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Original Article

Cystoscope-free ureteral stent removal: a safe and effective method during the COVID-19 pandemic

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Abstract: Ureteral stent must be removed within a certain period, usually performed under the cystoscope. However, cystoscopic operations procedures carry risks such as urethral injury, hemorrhage, and infection. This study aimed to implement a cystoscope-free method for ureteral stent removal during the COVID-19 pandemic to mitigate the complications associated with cystoscopy, reduce the risk of cross-infection, and conserve medical resources and time. We retrospectively reviewed 33 patients who underwent ureteral stent removal at our institution between August and December 2022 during the COVID-19 pandemic. A simple device, consisting of an F6 or F8 gastric tube with the front end passing through a 3-0 Prolene line was utilized to extract the double-J stents without cystoscopic assistance. The gastric tube with the line was inserted into the urethra to drain urine from the bladder, saline was injected into the bladder, and the gastric tube was rotated with the line for 4-5 weeks, after which the stent tube was removed by gently pulling it outward. Perioperative characteristics assessed included operation time, pain score, stent removal success rate, postoperative complications, and reasons for stent removal failure. Among the 33 cases included in the study, 17 were males and 16 were females; 20 patients were older than 14 years while 13 were younger. Cystoscope-free stent removal was performed in all cases, with a success rate of 96.9% (32 patients), including 25 cases (78.1%) completed in one operation, four cases (12.5%) in two operations, and three cases (9.4%) in three operations. The mean extubation time was 4.3 ± 1.5 minutes, and the average pain score was 2.1 ± 0.7. No serious postoperative complications were noted. Cystoscope-free ureteral stent removal can be executed by a single physician, demonstrating simplicity, safety, effectiveness, and fewer complications. This method reduces the risk of cross-infection and conserves medical resources and time during the COVID-19 pandemic, making it suitable for both adults and children.

Keywords: Ureteral stent, cystoscope-free, COVID-19, pandemic, urological surgeries

Introduction

Ureteral stents are commonly employed in kidney and ureter surgeries, including pyeloplasty, ureterovesical replantation, and the endoscopic treatment of upper urinary calculi in both adults and children [1]. The removal of ureteral stents typically occurs within a specified timeframe and is usually conducted under cystoscopy. However, cystoscopic procedures carry inherent risks, including urethral injury, hemorrhage, and infection [2, 3]. Furthermore, ureteral stenting in children, which often necessitates general anesthesia, intruduces additional pain and economic burdens, as well as heightened anesthesia and surgical risks. Additionally, the prevalence of COVID-19 has necessitated stricter measures for controlling nosocomial infections. Cystoscopy represents a significant source of cross-infection risk between doctors and patients during the diagnosis and treatment of urinary conditions [4].

Zimskind *et al.* first reported in 1967 that ureteral stents could alleviate ureteral obstruction caused by malignant tumors [5]. Sice then, these stents have become an important tool in endourological surgery. The term "double J

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stent", a crucial component of many urological procedures, was introduced by Finney *et al.* [6] in 1978. In response to the limitations of cystoscope removal and complications associated with ureteral stents [7], various stent removal methods that do not require cystoscopes have been developed, including magnetic aspiration stents with wires and degradable stents. Although magnetic stents can be removed quickly, their use is contraindicated during magnetic resonance imaging (MRI) due to the risk of urethral injury during catheter removal. Consequently, they have not gained widespread acceptance in clinical practice [8, 9]. While operating stents with wires is straightforward, it poses risk of significant displacement and early detachment, potentially leading to urethral discomfort and affecting sexual life [10]. Biodegradable stents have been tested in animal models, demonstrating complete and uniform degradation with good biocompatibility [11-13]. However, their clinical applicability remains to be fully verified [14].

Considering the existing shortcomings, we have explored and developed a method for ureteral stent removal that does not require the use of a cystoscope. This procedure can be performed in an outpatient setting, thereby avoiding the complications associated with cystoscopy, reducing the risk of cross-infection, and conserving medical resources and time. In this article, we report on 33 cases of cystoscope-free stent removal conducted during the COVID-19 pandemic at our clinical center. We analyze the clinical applicability value of this method and summarize our experiences.

Methods

Materials

The study involved patients who had their ureteral stents removed without cystoscopy in the Department of Urology at our hospital between August and December 2022. Prior to extubation, all patients underwent kidney, ureter, and bladder (KUB) plain film radiography to determine the location of the stent and to assess the presence of adnexal stones. Inclusion criteria encompassed pyeloplasty, ureterocystectomy, endoscopic treatment of upper urinary calculi, and gynecological tumor surgery involving the placement of a ureteral stent; either unilateral or bilateral stent placement was permitted. Additionally, preoperative evaluation of the stent was required to confirm that there was no shift, and patients must not have had any urinary infections prior to the procedure. Exclusion criteria included urethral stricture or deformity, hematological diseases, coagulation disorders, and the lack of informed consent from the patients or their families.

A total of 35 patients with ureteral stenting were treated, of which two were excluded from the study. In one instance, preoperative KUB and CT scans indicated that stones were adhered to the proximal end of the ureteral stent; however, the removal of the ureteral stent was unsuccessful at another facility. Consequently, ureteroscopic lithotripsy and ureteral stent removal were conducted after patients with COVID-19 were temporarily excluded from the emergency inpatient buffer wards. In another case, family members insisted on the removal of the catheter under general anesthesia within the hospital setting. It is recommended that the ureteral stent be removed under intravenous anesthesia following passage through the emergency inpatient buffer ward.

This study received approval from the ethical committee of the People's Hospital of the Tibet Autonomous Region. Written informed consent was obtained from the patients or from the families of the children after they were thoroughly informed about the operational procedures and associated risks.

Operating procedure

Items prepared for cystoscopy-free extubation included a dressing change kit, a 50 mL syringe, F6 or F8 gastric tubes, a 3-0 prolene line, and lidocaine cement. Male patients were positioned supine, while female patients were positioned supine and in a knee-bending outer stand position. A disinfected spreading towel was utilized. The 3-0 prolene line was threaded through a side hole at the front end of gastric tube No. F6 (**Figure 1A**), aligning the two lines before cutting the bent needle (**Figure 1B**). Lidocaine mucilage was injected into the urethra for local anesthesia and lubrication. The prepared gastric tube was inserted into the bladder via the urethra until urine outflow was observed (**Figure 1C**). Subsequently, 7-10 cm of the tube was continuously fed into the bladder,

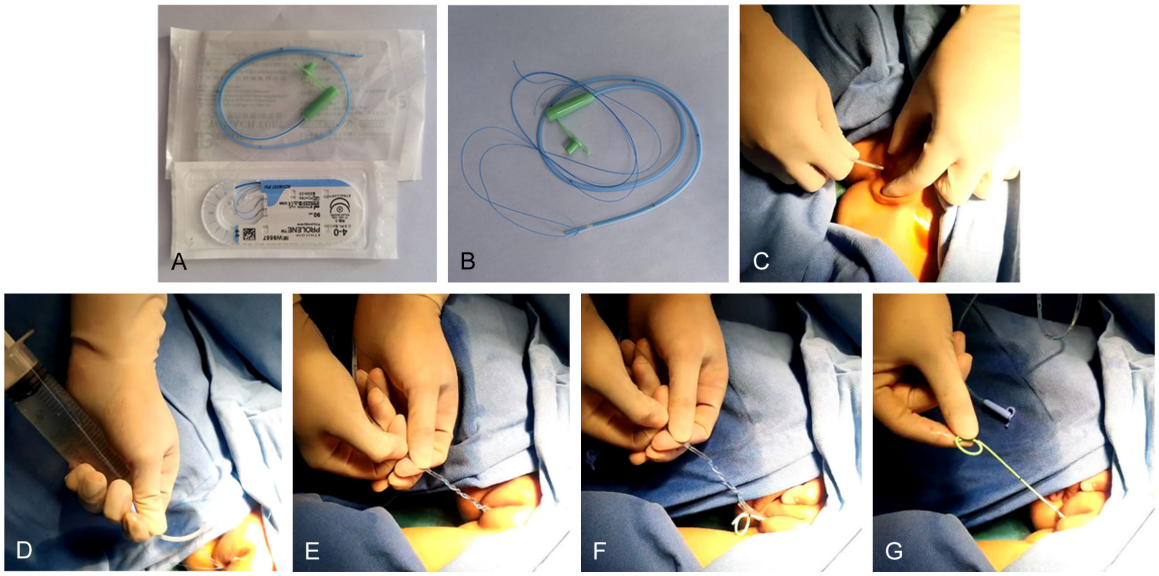

Figure 1. Cystoscope-free extubation device and operation process. A: 3-0 Prolene line; gastric tube no. F6; B: 3-0 Prolene thread was inserted into the lateral hole at the front end of the gastric tube; C, D: A gastric tube with lines was inserted into the urethra to empty the urine in the bladder, and normal saline was injected into the bladder; E-G: The gastric tube was rotated with the wire for 4-5 weeks, gently pulled out, and the stent tube was removed.

while gentle pressure was applied to the lower abdomen to facilitate urine drainage. A 50-mL syringe was then used to inject normal saline (20 mL for ages 0-8 years, 40 mL for ages 8-14 years, and 80 mL for those aged 14 years and older) through the gastric tube, after which the head-end switch of the gastric tube was closed (**Figures 1D** and **2B**). The distal end of the ureteral stent was looped within the bladder (**Figure 2A**). One hand secured the prolene line while the other hand pulled out a portion of the gastric tube. Both the line and the gastric tube were then simultaneously pushed into the bladder, repeating this process to insert as many prolene lines as possible (**Figure 2B**). The gastric tube and prolene wire were rotated clockwise or counterclockwise for 4 to 5 weeks. Following this, both the gastric tube and wire were fixed and gently pulled out together. If slight resistance was encountered, the gastric tube and wire could be wrapped around the distal end of the stent tube. If no resistance was felt, the gastric tube and wire could be further advanced and rotated again, leading to the eventual removal of the stent tube (**Figures 1E-G** and **2C**).

Observation indicators

The primary observation indices included the duration of the extubation process (from the insertion of a gastric tube with wires to the removal of a stent), the pain score (utilizing a 0-10 digital pain scale), the success rate of extubation, and the occurrence of postoperative complications. Successful removal of the stent tube is defined as the smooth extraction of the stent after the self-made tool is introduced into the bladder, ensuring that the stent tube is not entangled. During this process, the stent tube should be removed smoothly without causing any discomfort to the patient.

Statistics

Statistical software (SPSS 27.0) was employed to analyze the data. Paired variables were expressed as ratios (%) and compared using the χ^2 test. Continuous variables were presented as mean ± standard deviation (SD) and analyzed with the Shapiro-Wilk test. The t-test was utilized when the data conformed to a normal distribution; otherwise, the independent sample Mann-Whitney U test was applied. A *p*-value of less than 0.05 was considered statistically significant.

Result

The study included 33 patients (17 males and 16 females), comprising 20 patients older than 14 years and 13 patients aged 14 years or

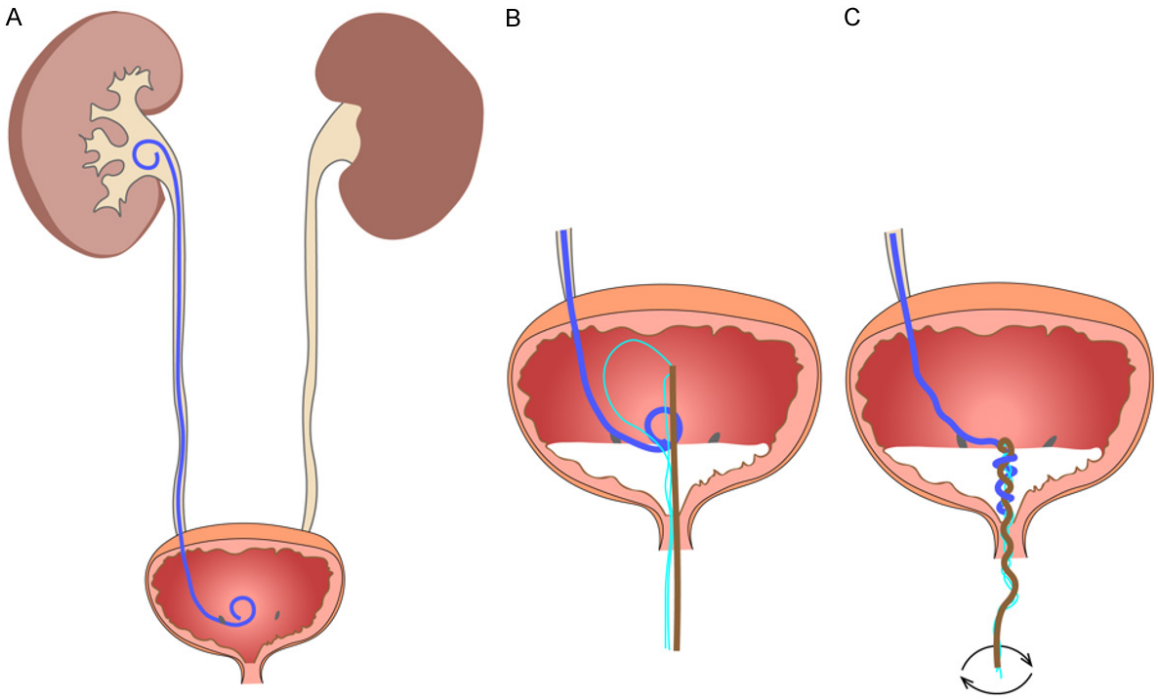

Figure 2. Schematic diagram of cystoscope-free extubation. A: The distal end of the ureteral stent was looped in the bladder; B: The prolene line was placed into the bladder with a gastric tube, saline was injected, and a line was inserted into the bladder as much as possible; C: The gastric tube was rotated with the wire for 4-5 weeks, and the distal end of the stent tube was wound.

younger, with a mean age of 26.5 ± 18.98 years. The cohort consisted of 10 cases following pyeloplasty, 7 after ureterovesical replantation, 8 after soft/hard ureteroscopic lithotripsy, 7 after percutaneous nephrolithotomy, and 1 after gynecological tumor surgery. Among these patients, 17 (51.5%) had stents placed on the left side, 12 (36.4%) on the right side, and 4 (12.1%) on both sides. Stents were typically removed 8 weeks post-pyeloplasty and ureterocystectomy, and 4 weeks post-percutaneous nephrolithotomy and ureteroscopic lithotripsy. All patients experienced delays in catheter removal, with a mean delay of 48 ± 30 days. Urinary irritation was reported in 28 patients (84.8%) before extubation, 25 of whom (75.7%) experienced intermittent gross hematuria. Additionally, 4 patients (12.1%) were administered tamsulosin hydrochloride sustained-release capsules orally (see **Table 1**).

Among the 33 patients who underwent cystoscope-free stent removal, 32 (96.9%) were successfully extubated. This included 25 patients (78.1%) who required one operation, 4 patients (12.5%) who needed two operations, and 3 patients (9.4%) who underwent three operations. In one case where tube removal was unsuccessful due to significant obstruction of the gastric tube, emergency cystoscopy and forceps were utilized. The average duration for cystoscope-free extubation was 4.3 ± 1.5 minutes, and the average pain score recorded was 2.1 ± 0.7. No serious postoperative complications were observed. Telephone follow-ups were conducted on postoperative day 3, revealing that 25 patients with preoperative urinary tract irritation and hematuria experienced relief. By postoperative day 7, none of the patients reported any discomfort (see **Table 1**).

Discussion

This study demonstrated that none of the patients underwent stent removal within the pre-planned timeframe during the COVID-19 pandemic. The majority experienced varying degrees of urinary tract irritation, and approximately three-quarters exhibited gross hematuria.

In the cystoscope-free extubation method, a 3-0 Prolene line was threaded into the front end of the F6 gastric tube, and lidocaine gel

Table 1. Basic patient profile

Total number of patients (cases)	33
Age (years)	
>14	20 (60.6%)
≤14	13 (39.4%)
Sex	
Male	17 (51.5%)
Female	16 (48.5%)
DJ tube position	
Left side	17 (51.5%)
Right side	12 (36.4%)
Both sides	4 (12.1%)
Surgical History	
Pyeloplasty	10 (30.3%)
Ureteral bladder reimplantation	7 (21.2%)
Ureteral soft/rigid lithotripsy	8 (24.2%)
Percutaneous nephrolithotripsy	7 (21.2%)
Gynecologic Oncology Surgery	1 (0.3%)
Number of successful removal operations	
Once	25 (78.1%)
Twice	4 (12.5%)
Three times	3 (9.4%)
Cystoscope not removed	1 (0.3%)
Reasons for failed extubation	
Gastric tube tangled with the distal end of the stent tube and knotted to excessive resistance	1 (0.3%)
Serious complications	
None	33 (100%)
Operation time and pain score	
Operation time (minutes)	4.3 ± 1.5
Pain score	2.3 ± 0.7
Preoperative symptoms	
Urinary tract irritation	28 (84.8%)
Hematuria	25 (75.7%)
Post-operative symptom relief time	
3 days	25 (75.7%)
7 days	33 (100%)

was injected into the urethra for local anesthesia and lubrication. The Prolene thread, composed of polypropylene, exhibits high toughness and negligible water absorption [15]; thus, its elasticity remains unaffected by the aqueous environment of the bladder, facilitating the winding of the stent tube. The F6 or F8 gastric tube is thin and flexible, allowing it to traverse the urethra smoothly without causing significant damage, and it can be operated on multiple times. In our two most recent patients, we employed ultrasound-guided cystoscope-free extubation. Ultrasonic monitoring (**Figure 3**) indicated that the distal end of the stent tube floated in the bladder after saline injection, becoming entangled with the distal end of the stent and moving as the rotating gastric tube with wires was pulled outward. The use of ultrasonic monitoring enhances the accuracy of the procedure.

Since the onset of the global COVID-19 pandemic [16], and specifically in Tibet in August 2022, hospitals have implemented closed-loop management systems, established buffer rooms, and temporarily postponed elective and

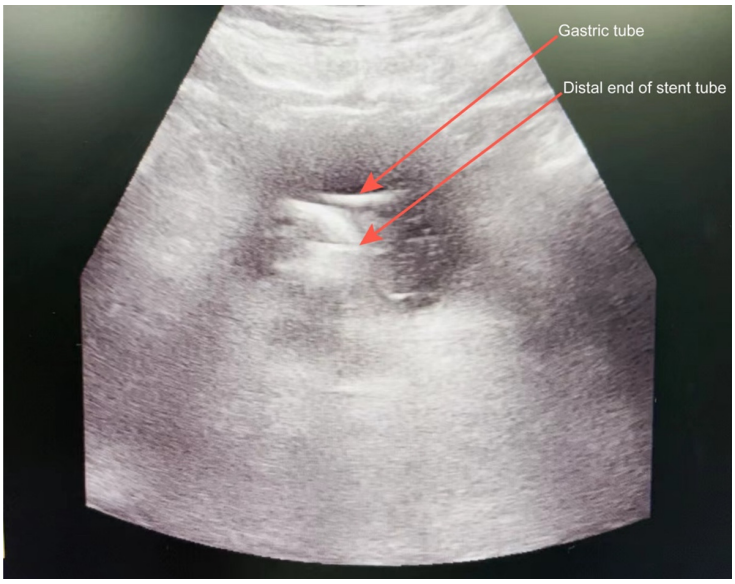

Figure 3. Ultrasound view of the distal end of the stent tube and the wire-banded gastric tube. The distal end of the floating stent tube was visible on ultrasonography after the bladder.

routine operations. Fan et al. [17] suggested that during the pandemic, the diagnosis and treatment of urological diseases should prioritize emergency surgeries, while non-emergency and invasive procedures, such as urethral catheterization and cystostomy, should be deferred until a comprehensive evaluation of the conditions can be conducted. It was recommended that such operations be performed in an outpatient or emergency room setting. Shaw et al. [18] argued that surgeons should adhere to the treatment principle of "emergency first, simple within a time limit, and delayed at an elective date" for patients with urinary calculi during the pandemic. Literature indicates that approximately 80% of patients experience urinary tract irritation and pain following the placement of indwelling ureteral stents [19, 20]. The incidence of stent-related side effects is directly proportional to the duration of indwelling. Consequently, early stent removal is optimal for minimizing adverse reactions and enhancing therapeutic outcomes [21]. Our approach, which can be conducted in a single outpatient setting, alleviates the strain on medical resources associated with inpatient extubation during the pandemic while concurrently reducing the risk of cross-infection related to COVID-19.

Recent studies have demonstrated the efficacy of similar methods for ureteral stent removal in both children [22] and adults [23]. In this study, the success rate of cystoscope-free extubation was found to be 96.7%, with no complications reported among the patients. This indicates that the method is both safe and effective. A total of 31 patients underwent ureteral stent removal without the use of cystoscopy. Notably, one male child exhibited high resistance during the removal of the gastric tube, and upon cystoscopy, it was discovered that the distal end of the stent had become entangled and knotted with the gastric tube. It is likely that the gastric tube and prolene wire rotated more than five times, leading to excessive winding and knotting of both the gastric tube and the stent. Furthermore, it is crucial to avoid urethral injury resulting from forceful extubation, necessitating prompt cystoscopy when complications arise. In this study, cystoscope-free extraction was successfully performed on four patients with indwelling bilateral ureteral stents, while non-cystoscopic extubation was not conducted in two patients. Therefore, it is essential to strictly control preoperative indications and to ensure that consent and active cooperation are obtained from patients and their families. In conclusion, our method is applicable to adults, children, and patients with bilateral stents, demonstrating significant clinical value, particularly during the COVID-19 pandemic.

To ensure the smooth removal of the non-cystoscopic catheter, our center's experience can be summarized as follows: 1. The patient was preoperatively informed about the advantages, procedural steps, and risks associated with this method, and active cooperation along with informed consent were obtained. Indications such as stent displacement, stent wall stones, short distal stent exposure in the bladder, and the necessity for direct cystoscopy or ureteroscopy in cases of urethral stricture should be strictly evaluated through cystoscopy prior to ureteroscopy; 2. The Prolene wire should be advanced into the bladder as much as possible, as a longer Prolene thread within the blad-

der increases the likelihood of successfully capturing the stent tube (**Figure 2B**); 3. The gastric tube was inserted in reverse through the urethra into the bladder. Initially, the urine in the bladder was evacuated, followed by the injection of normal saline (20 mL for patients aged 0-8 years, 40 mL for those aged 8-14 years, and 80 mL for patients over 14 years). When the bladder is full, its internal space is large, making it challenging to capture the stent tube while the gastric tube rotates. When the bladder is empty, the bladder wall collapses, resulting in an insufficient space within the bladder. Consequently, the distal end of the stent tube may easily adhere to the bladder wall (**Figures 1C**, **1D** and **2B**). The gastric tube was rotated with wires four to five times on the same side as the stent position (**Figures 1E** and **2C**). During the removal process, there should be no resistance, and in most cases, the stent is not attached. If the stent is properly hooked, slight resistance may be encountered. However, if resistance is excessive, it is advisable to avoid forceful removal and to perform cystoscopy or ureteroscopy promptly, if necessary. Different operators exhibit varying levels of proficiency and one-time success rates. The F6 and F8 gastric tubes are thin and flexible, allowing for repeated operations, which minimizes the risk of urethral loss. This method of catheter removal was conducted under ultrasound guidance, with the distal end of the ureteral stent identified via ultrasound as the gastric tube with the line was withdrawn, indicating that the stent was entangled with the gastric tube along the line. If the ultrasonic probe fails to detect the movement of the stent, it suggests that the stent is not captured by the gastric tube with wires. The procedure can be repeated until the gastric tube is successfully extracted, following the ultrasonic probe's detection of stent movement, thereby enhancing the likelihood of successful stent removal in a single operation.

However, this method has several limitations. First, the operation cannot be performed under direct visual guidance. Additionally, a 100% success rate and complete removal cannot be guaranteed in a single procedure. Second, the preoperative evaluation lacks quantification, indicating a need for further exploration and improvements. Furthermore, the success rate of this method is contingent upon the proficiency of the surgeons involved. This study included a limited number of patients and did not compare results with cystoscopic extubation. The cases of ultrasound-guided catheter removal using this method were few, suggesting that further experience is necessary.

Conclusion

The method for removing stents is straightforward and uncomplicated, resulting in fewer adverse reactions and only mild discomfort. Particularly during the COVID-19 pandemic, this approach can help conserve medical resources and minimize the risk of cross-infection. Therefore, it is advisable to promote this method in clinical settings.

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Written informed consent was obtained from the patients or from the families of the children.

Disclosure of conflict of interest

None.

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