis over this period. It is also the first study in France to examine the distribution by hospital type, providing a clear understanding of practices across the territory. Indeed, the use of the PMSI database enabled us to capture the entire adult French population treated for upper urinary tract stones.

The increase in interventions for upper urinary tract stones in France continues a trend observed in developed countries since the 1990s. A systematic review by Geraghty et al. covering 1996–2016, involving six developed countries (UK, USA, New Zealand, Australia, Canada, and Brazil), found an increase in the total number of interventions, with a significant rise in the proportion of ureteroscopies compared with ESWL, PCNL, and open surgeries [5]. More recently, Turney et al. examined hospitalizations and the total number of interventions for upper urinary tract stones in Germany, France, and England between 2010 and 2019. The conclusions are similar, with increases in hospitalizations and interventions and a rise in the proportion of ureteroscopies compared with ESWL [6].

This increase primarily reflects the rising prevalence of lithiasis [1]. It seems to be linked to changes in dietary habits, sanitation, environmental factors, and the prevalence of conditions that predispose to lithiasis (obesity, diabetes, metabolic syndrome) [7,8].

Regarding the patient profile, our study confirmed the peak incidence of lithiasis described between the fourth and seventh decades of life, with a sex ratio of approximately 2 [2]. Daudon et al. reported that stone composition varies significantly by sex and age. Thus, infectious stones predominate at the extremes of life; calcium-dependent stones (weddellite) are more common in young adults; oxalate-dependent stones (whewellite) are most frequent between 30 and 70 years; and uric acid stones are more common after age 60. There are significant quantitative differences between the sexes. In men aged 20 to 30, weddellite predominates (40.6% of stones), whereas it accounts for only 18.8% of stones in women of the same age group. In women, there is a higher proportion of carbapatite and struvite stones [9]. These variations in stone composition were not captured by the PMSI, and we did not cross-stratify sex ratios by age group, which may explain the sex ratio close to 1 observed in PCNL (percutaneous nephrolithotomy) in our study.

The significant increase in surgical interventions, with a greater proportion of invasive procedures (URS vs. ESWL), raises several questions for patients with upper urinary tract stones. On the one hand, there is the issue of overtreatment: should we favor medical treatment, which sometimes allows spontaneous stone expulsion, thereby avoiding surgical risks but at the cost of potential pain and an increased risk of infection? On the other hand, if surgical management is chosen, should we prioritize URS, which offers better results in terms of Stone Free Rate (SFR) but carries more complications, or ESWL, which carries a higher risk of reintervention but fewer complications and an identical SFR at three months [10]? French

and European guidelines do not resolve these issues, as they do not recommend ureteroscopy as first-line treatment and allow for Medical Expulsive Therapy (MET) for ureteral stones of 5 to 10 mm [4,11].

The increase in the proportion of URS is linked to the development of new technologies, including new lasers such as the fibered Thulium, which seems to offer better results in terms of SFR [12], and to improvements in ureteroscope performance, including single-use ureteroscopes [13]. Moreover, the results of URS are most often immediate, unlike ESWL, which more often requires multiple interventions and has delayed effects. Finally, from a medico-economic standpoint, studies tend to favor the cost-effectiveness of URS compared to ESWL [14].

Of course, the reduction in the number of interventions in 2020 was due to the COVID-19 pandemic. National academic societies encouraged rescheduling or close monitoring of all non-urgent, non-threatening upper urinary tract stone cases during the pandemic [15]. However, treatment delays during the crisis had consequences, including an increase in the rate of complicated stones [16].

We found that a clear majority, over 70%, of ureteroscopy and ESWL procedures in France are performed in private establishments. This pattern can be explained, on the one hand, by the payment method for URS and ESWL procedures. Indeed, these are well-reimbursed under fee-for-service billing, which may encourage more frequent proposals for these interventions, which are considered profitable. Moreover, as we found, these procedures are performed mostly on an outpatient basis, with a steady reduction in length of stay over the years. Finally, these interventions are associated with few complications. All of this explains why these interventions are well-suited for the private sector. Turney et al. compared the length of stay for ESWL, PCNL, and URS in France, England, and Germany between 2010 and 2019, finding the shortest lengths of stay for each procedure in France [6]. Let us recall that, as of December 31, 2021, the French hospital sector includes 2,987 healthcare establishments: 1,344 public hospitals, 982 private clinics, and 661 private non-profit establishments. Regarding the activity of medicine, surgery, and obstetrics, public establishments provide 66% of the beds and places, private for-profit establishments 25%, and private non-profit establishments 9% [17].

Conversely, we found that a majority of PCNL procedures were performed in university hospitals, with a growing trend over the years. PCNL remains the most invasive procedure and is increasingly reserved for stones inaccessible via URS, typically for rare, complex cases referred to expert centers. However, numerous studies have evaluated URS for large renal stones (> 2 cm), showing good effectiveness in terms of Stone-Free Rate, with few complications [18]. Thus, we can predict a continued decline in PCNL in the future, as new technologies, such as the thulium fiber laser, which is particularly effective in this indication, become available on the market [19].

The main limitation of this study concerns the data collection method. Indeed, using the PMSI database allows broad inclusion and excellent external validity, but the data primarily serve a medico-economic purpose, supporting funding for healthcare establishments. The diversity of codes, their complexity, and the reimbursement differences they generate are sources of bias. Georgescu described several types of

over-coding, ranging from optimizing diagnoses and treatments to fabricating comorbidities to improve reimbursement [20].

One limitation worth noting is the lack of detailed information on patients' comorbidities and perioperative risk profiles. These factors are known to influence the selection of endourological procedures, perioperative management, postoperative complications, and hospital length of stay, particularly among patients requiring complex stone surgery. Consequently, they may affect referral patterns and the distribution of procedures across centers [21,22].

Furthermore, the existing codes for surgical interventions for upper urinary tract stones indicate the stone's location but not its size. Yet French guidelines primarily base treatment decisions on stone size (18).

Our study provided an overview of surgical practices in France for managing upper urinary tract stones. The objective is to improve the quality of patient care, which requires individualized management. Further investigations are needed to assess patient comorbidities, postoperative complications, risk factors, and re-treatment rates after each surgery.

Conclusion

Our study examines the increase in the number of surgical procedures for UUT stones in France from 2016 to 2022. We identified three main trends: a significant decline in ESWL procedures in favor of URS, a steady reduction in hospital stays, and a shift in the surgical management of lithiasis toward the private sector.

This study suggests that URS activity will continue to increase in France in the coming years. Therefore, improvements in technology to optimize stone treatment, better anticipate and reduce postoperative complications, and adapt healthcare facilities' capacity to manage stones can be expected, along with enhanced training for healthcare professionals in endourology to meet the demand.

Declarations

Author's Contribution

C Ciolek: Project development, Data collection and management, Data analysis, Manuscript writing

Charles Mazeaud: Project development, Data analysis, Manuscript editing

JL Gaudry and D Koffi: Data collection and management

A Blondeau, J Hubert, P Eschwege: Manuscript editing

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Figures

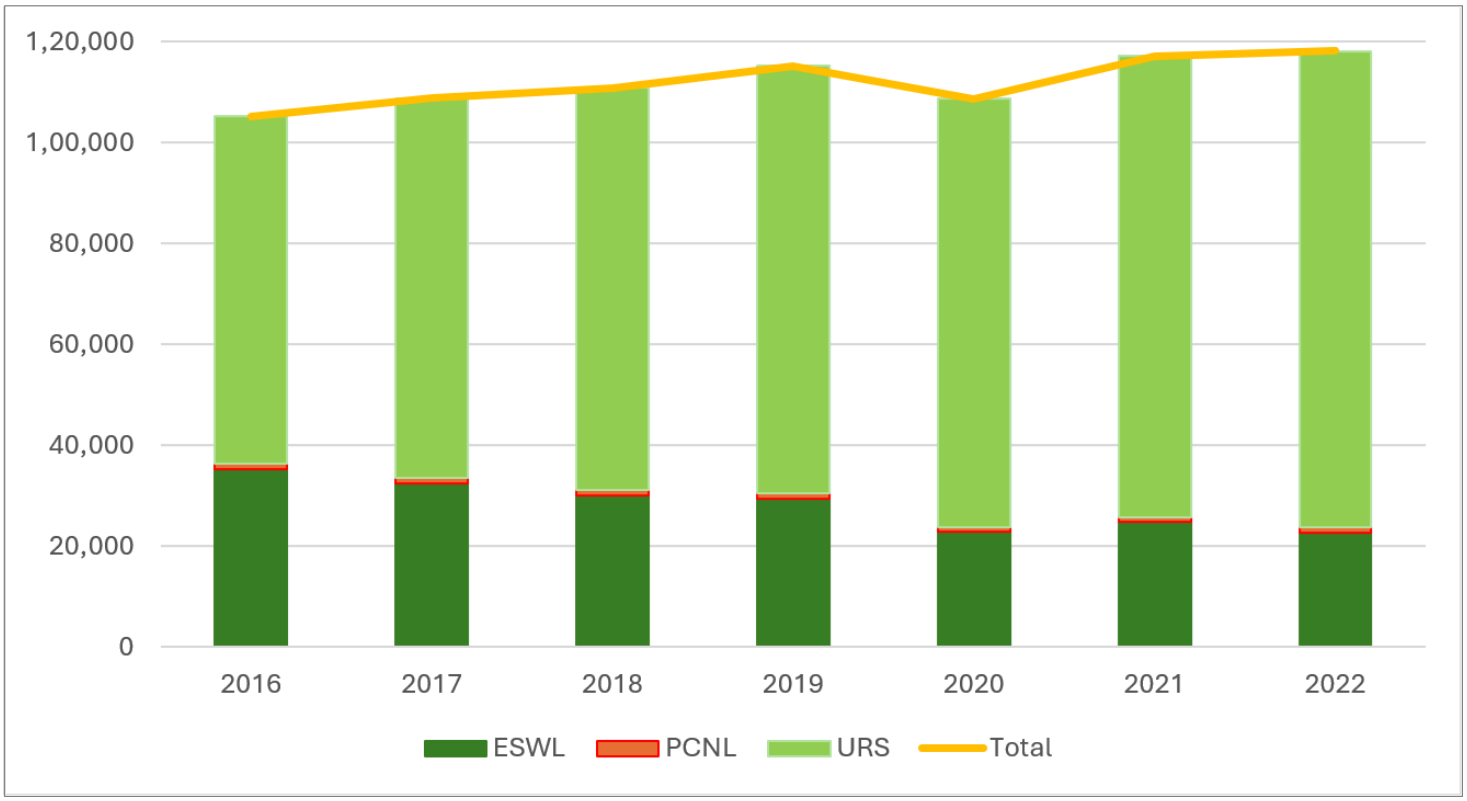
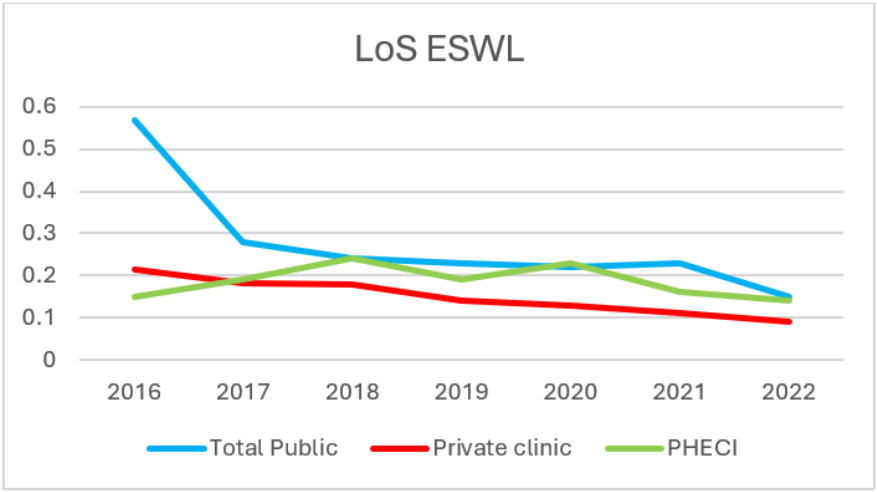
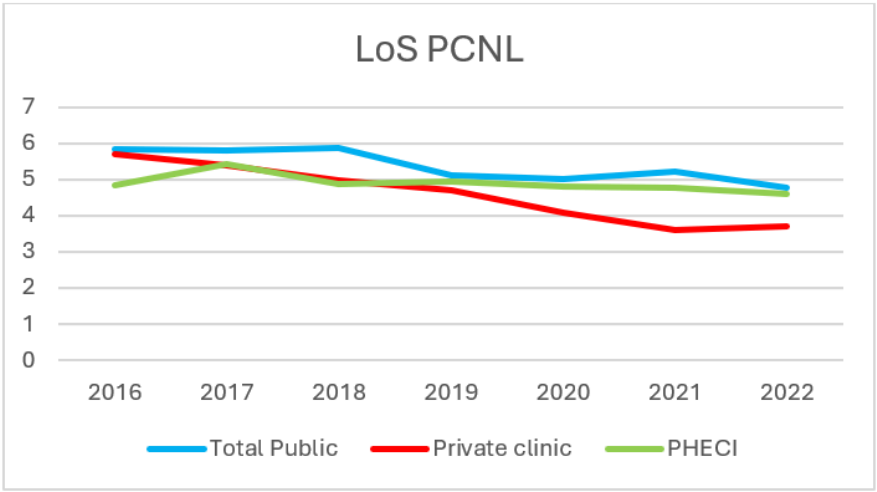


Figure 1

Number of UUT procedures in France between 2016 and 2022





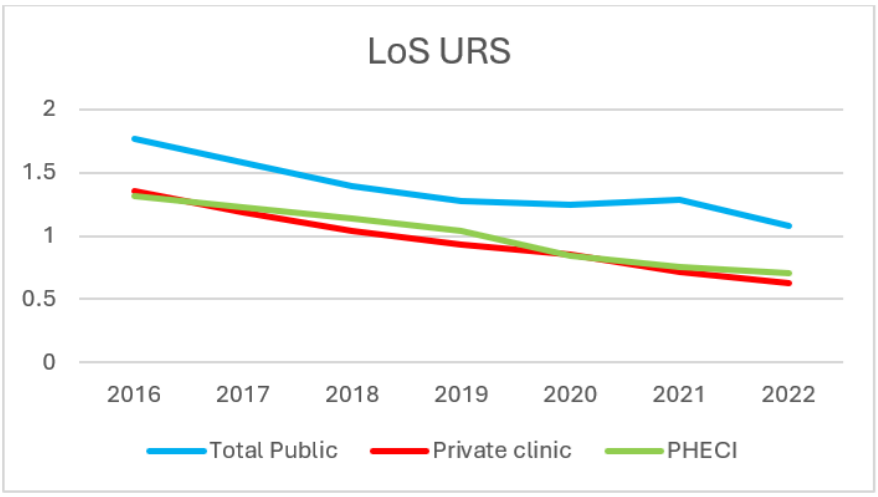


Figure 2

Evolution of average Length of Stay for ESWL, PCNL, and URS from 2016 to 2022.

LOS (day): length of stay, PHECI = Private Health Establishments of collective interest