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ORIGINAL SCIENTIFIC REPORT

Outpatient Appendectomy in an Emergency Outpatient Surgery Unit 24 h a Day: An Intention-to-Treat Analysis of 194 Patients

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Abstract

Objective To evaluate the feasibility and outcomes of patients operated on for uncomplicated acute appendicitis (UAA) in our 24-h emergency outpatient surgery unit.

Methods This was a prospective observational study with intention-to-treat (ITT) analysis. From 12/2013 to 03/2015, all consecutive patients admitted for acute appendicitis (AA) were prospectively screened. A computed tomography or abdominal ultrasound confirmed the diagnosis of AA. Eligibility criteria for outpatient appendectomy were: UAA, no comorbidity, no physical or mental condition preventing participation in the study, absence of pregnancy, age older than 15 years, an accompanying adult person available for the hospital discharge and place of residence within 1 h of our hospital. In the case of intraoperative complication (abscess, local or general peritonitis) or complication of general anesthesia, patients were excluded from the outpatient pathway. The primary endpoint was the feasibility of outpatient appendectomy among all consecutive patients admitted for UAA.

Results Of the 194 screened patients, 150 (77%) presented an UAA and 102 (68%) were eligible for an outpatient procedure. Thirteen eligible patients (13%) were excluded from the outpatient circuit (7 intraoperative and 6 postoperative contraindications). Outpatient appendectomy was performed in 89 patients, representing 59% (89/150) of the ITT population and 87% (89/102) of the eligible patients. The median length of hospital stay was 13 h. Postoperative complications were observed in six patients (6%).

Conclusions This study reports a safe and feasible management of UAA. Our organization allows a short hospitalization for postoperative recovery without using conventional surgery beds and enables discharge throughout the night.

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Introduction

With 250,000 procedures performed each year in the USA, acute appendicitis remains the most common indication for emergency general surgery [1]. Although an increasing number of studies assessing the use of antibiotics instead of surgery for treating patients with uncomplicated acute appendicitis (UAA), appendectomy still remains the standard of care [2–5]. Laparoscopic appendectomy was first described in 1983 by Semm [6] and has been generalized thereafter, since several prospective studies demonstrated this approach to be less painful, associated with faster recovery and a lower incidence of wound infection in comparison with open surgery [7, 8].

In France, development of ambulatory surgery has become one of the major issues of public health policy during the last decade. This has led to the recent publication of criteria for ambulatory surgery which are (1) a hospital stay of less than 12 h, (2) not requiring overnight hospitalization and (3) performed in a dedicated unit [9]. In 2011, three French surgical societies [the French Society of Digestive Surgery (SFCD), the Association of Hepatobiliary Surgery and Transplantation (ACHBT) and the French Association for Ambulatory Surgery (AFCA)] recommended ambulatory surgery for elective digestive procedures such as cholecystectomy, inguinal hernia repair, fundoplication for gastroesophageal reflux disease, laparoscopic gastric banding and proctology procedures. Although appendectomy seems to fulfill all theoretical criteria for ambulatory surgery (short-duration procedure, fast postoperative recovery, involvement of young healthy patients), it was not included in these recommendations because of the lack of solid evidence and because it is performed in an emergency setting [10].

In 2009, the French Society of Anesthesia and Reanimation (SFAR) published new recommendations that allowed outpatient surgery in emergency [11]. Outpatient surgery differed from ambulatory surgery, as it implies a length of stay (LOS) less than 24 h, which could include overnight hospitalization, and did not require a specific unit. These criteria were more suitable to emergency surgery and led us to create a 24-h emergency outpatient surgery unit at our tertiary referral center (the Pitié-Salpêtrière University Hospital, Paris, France) in May 2011 [12].

In the literature, few studies have reported on the feasibility and early results of outpatient appendectomies with different outpatient protocols and heterogeneous selected population [13–27]. The aim of the present prospective observational study was to evaluate the feasibility and outcomes of patients operated for UAA in our 24-h emergency outpatient surgery unit.

Materials and methods

Study population

This was a prospective observational study with an intention-to-treat (ITT) analysis. From December 2013 to March 2015, all patients with acute appendicitis were screened in our emergency department (ED). Eligibility criteria for an outpatient procedure were the following: UAA, no comorbidities (ASA I or II), an accompanying adult person available for the hospital discharge and place of residence within 1 h of our hospital. Diagnosis of AA was confirmed by a computed tomography (CT) scan or abdominal ultrasound, with a thickening of the appendix (transverse diameter greater than 6 mm) and peri-appendicular fat stranding. Complicated appendicitis was defined by the presence on radiological examination of an appendiceal or pelvic abscess, radiological pneumoperitoneum and/or general peritoneal effusion.

Exclusion criteria were the following: physical or mental condition preventing participation in the study, pregnancy and age younger than 15 years. In the case of abscess, local or general peritonitis discovered during surgery or if a complication of general anesthesia occurred, patients were excluded from the outpatient pathway and hospitalized in the surgical ward. All eligible patients were included prospectively after obtaining oral consent to receive ambulatory surgery. The inclusion period was extended to recruit a relevant sample size, with at least 100 eligible patients. Since the study was observational, written informed consent was not required. Nevertheless, all patients were informed about their inclusion in the database and had the option to refuse it. The database was declared to the French National Commission on Computing and Liberty (CNIL, Paris, France).

Description of the emergency outpatient surgery unit

In May 2011, we set up a 24-h emergency outpatient unit for patients requiring an urgent surgical procedure compatible with a short LOS (Fig. 1) and in agreement with recommendations of the French Society of Anesthesiology and Intensive Care (SFAR) [12]. Physicians identified eligible patients in the ED, and the anesthesiologist and the surgeon confirmed inclusion in the outpatient protocol. All information was given to the patient during the anesthesia consultation. If the patient agreed to the outpatient management, he or she was admitted directly to the operating room with a higher priority. No patient was discharged for a night at home with oral antibiotics and readmitted the day after.

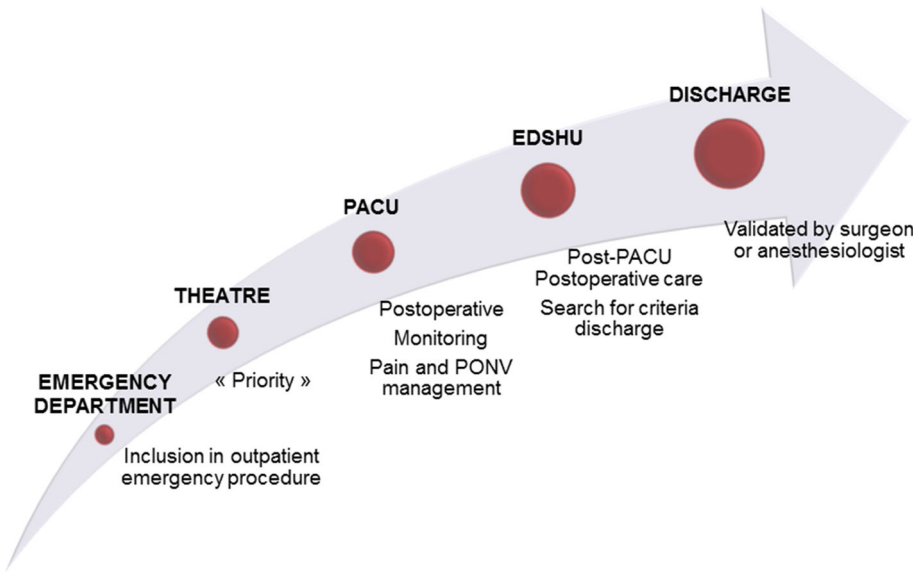

Fig. 1 Emergency outpatient unit pathway. *PACU* post-anesthesia care unit; *EDSHU* emergency department short hospitalization unit; *PONV* postoperative nausea and vomiting

After appendectomy, patients were monitored in the post-anesthesia care unit (PACU) until they had a modified Aldrete score of more than 10 [28]. In the absence of a perioperative contraindication for outpatient surgery (complicated surgery or complication of general anesthesia), patients were admitted to the ED short hospitalization unit of the ED (EDSHU). In EDSUH, patients were judged able to be discharged if they had pain controlled by usual analgesics, no vomiting or nausea and no fever. Discharge could occur at any time of the day or night after being validated by the surgeon or the anesthesiologist in charge of the patient. During their stay in the EDSHU, ED team supervised care.

All patients were contacted by phone within 48 h following discharge and were seen at the outpatient clinic within 7 days.

Surgical technique

The choice of surgical approach (laparoscopy or open surgery) was left to the surgeon's discretion. For laparoscopic appendectomy, a 10-mm optic trocar was introduced at the umbilicus with open laparoscopy. Two other 5-mm ports were then placed in the suprapubic and left iliac fossa positions. The mesoappendix was coagulated by bipolar forceps. The appendiceal base was tied with a preformed suture loop. The appendix was then extracted in a bag through the 10-mm port.

For open appendectomy, an incision was made over McBurney's point. On entering the peritoneum, the appendix was identified, mobilized, and then ligated and divided at its base. Each layer of the abdominal wall was then closed in turn. Neither drainage nor nasogastric tube were routinely used. In case of UAA, a single dose of antibiotic was administrated during the induction of general anesthesia.

Postoperative care

After transfer from the PACU to the EDSHU, all patients were given a light meal and encouraged to move. The usual analgesics were dispensed, and treatments to prevent nausea were administered if needed.

Data collection

Main clinical, biological and radiological preoperative data were collected in the electronic database of the ED. Times between arrival at the emergency, diagnosis, surgery and discharge, intraoperative data and postoperative complications were also collected. Postoperative complications were graded according to the Clavien–Dindo classification [29].

Statistical analysis

For descriptive analysis, categorical variables are presented as frequencies and percentages and compared using the Fisher exact test. Continuous variables are presented as median and range and compared using the Mann–Whitney *U* test or the Kruskal–Wallis *H* test, as appropriate. Inpatient and outpatient records of all eligible patients were individually reviewed. Missing data were retrieved from medical charts. Morbidity included all complications occurring postoperatively and within 30 days after

Table 1 Characteristics of patients eligible for an outpatient procedure

Characteristics	Total ($n = 102$) (%)
Men	54 (53)
Women	48 (47)
Age, years	30 [15–64]
BMI, kg/m^2	23 [17–37]
ASA score	
1	93 (91)
2	9 (9)
3–4	0
White blood cells, 10^6/l	
<10,000	24 (24)
10,000–15,000	52 (51)
>15,000	24 (24)
NR	2 (2)
Serum CRP level, mg/l	
<5	27 (27)
5–30	42 (41)
>30	31 (30)
NR	2 (2)
Preoperative radiological data	
Peritoneal effusion	9 (9)
Appendix diameter	10 [5–19]

Data are expressed as median [range] or number (percentage)

ASA American Society of Anesthesiologists; *BMI* body mass index; *CRP* C-reactive protein; *NR* not reported

discharge. All tests were two-tailed with a significance level set at $p < 0.05$. Statistical analyses were carried out using the JMP software (version 12.1.0; SAS Institute, Cary, NC).

Results

Patients and operative results

During the study period, 194 consecutive patients were included in this study. UAA was diagnosed in the ED in 150 (77%) of these patients. Among them, 102 patients (68%) were eligible for an outpatient procedure. Clinical, biological and radiological data are summarized in Table 1. Time of arrival at the ED for eligible patients is depicted in Fig. 2. Nearly two-thirds of them (63%) presented between 12 am and midnight. In the remaining 48 cases, preoperative contraindications observed were the following: ASA score >2 ($n = 16$, 33%), living alone ($n = 11$, 23%), lack of understanding the protocol ($n = 9$, 19%), home–hospital travel time >1 h ($n = 3$, 6%), pregnancy ($n = 2$, 4%), refusal ($n = 1$, 2%) and not reported ($n = 6$, 13%).

A laparoscopic approach was used in 101 (99%) patients. The majority of appendectomies occurred during the night between midnight and 6 am (Table 2). Seven patients (7%) presented intraoperative contraindications for outpatient appendectomy: complicated appendicitis in five cases (5%) and complications from general anesthesia in the other two patients (2%, one anaphylactic reaction and one severe hypoxemia during the laparoscopic procedure).

After the surgical procedure, 95 patients (93%) were admitted to EDSUH. An outpatient procedure was performed in 89 cases (87%). The remaining 6 (6%) patients required an unexpected overnight hospitalization for the following reasons: acute urine retention ($n = 2$, 33%), pain requiring parenteral analgesics ($n = 1$, 17%) and the absence of appropriate supervision and assistance at home ($n = 3$, 50%). In ITT, among the 150 patients presenting

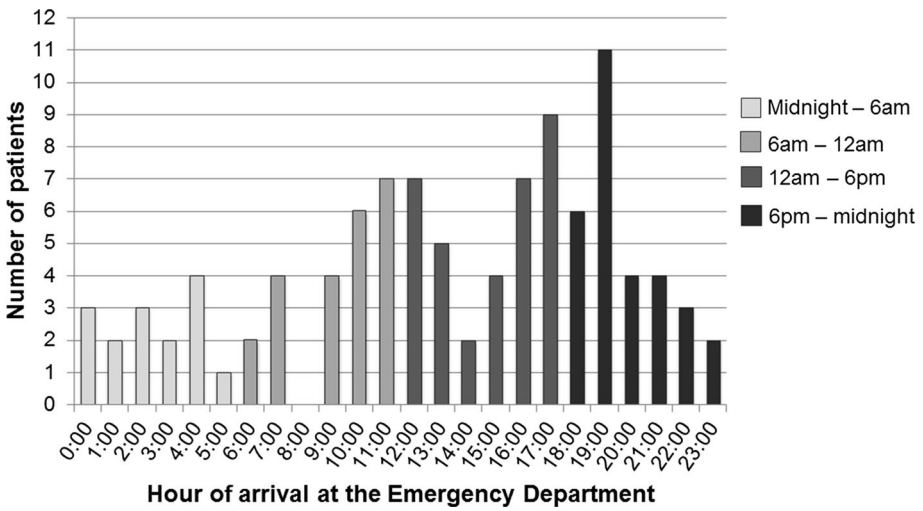

Fig. 2 Hour of arrival at the emergency department for eligible patients ($n = 102$)

Table 2 Intraoperative data

Operative data	Total ($n = 102$) (%)
Laparoscopy	101 (99)
Open surgery	1 (1)
Conversion	0
Operative time, min	40 [10–80]
Time of surgery:	
6 am–12 am	16 (16)
12 am–6 pm	15 (15)
6 pm–12 pm	30 (30)
12 pm–6 am	39 (38)
Not reported	2 (2)

Data are expressed as median [range] or number (percentage)

with UAA, 89 underwent an outpatient procedure, which represents 59% of cases. In per-protocol analysis ($n = 102$), 87% underwent an outpatient procedure (Fig. 3). The distribution of time of discharge for the 89 patients who underwent an outpatient procedure is represented in Fig. 4.

Postoperative outcomes

Times for each step of the outpatient circuit are represented in Fig. 5. Among eligible patients ($n = 102$), 44 patients (43%) included in the outpatient procedure had a LOS <12 h. We then looked at whether the delays varied according to the time of the operation. Median LOS was significantly shorter for patients operated on during daytime (between 6 am and 6 pm) than for those operated on overnight (10.5 h, range 6–23 vs. 14 h, range 9–23, $p = 0.006$). When looking in details, median LOS was significantly longer for patients operated on between 6 pm and midnight (15 h, range 9–23 h) than for those operated on elsewhere in the day (6 am–12 am: 11.5 h, range 6–23 h; 12 am–6 pm: 10 h, range 7–22 h; midnight–6 am: 13 h, range 9–20 h) ($p = 0.034$).

Six patients had postoperative complications (6%): 2 hematoma, 1 orchiepididymitis, 1 peritoneal infiltration, 1 colitis and 1 pelvic abscess. Among them, two patients required re-hospitalization (2%). The patient presenting with colitis returned to the ED on postoperative day 6, at which time he was treated by parenteral antibiotic administration during 4 days. The patient with pelvic abscess was re-operated on postoperative day 2 for drainage and was finally discharge 3 days later. Among the 95 patients who were initially admitted to EDSUH, overall morbidity rate was 9%. According to the Clavien–Dindo classification, postoperative complications were as follow: grade I in 5 patients (5%), grade II in 3 patients (3%) and grade III in 1 patient (1%). Overall morbidity rate was not different between patients operated on during daytime and those operated on overnight (14 vs. 8%, $p = 0.45$).

AA was confirmed on pathological examination in 99 cases (97%). Two remaining patients were found to have neuroendocrine tumors, and one additional had a peritoneal reaction without appendicitis.

Discussion

The aim of this prospective study was to evaluate the feasibility of appendectomy in a dedicated 24-h emergency outpatient unit. We found that management of these patients was safe and feasible with intention to treat in 59% of cases. This rate increased to 87% for those with UAA, without comorbidity and who been socially classified as being suitable for outpatient management.

In France, ambulatory surgery is defined by a LOS inferior to 12 h, with a procedure occurring during daytime in a specific department/unit dedicated to ambulatory surgery. These criteria were judged to be too restrictive in the context of emergency surgery as they imply surgery to be planned ahead of time [11]. For this reason, our hospital set up a dedicated 24-h emergency outpatient unit for patients requiring emergency surgery compatible with a short LOS in agreement with French recommendations [12]. This emergency outpatient unit implies a medical and paramedical staff trained to manage a continuous flow of patients, allows a short hospitalization for postoperative recovery, without using conventional surgery beds and enables discharge at any time of the night. Moreover, our protocol was designed to have a large inclusion of patients, as final diagnosis was assessed after prompt surgical exploration and patients could be hospitalized at any time.

To our knowledge, only six prospective studies have been reported on outpatient or ambulatory appendectomy [13, 16, 17, 22, 25, 27]. In the series of Dubois et al. [22], including 161 patients, the rate of outpatient appendectomy ranged from 45% in ITT to 66% in an eligible population. In the series of Sabbagh et al. [25], outpatient procedures were able to be performed in 52% of patients in ITT (64/123) and in 73% of eligible patients (64/88). In a large study including 345 patients, Frazee et al. [26] found that 305 patients (88%) were successfully managed in the outpatient setting. In a recent study of 184 patients, aiming to establish and validate a score for ambulatory appendectomy, the success rate for this approach was 21% in ITT and 37% in eligible patients [27]. The wide variations of the reported rates of outpatient appendectomy between these series may be explained by the use of different

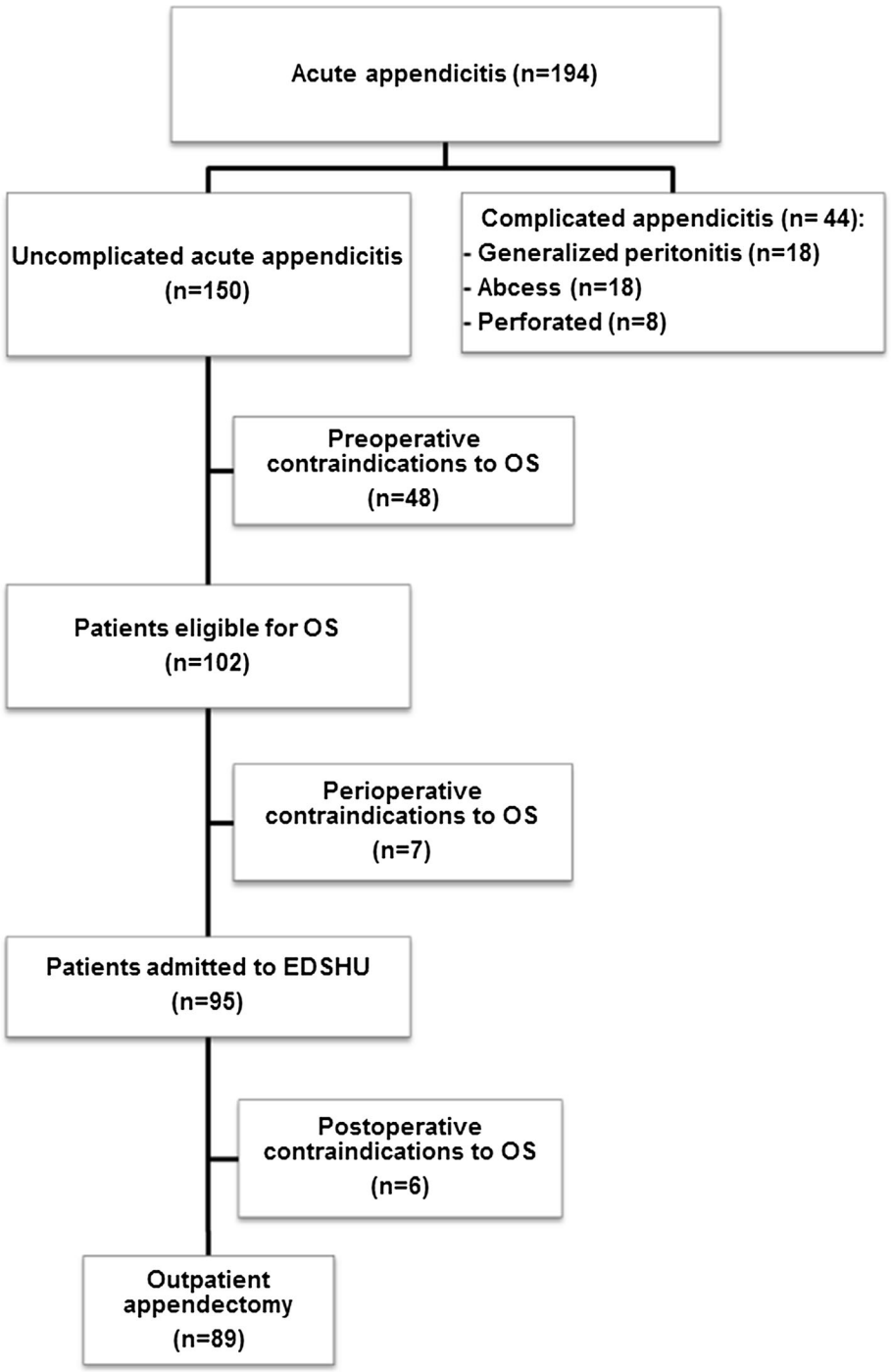

Fig. 3 Patient selection for outpatient appendectomy. *OS* outpatient surgery; *EDSHU* emergency department short hospitalization unit

eligibility criteria and definition of "outpatient" management of these patients.

It is noteworthy that in our experience, selection of UAA was mainly based on CT-scan and no biological criteria of exclusion were used. In the series of Lefrançois et al. [27], patients suitable for ambulatory appendectomy should fulfill at least four out of the five following criteria: body mass index <28 kg/m^2, white cell count <15/μl, C-reactive protein <30 mg/l, no radiological signs of perforation and appendix diameter ≤10 mm. This strict selection explained the low rate of appendectomy truly performed in an ambulatory fashion, as eligible patients were supposed to go back home and return to the ambulatory surgery unit the following morning. Applied to our series, these criteria would have excluded 25/89 (28%) patients with UAA from the outpatient management. In the

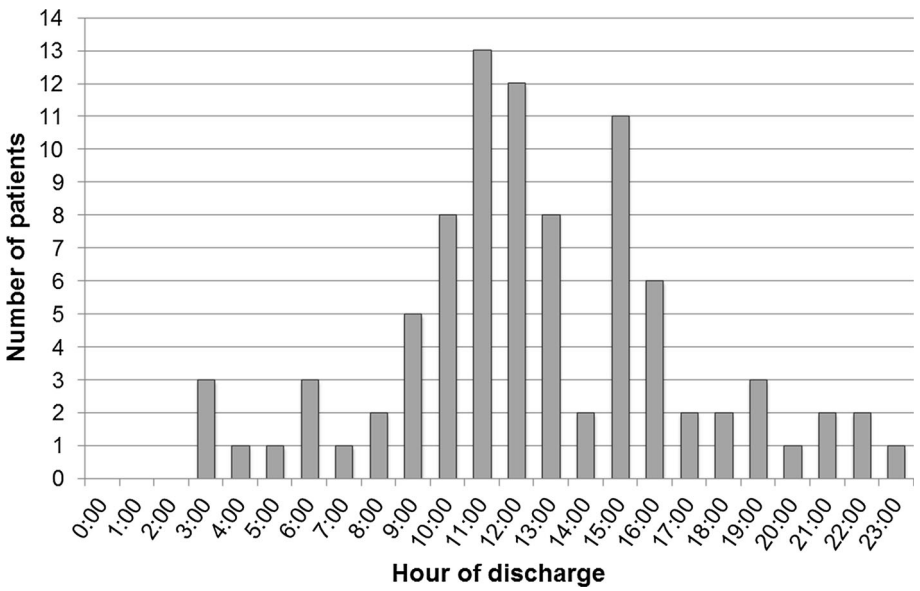

Fig. 4 Distribution of time of discharge for the patients with outpatient procedure ($n = 89$)

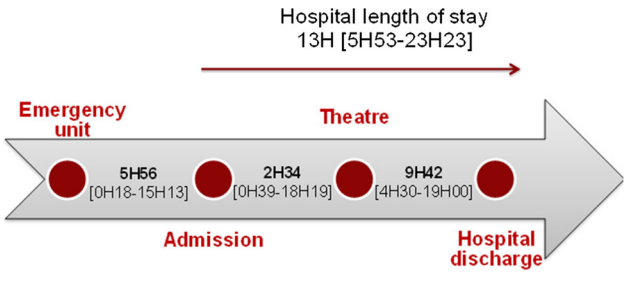

Fig. 5 Time spent at each step during the outpatient management ($n = 102$). Durations are presented as median [range]

series reported by Dubois et al. [22] and Sabbagh [25], all patients with AA were considered for the outpatient protocol except those with severe comorbidities or having usual contraindication for this type of management (living alone, home–hospital travel time >30 min to 1 h, no accompanying adult person available for the hospital discharge). In our series, a complicated AA was diagnosed during surgical exploration in five patients (5%), which is in the lower range of 6–21% reported by others [22, 25, 27]. Once again, this difference may be due to the selection criteria for UAA.

Unplanned overnight hospitalization was required in 6 patients (6%) in our series. Lack of an accompanying adult person available for the hospital discharge was the main cause, observed in 3 cases. This situation occurred despite the necessity for the patient to give the name and phone number of a family member or a friend who would supervise and assist at home the patient at the discharge. We assume that this situation was caused by schedules of output at any time of the day or night. Nevertheless, our rate of unplanned overnight hospitalization was lower than the rates of 12–34% reported by others [22, 25, 26].

In our series, the median LOS, from admission to hospital discharge, was 13 h (range 6–23), with 44 patients (43%) with a LOS inferior to 12 h. On the one hand, the median delay between diagnosis and surgery of 2h34 was considered to be acceptable, as priority was given for patients with UAA and suitable for our outpatient protocol. On the other hand, in our view the median delay of 9h42 between PACU admission and hospital discharge needed to be shortened. When comparing this delay according to the hour of appendectomy (day time vs. overnight), we observed a significant difference between the two periods probably due to the fact that we were reluctant to discharge patients during the middle of the night, especially those operated on between 6 pm and midnight. Efforts have been made recently to improve this specific point.

In this cohort, no mortality was observed. Unplanned consultation concerned 4 (4%) patients leading to readmission for two of them with one patient who required reintervention. Our rate of unexpected consultation and readmission is in the range of 0–11% and 0–5% reported in other series [18, 21, 22, 25, 27].

Appendectomy still remains the treatment of choice for UAA [5]. In our institution, no patient with UAA on CT or abdominal ultrasound is treated with antibiotic therapy alone. Indeed, nonoperative antibiotic treatment has been reported to be less effective than emergency appendectomy in several randomized controlled trials, with a recurrence rate of 25–30% in the long term [2–4]. Most patients with UAA presented to the ED during the afternoon or the evening. This finding is in line with a recent observational study by Drake et al. [30] including 7548 patients. It can

explain why the majority of appendectomies occurred during the night, because all patients with UAA were referred immediately to the operating room, as soon as the diagnosis was established. Time of surgery for patients with non-perforating appendicitis is still matter of debate. Although several studies emphasized that time to intervention could be delayed beyond 24 h [31], it is our policy to perform a prompt surgical intervention. Our attitude is based, in particular, on the results by Teixeira et al. [32] who found that a delay of more than 6 h between time from admission to appendectomy significantly increased the risk of surgical site infection. Recent guidelines on acute appendicitis also recommend performing appendectomy as soon as possible [33].

In conclusion, this study reports a safe and feasible management of UAA using a dedicated 24-h emergency outpatient unit implying a medical and paramedical staff trained to manage a continuous flow of patients. This organization allows a short hospitalization for postoperative recovery without using conventional surgery beds and enables discharge all night long. Applied to AA, this management was successfully performed in 87% of patients with UAA.

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Compliance with ethical standards

Conflicts of interest The authors declare that they have no competing interests.

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