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Lessons Learnt (Clinical Outcomes and Cost Savings) from Virtual Stone Clinic and Their Application in the Era Post-COVID-19: Prospective Outcomes over a 6-Year Period from a University Teaching Hospital

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Abstract

Introduction: We introduced a nurse-led telephone-based virtual stone clinic (VSC) follow-up for the surveillance of patients with asymptomatic renal calculi or those at a high risk of recurrent kidney stone disease (KSD). The aim of this study was to look at the outcomes of VSC and its role in the post-COVID era.
Methods: Prospective outcomes audit was done for all patients referred to the VSC for a 6-year period (March 2014–April 2020). VSC is led by specialist stone nurses for on-going surveillance of KSD patients.
Results: A total of 290 patients were seen (468 individual appointments; 1.6 ± 1.0 per patient), with a mean age of 57.0 ± 15.8 years (range: 17–92) and a men–women ratio of 3:2. The referral was for surveillance of asymptomatic small renal stones (230, 79.3%); history of recurrent stone disease (45, 15.5%); solitary kidneys (5, 1.7%); cystine stones; young age; and other conditions (10, 3.4%). The mean stone size was 5.0 ± 2.7 mm, followed up with kidney, ureter, and bladder radiograph (225, 77.6%) and ultrasound scan (USS) (65, 22.4%), for median duration of 12 months (range: 3–24 months). At the end, 132 patients (45.6%) remained in VSC, 106 (36.6%) were discharged, 47 (16.2%) returned to face-to-face clinic or treatment, and 5 (1.7%) had emergency admissions. Of 47 patients who returned, 23 (48.9%) developed new symptoms, 21 (44.6%) had stone growth, and 3 defaulted to face-to-face appointment. Thirty-five patients needed surgical intervention (URS-21, SWL-13, and PCNL-1) and 10 were managed conservatively. VSC reduced the cost per clinic appointment from £27.9 to £2 per patient (93% reduction), equating to a total saving of £12,006 for the study period.
Conclusion: Nurse-led VSC not only provided a safe follow-up but also allowed to substantially reduce the cost of treatment by allowing patients to be either discharged or return to a face-to-face clinic or surgical intervention if needed. Post-COVID, this model using telemedicine will have a much wider uptake and further help to optimize health care resources.

Keywords: virtual, stone, telephone, telemedicine, clinic

Introduction

Kidney stone disease (KSD) is a common condition with a reported prevalence of 10%–15% in Europe.[1,2] An increase in incidence is likely related to warm weather, increasing rates of obesity, type 2 diabetes mellitus, and a lithogenic diet.[3–6] As a result, the cost of managing KSD is rising, partly from the rise in number of KSDs diagnosed and partly because of a doubling of the annual number of stone procedures performed over the past decade.[1–3] Treatment of these stones includes ureteroscopy (URS), extracorporeal shock wave lithotripsy (SWL), and percutaneous nephrolithotomy (PCNL). The cost of KSD is now estimated to be more than the combined cost of prostate and bladder cancer.[7] Up to half of these patients will develop a recurrence of KSD within a time frame of 5–10 years.[8,9]

The incidence of asymptomatic renal calculi appears to be increasing, in part, from increased abdominal imaging where KSD is an incidental finding.[10] The conservative management of small asymptomatic renal calculi remains unclear because of paucity of evidence and is addressed in both American Urological Association (AUA) and European Association of Urology (EAU) guidelines[11,12] (Table 1). For a 5-year period, an estimated 48.5% will develop symptoms,

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Table 1. Comparison of American Urological Association and European Association of Urologists Guidance on Small Asymptomatic Renal Stone Management

Organization	*Guidance*	*Level of evidence*
AUA	Patients with asymptomatic nonobstructing caliceal stones may be offered active surveillance.	Conditional recommendation. Grade C evidence
EAU	Periodically follow-up conservatively managed renal stones, initially after 6 months, then annually. Symptoms and stone status (by ultrasonography, KUB, or CT) should be assessed.	Strong recommendation (LE:4)
	Active treatment should be offered for renal stones in cases of stone growth, *de novo* obstruction, associated infection, and pain.	Weak recommendation (LE:3)

AUA = American Urological Association; EAU = European Association of Urologists; KUB = kidney, ureter, and bladder radiograph; LE = level of evidence.

with approximately half of these having spontaneous passage.[13] A systematic review identified that rate of surgical intervention ranged from 7.1% to 26.6%, which was irrespective of the duration of surveillance.[14] Renal stones <5 mm and nonlower pole renal stones are most likely to result in development of symptoms.[15] EAU guidelines suggest that asymptomatic renal calculi <15 mm may be observed, while the AUA guidelines do not provide a size criteria. If renal calculi are observed, both groups recommend periodic assessment with imaging and intervening in a scenario of new pain, associated infection, or stone growth. The clinical and economic burden of providing a face-to-face surveillance service for asymptomatic KSD can impact on waiting times for assessment for other conditions including malignancies.

Telemedicine or telehealth is the use of telecommunication devices to facilitate health care interactions remotely.[16,17] These interactions can happen between clinicians and patients, and include the use of telephone, e-mail, or videoconferencing.[16,17] It is a burgeoning field that has a great potential for improving patient experience of care provided and reducing health care costs.[16] Telemedicine thus far has had a rather limited role in urology, with relatively few studies describing its use compared with some other specialities.[18] However, in light of the coronavirus disease-19 (COVID-19) pandemic of 2020, there is renewed interest in telemedicine.[19] As governments and health care systems have sought to reduce social contact to reduce the viral transmission, the rapid implementation of telemedicine has become necessary to maintain essential outpatient services.[20]

Six years ago, we introduced a nurse-led telephone-based virtual stone clinic (VSC) follow-up for the surveillance of patients with asymptomatic renal calculi or those at a high risk of recurrent KSD. The aim of this study was to look at the outcomes of VSC and its application for patients with kidney stones in the post-COVID era.

Materials and Methods

Prospective outcomes audit was done for all patients referred to the VSC at a single university teaching hospital for a 6-year period between March 2014 and April 2020. The VSC is a urology service led by specialist stone nurses, designed to monitor patients with small asymptomatic renal stones and those with a high risk of stone recurrence. High-risk patient groups were deemed to be those with recurrent stone disease, solitary kidneys, <25 years of age at diagnosis, cystine stones, and comorbidity predisposing to stone formation. Patients with large stones and multiple comorbidities who chose not to have surgical intervention were also included.

Patients were initially reviewed by a member of the specialist endourology stone team in a face-to-face clinic appointment. This included a minimum of basic stone screening at this time, and all were given a dietary advice sheet. The patients who fulfilled inclusion criteria were given an informed choice of further follow-up through the VSC. The follow-up was tailored to each individual case. The timing of follow-up was 3, 6, or 12 months depending on stone stability and risk factors involved. In the weeks before the appointment, interval imaging was performed at the most convenient timing and location for the patient. Imaging modality was kidney, ureter, and bladder radiograph (KUB) for radio-opaque stones and ultrasound scan (USS) of the urinary tract for radiolucent stones, identified before their VSC appointment.

VSC was held through the modality of telephone consultations that were conducted by urology specialist nurses. These nurses were trained for this role by the senior author (B.K.S.) for a minimum of 6 months and had undergone a focused training. This included being an observer and then doing patient counseling under supervision, learning to read, and decipher KUB (minimum 50 KUB), and finally seeking help from a senior team member for complex clinical scenarios. The nurses were given clinical governance approval for their independent roles in VSC. Both USS and KUB were done and reported by the trained radiology team before patient consultation.

During these consultations, the results of imaging were reviewed and the patient was able to report new symptoms, and was offered any further appointments with mutual consensus. Fluid intake was discussed, and secondary prevention advice was also offered. Telephone consultations typically lasted 5–10 minutes each. If patients were not contactable after three attempts, they and their general practitioners (GPs) were written to and, after discussion with the clinician in charge, were either discharged from the clinic with a community-based follow-up or referred back to face-to-face clinic based on their clinical situation.

Possible outcomes from the consultation were to continue with virtual clinic appointments, discharge from clinic, or return to face-to-face consultation. Patients returned to face-to-face consultation if they developed new symptoms, had stone growth, or patient preference for face-to-face consultation.

The equivalent face-to-face clinic appointment was run by the consultant urologist in conjunction with a nurse in an outpatient department, where each follow-up appointment was scheduled for 15 minutes. This was set up by the hospital administration team in accordance with the British Association of Urological Surgeons guidance on outpatient clinics.[21]

The cost analysis for our study was performed using salaries for a consultant, band five nurse (outpatient department nurse) and band six nurse (urology specialist nurse) from the pay scales published by National Health Service (NHS) employers.[22]

Results

A total of 290 patients have been enrolled in the VSC for the 6-year period, with a total of 468 individual appointments (Table 2 and Fig. 1). The mean number of appointments per patient was 1.6 ± 1.0 with a range of 1–5. The mean age was 57.0 ± 15.8 years with a range of 17–92 years, and a gender distribution of 172 (59.3%) men and 118 (40.7%) women.

The most common reason for referral was for monitoring of asymptomatic small renal stones in 230 (79.3%) patients. The other reasons were patients referred for a history of recurrent stone disease (45, 15.5%), patients with solitary kidneys (5, 1.7%), history of cystine stones (3, 1%), young age <25 years at diagnosis (3, 1%), and patients with high-risk of recurrence and comorbidities including hyperparathyroidism, and inflammatory bowel disease with surgical resection (4, 1.4%).

Of the patients with renal stones at the time of referral, the mean stone size was 5.0 ± 2.7 mm. Imaging modality was KUB in 225 patients (77.6%) and USS of the urinary tract in 65 patients (22.4%). The median duration of follow-up was 12 months with a range of 3–24 months.

At the end of the study period, 132 (45.6%) patients remained in the VSC with further follow-up appointment planned, 106 (36.6%) were discharged, 47 (16.2%) returned to face-to-face clinic or required treatment, and 5 (1.7%) were admitted as an emergency in the interim. The most common reason for discharge from VSC was no change in symptoms or stone status in 76 patients (71.7%). Other reasons included spontaneous passage of stones (13, 12.2%), not attending their repeated appointments (7, 6.6%), death caused by unrelated reasons (4, 3.8%), moving out of the hospital catchment area (4, 3.8%), and patient preference to discontinue further follow-up (2, 1.9%).

A total of four patients who had previously been discharged returned with symptomatic stone disease. Of these, two patients were referred to the outpatient department after new stone development 4 years after being discharged. One patient presented with ureteral colic and passed the stone spontaneously with conservative management. A further patient developed urosepsis secondary to an obstructing ureteral stone, requiring inpatient nephrostomy and awaiting definitive management. A total of five patients were admitted acutely

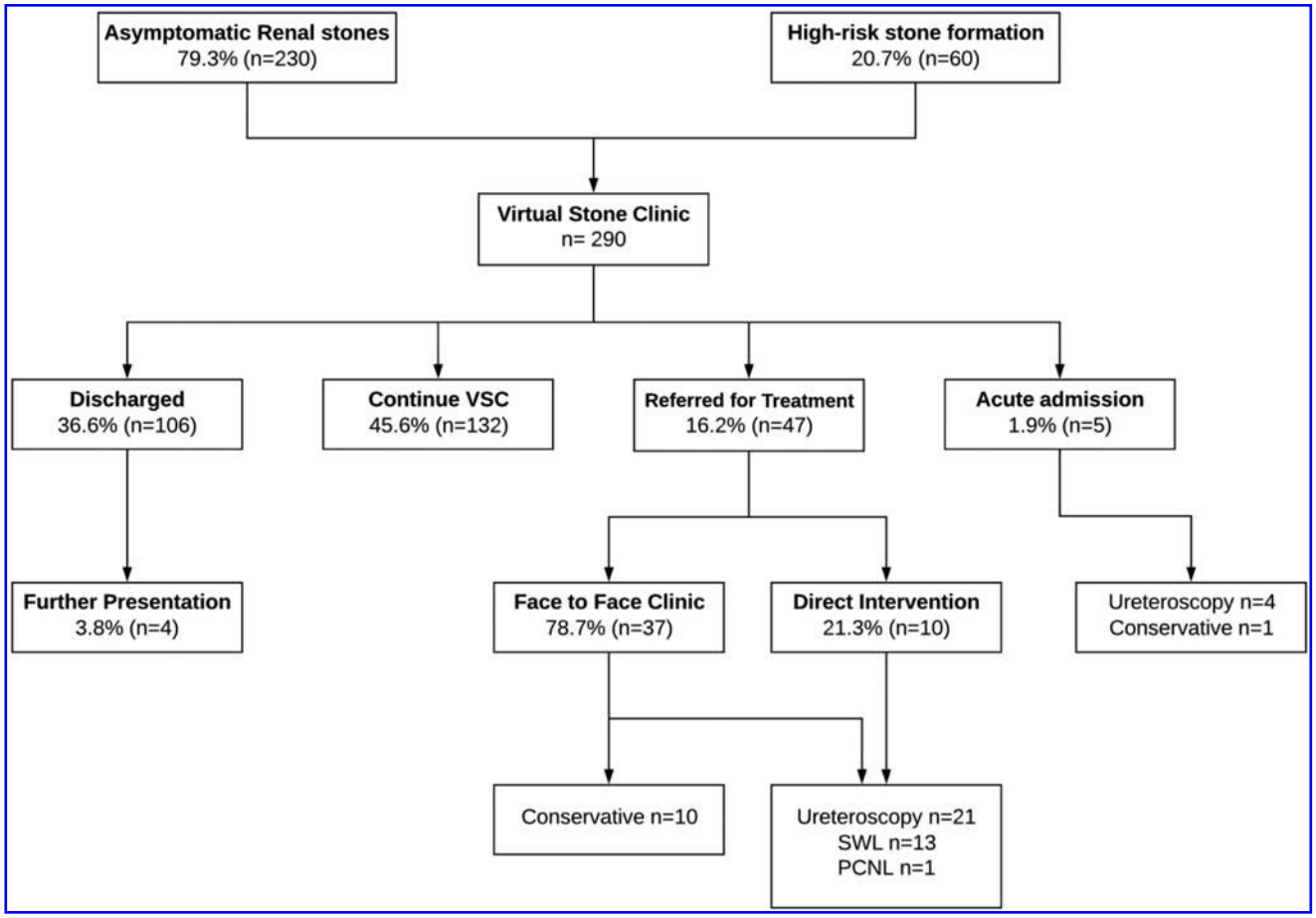

FIG. 1. Flow chart displaying outcomes of patients admitted to the virtual stone clinic.

Table 2. Patient Demographics, Reason for Virtual Stone Clinic Referrals, Outcomes, and Cost of Clinic Appointments

Demographics		
Age (years)	57.0 ± 15.8	
Gender (M:F)	172:118 (59.3%:40.7%)	
Stone size (mm)	5.0 ± 2.7	
Reason for referral	*No. (%)*	
Asymptomatic renal stones	230 (79.3)	
History of recurrent stones	45 (15.5)	
Solitary kidney	5 (1.7)	
Previous stone and <25 years of age	3 (1.0)	
Comorbidity predisposing to stone formation	4 (1.4)	
Cystine stone history	3 (1.0)	
Outcomes and cost analysis from VSC		
Outcome	*No. (%)*	*Reason*
Continuing VSC FU	132 (45.6)	
Discharged	106 (36.6)	No change: 76 (71.7%) Passed stone: 13 (12.2%) Patient preference: 2 (1.9%) Did not attend: 7 (6.6%) Patient death: 4 (3.8%) Moved out of area: 4 (3.8%)
Face-to-face clinic	47 (16.2)	New symptoms: 23 (48.9%) Stone growth: 21 (44.6%) Patient preference: 2 (4.3%) Noncompliance: 1 (2.1%)
Acute admission	5 (1.7)	
Cost	*Face-to-face clinic*	*VSC*
Tariff (appointment)	£73.86	£46.71
Total cost	£34566.48	£21860.28
Variable	*Cost per clinic appointment*	
	Face-to-face clinic (15 minutes)	*VSC (7.5 minutes)*
Consultant pay	£9.60	—
Band 5 nurse pay	£3.19	—
Band 6 nurse pay	—	£2.01
Room immobilization	£15.15	—
Total	£27.94	£2.01

VSU = virtual stone clinic.

while being monitored in the VSC, of whom four were treated with URS and one was managed conservatively.

Of the 47 patients who were referred to face-to-face clinic or for intervention, the most common reason was development of new symptoms (23, 48.9%), followed by stone growth (21, 44.6%), patient preference (2, 4.3%), and patient referred back to face-to-face clinic for nonattendance of VSC (1, 2.1%).

A total of 35 patients needed surgical intervention (URS-21, SWL-13, and PCNL-1), 10 were managed conservatively, 1 patient did not attend the appointment, and another is awaiting clinic appointment. Ten patients were referred directly for surgical intervention from the VSC without face-to-face clinic appointment.

Cost analysis showed a cost saving of £25.93 per clinic appointment for a VSC compared with a face-to-face clinic appointment (a 93% cost reduction), equating to a total saving of £12,006 over the course of the study. We did not calculate the indirect cost of the study related to patient travel, parking, and loss of work in this study.

Discussion

Meaning of our study

Our results show that a nurse-led VSC offers a robust and cost-effective service for surveillance of kidney stones in high-risk groups. It gives a choice to the patients on the type

of follow-up, with reassurance of swift action in case of symptoms or stone growth. Based on the current tariffs, it reduced the cost per clinic appointment from £27.9 to £2, which was a 93% reduction in cost.

There were only two patients who chose to return to face-to-face clinic in place of telephone consultation, demonstrating the acceptability of the VSC to almost all patients (99.3%). The number of patients who ''did not attend'' was also favorably low, with a total of eight (2.8%) patients discharged or returning to face-to-face clinic. This is less than half of the national average rate of 8.2% for nonattendance of a follow-up outpatient clinic in NHS England in the final quarter of 2019.[23]

Practicality of VSC

All face-to-face stone clinic consultations in the tertiary endourology services were held at a single center covering a 2 million population in a large geographical area. Consequently, patients travel large distances to attend clinics, which is associated with a time commitment that extends many hours beyond the 15-minute appointment they attend for. This can negatively impact patients because of difficulty with work and childcare arrangements alongside costs associated with traveling to and from the hospital and parking charges. In contrast, telephone consultation can be held in any location where privacy and confidentiality can be maintained. Many smaller hospitals within the geographical vicinity offer a walk-in service for scans, allowing the patients to choose the time and location at their convenience.

Comparison of our clinic with previous VSCs

Two other groups within the United Kingdom have developed VSCs where they have seen similar success and cost saving since its introduction.[24,25] However, the services they have developed are primarily designed for new referrals, especially for acute ureteral stones with limited data on long-term outcomes for surveillance. Smith and colleagues operate a triage system where referrals are reviewed by a consultant urologist and the outcome communicated by letter, without direct patient interaction.[24] They report a substantial cost reduction in running costs relating to the clinic; however, they opted for noncontrast CT as the preferred imaging choice adding to the indirect costs of the service.

Connor et al. similarly discuss a service for acute renal colic referrals in which a telephone consultation was held with the patient.[25] However, approximately half of these patients were still required to attend a face-to-face appointment as a follow-up. They additionally addressed the environmental benefits of VSC compared with attending the hospital and calculated a reduction in greenhouse gas emissions despite being an inner city hospital serving a densely populated but geographically small area.[25] Although not directly assessed here, the environmental benefits are likely to be considerably more profound in our study because of a large population and area served by the hospital, which would require longer journeys.

Use of telemedicine in the post-COVID era

Although telemedicine was used even before the COVID-19 pandemic, its uptake and progression have been limited by factors including lack of technological infrastructure and adequate staff training.[26] Other barriers to widespread adoption include resistance to change, cost of implementation, and reimbursement issues.[27] Telemedicine is a key component of the NHS long-term plan published in 2019, in which they intend to reduce face-to-face outpatient visits by a third for the next 5 years. As the technology progresses and uptake within hospital trusts become more widespread, there is likely to be a transition toward the facilitation of video consultations. The face-to-face interaction that this will bring addresses one of the major criticisms of telephone consultations. Post-COVID-19, the use of telemedicine will increase and is likely to continue in the future.[28,29] Although waves of COVID-19 continue to affect urologists globally, rising incidence of kidney stones means that patients will need to be continually prioritized based on the urgency, and the use of telemedicine would be essential in the pandemic and postpandemic periods.[4,29]

Limitations

Although patient compliance was good with few patients opting to transfer back to a face-to-face outpatient appointment, we did not perform formal qualitative assessment of patient experience and the duration of follow-up was relatively short. Details on metabolic assessment, treatment, and dietary recommendations are also missing. Similarly, we only used telemedicine for follow-up patients and future studies should also look at both new and follow-up patients in this setting and the training provided to conduct such clinics.

Conclusion

Nurse-led telephone VSC follow-up is well received by the patients. Based on the clinical needs, this allowed some patients to be either discharged or returned to a face-to-face clinic or for surgical intervention. This not only provided a safe follow-up but also allowed to substantially reduce the cost of treatment. Post-COVID, this model using telemedicine will have a much wider uptake and further help to optimize health care resources.

Author Disclosure Statement

No competing financial interests exist.

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Abbreviations Used

AUA = American Urological Association
COVID-19 = coronavirus disease-19
CT = computed tomography
EAU = European Association of Urologists
KSD = kidney stone disease
KUB = kidney, ureter, and bladder radiograph
NHS = National Health Service
PCNL = percutaneous nephrolithotomy
SWL = extracorporeal shock wave lithotripsy
URS = ureteroscopy
USS = ultrasound scan
VSC = virtual stone clinic