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POSITIVE IMPACT OF ULTRASOUND IN MANAGEMENT OF ACUTE APPENDICITIS IN CHILDREN

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ПОЛОЖИТЕЛЬНЫЙ ЭФФЕКТ ПРИМЕНЕНИЯ УЛЬТРАСОНОГРАФИИ ПРИ ЛЕЧЕНИИ ОСТРОГО АППЕНДИЦИТА У ДЕТЕЙ

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In the study was to quantify the impact of ultrasound (US) in the diagnosis and general management of acute appendicitis in children. Retrospective review of children assessed for acute abdominal pain in the Emergency Department (ED). Out of 327 patients, 145 (44.4 %) were examined also with US. A total of 154 patients underwent surgery, of which 67 (43.6 %) after US scan and 87 (56.4 %) with no US. Differences in surgical timing and procedure, histologic findings and length of stay in

the two groups were analyzed. In the US group the time gap between first examinations in ED to surgical intervention almost halved; operative time was shorter and total length of stay reduced. In conclusions, our study confirms the highly positive value of US evaluation in the initial assessment of abdominal pain in children.

Keywords: acute appendicitis, ultrasound, early diagnosis, assessment, Emergency Department

В исследовании проведено количественное определение роли ультразвукового исследования (УЗИ) в диагностике и общем лечении острого аппендицита у детей. Проведен ретроспективный обзор с оценкой острой боли в животе у детей в отделении неотложной помощи (ОНП). Из 327 пациентов 145 (44,4 %) были обследованы с применением УЗИ. В общей сложности 154 пациента были прооперированы, в том числе 67 (43,6 %) после УЗ-исследования и 87 (56,4 %) – без УЗИ. Были проанализированы различия в сроках и процедуре хирургического вмешательства, гистологические данные, продолжительность стационарного лечения в двух группах. В группе с использованием УЗИ временной разрыв между первыми исследованиями в ОНП и хирургическим вмешательством снизился почти в два раза; продолжительность оперативного вмешательства было короче, а общее время пребывания в стационаре сократилось в сравнении с группой без применения УЗИ. Таким образом, исследование подтверждает высокую положительную ценность УЗ-исследования при первоначальной оценке боли в животе у детей.

Ключевые слова: острый аппендицит, ультразвук, ранняя диагностика, оценка, отделение неотложной помощи

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CT – Computer Tomography
ED – Emergency Department
OR – Operating Room

TULAA – Transumbilical Laparoscopic Assisted Appendectomy
US – UltraSound

Acute appendicitis presents with a cohort of symptoms sometimes of difficult interpretation [1]. Variations in the appendix position, patient's age and degree of inflammation make clinical presentation of appendicitis somewhat inconsistent, while an accurate diagnosis is mandatory to avoid complications from an inappropriate or delayed surgical management. It has been demonstrated that a diagnostic approach based only on history and clinical examination leads to an unacceptably high percentage of negative appendectomy rate (between 9.2 and 35 %) [2, 3]. Clinical signs as McBurney, Rovsing and Blumberg are not always present, and sometimes are not of any help; the same applies also for laboratory tests.

Imaging modalities were therefore developed to increase diagnostic accuracy: according to some Authors, CT is the most sensitive and specific method to investigate the presence of acute appendicitis [4]. However, pediatric patients are particularly sensitive to ionizing radiation and 30 % of all pediatric CT examinations are unlikely to benefit the individual or could be easily and effectively replaced by a non-ionizing imaging technique [5]: among them, ultrasonography (US) has gained more and more momentum [6, 7], but its overall impact is not always properly appreciated.

Aim of the investigation was to study of quantify the impact of US in the diagnosis and general management of acute appendicitis in children. We hypothesize that using US in early diagnosis reduce decision-making times for surgery and length of stay.

Material and Methods. Medical records of 327 children (188 males, 139 females, M:F ratio 1:0.7) referred to the Pediatric Emergency Department (ED) of Policlinico San Matteo Research Hospital between 1st January 2016 and 31st December 2017 for abdominal pain and suspected appendicitis were retrospectively reviewed.

182 patients (55.6 %; M:F ratio 1:0.4) underwent clinical evaluation only (non-US group), while in 145 children (44,4 %; M:F ratio 1:1.3) clinical evaluation was integrated with an abdominal US examination performed directly in the ED (US group). In no cases CT scan was performed.

Decision to integrate clinical and laboratory diagnosis with US imaging in the ED was related to confuse clinical picture at admission or relapsing abdominal pain. Higher risk of ovarian pathology suggested a more generous utilization in girls, while in boys with a clear-cut clinical and laboratory picture US was usually deemed unnecessary for the diagnosis.

In the non-US group 95/182 children (52.2 %) were discharged, while 87/182 (47.8 %), admitted for further examinations, were thereafter operated upon. In the US group 78/145 children (53.8 %) were discharged, while 65/145 (44.8 %) turned out to be positive for acute appendicitis and immediately operated upon. In 2/145 cases (1,4 %) diagnosis was still uncertain after US and children were operated only one day after. These data are summarized in Table 1.

Table 1

Clinical cases distribution

	Ultrasound performed	Ultrasound not performed	TOTAL
Non operated upon	78 (53.8 %)	95 (52.2 %)	173 (52.9 %)
Operated upon	67(46.2 %)	87 (47.8 %)	154 (47.1 %)
TOTAL	145 (100 %)	182 (100 %)	327 (100 %)

In 56 out of 65 US positive cases (86.1 %) the scan showed direct signs of appendicular inflammation, namely wall thickness >0.3 cm, hypo-echogenicity, increased Doppler signal and/or presence of a coprolite; in 9 cases (13.9 %) appendix was not appreciable, but

periappendicular signs as thickened mesentery, nodal hypertrophy and free fluid or collection were present.

The study was then conducted on the two groups of patients undergoing appendectomy, those not examined with US (87 children) and those examined with US (67 children), comparing for each group surgical timing and procedure, histopathology findings, total length of stay.

Chi-square analysis was utilized to compare results.

Results and Discussion

Surgical timing

Delay between ED evaluation and entrance in the operating room (ED-OR ΔT) was $442 \pm 297'$ for US group and $815 \pm 742'$ for non-US group ($p < 0.0001$).

Operative room time (OR ΔT) – calculated as time elapsed from the entrance in the OR to the end of the anesthesia awakening phase – was $93 \pm 28'$ for the US group and $109 \pm 41'$ for the non-US group ($p < 0.003$). Duration of surgery (from initial incision to skin suture) turned out to be $61 \pm 27'$ for the US group and $72 \pm 36'$ for the non-US group ($p = 0.04$).

Surgical procedure

Primary surgical approach utilized in all 154 operated cases was transumbilical laparoscopic assisted appendectomy (TULAA). In 126 cases (81.8 %) appendectomy was performed without need to conversion (51.6 % US group, 48.4 % non-US). In 20 cases (13.0 %; 2 in US group, 18 in non-US group) a conversion to multi-trocar laparoscopy was required, while in 8 cases (5.2 %, all non-US group; $p < 0.0001$) conversion to open appendectomy was needed. Intraoperative conversion rate was therefore 3.0 % in the US group and 30.2 % in non-US group. No further intraoperative complications were recorded in both groups.

Postoperative period

Postoperative length of stay in the ward was 3.0 ± 1.4 days in US group vs 3.8 ± 2.2 days in non-US group ($p = 0.014$). Bowel movements appeared 1.35 ± 0.61 days in US group and 1.96 ± 0.79 days in non-US group ($p = 0.0027$). Antibiotic therapy was administered for 59 ± 38 hours in US group and for 78 ± 52 hours in non-US group ($p = 0.02$), while analgesia respectively for 45 ± 24 hours and 53 ± 32 hours. Timing data are summarized in Table 2.

brin-granulocyte. Comparing histology with US findings, when direct signs were present appendicitis was in most cases suppurative, while the presence of periappendicular signs – even if the appendix was not identifiable – was related to a higher prevalence of gangrenous appendicitis. Main US patterns are depicted in Figure 2.

Fig. 1. Degree of inflammation vs US findings

US Direct Signs		US Periappendicular signs	
Wall thickness > 0.3 cm		thickened mesentery / omentum / peritoneum	
Hypo-echogenicity		nodal hypertrophy	
increased doppler signal		free fluid	
presence of coprolite		collection	

Fig. 2. Main US findings in acute appendicitis

Table 2

Timing data of investigation

	Ultrasound group	Non-US group	p-value
<i>Surgical timing in minutes</i>			
ED-OR ΔT	442 ± 297	815 ± 742	$p < 0.0001$
OR ΔT	93 ± 28	109 ± 41	$p < 0.003$
Surgery duration	61 ± 27	72 ± 36	$p = 0.04$
<i>Post operative timing in dayspen</i>			
Length of stay	3.07 ± 1.42	3.8 ± 2.2	$p = 0.014$
Bowel movements	1.35 ± 0.61	1.96 ± 0.79	$p = 0.0027$
Antibiotic treatment	59 ± 38	78 ± 52	$p = 0.02$
Analgesia	45 ± 24	53 ± 32	$p = n.s.$

Histopathology

Relative incidence of degree of inflammation vs US signs is summarized in Table 3 and illustrated in Figure 1.

Histopathology examination showed higher prevalence of gangrenous appendicitis in non-US vs US group (47.2 % vs 31.2 %). 17 out of the 154 operated cases (11.0 %) showed histological diagnosis of chronic or exacerbation of chronic appendicitis, with hyperplasia of the mucosa-associated lymphoid tissue and signs of fi-

Acute appendicitis diagnosis can be challenging, but nevertheless an accurate diagnosis is mandatory for the proper surgical management to avoid complications. Even if abdominal pain is nearly a universal symptom, it may be difficult to assess in very young children; older children can give a history of their illness, toddlers and young school-aged children need a caregiver to communicate their history and this may not necessarily be accurate, because each caregiver may have a different perspective on the condition of the child [8]. Clinical findings in acute appendicitis may vary a lot showing a fair to moderate interrater reliability [9], hence the need of a more reliable imaging diagnostic tool.

Comparing the diagnostic performances of both US and CT scan for the diagnosis of appendicitis, Doria et al. reported sensitivity and specificity of US in children at around 88 % and 94 % respectively, while the pooled sensitivity and specificity for CT in children was 94 %

and 95 % [4]. A recent study by Elikashvili et al. showed a 60 % sensitivity of bedside ultrasound in pediatric appendicitis (95 % CI=46 % to 72 %) and a specificity of 94 % (95 % CI=88 % to 97 %) [10]. In some other series, slightly higher sensitivity of 83 % was reported [11, 12]. Despite this very high accuracy in detecting appendicitis, CT carries some non-negligible problems, particularly in children: actually, interest in emphasizing the risks of ionizing radiations is increasing [13], thus increasing as well the interest given to the US-assisted diagnosis of appendicitis [14] that prompted us to perform this study.

Main criticism that can be moved to it is the lack of a formal randomization of children to be submitted to US in the ED. On the other hand – once accepted some bias such as the wider adoption of US in girls – the relatively long span of time in which the study was performed, the variety of clinical pictures and of clinicians examining children suffering of abdominal pain and requesting an US in a 24/7 ED inflow, allow to consider our series sufficiently randomized, although informally.

One study confirmed that adoption of US as an ED diagnostic tool allows a faster diagnostic workup and management: actually, US examined children underwent surgery in half of the time needed in non-US patients. This resulted also in shorter duration of surgery and in faster discharge from the hospital.

The first consequence of a decreased ED-OR T after US evaluation turned out to be a significant reduction in the length of surgery, as a consequence of a shorter pre-operative time interval resulting in a lower incidence of conversions, typically ensuing a long-lasting inflammatory process (Table 3).

Disclosures:

The authors declare no conflict of interest.

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Table 3
Degree of inflammation vs US findings

Degree of appendiceal inflammation	Non-US group	US group		
		Direct signs	Periap-pendicular signs	Doubtful findings
Acute simple	23 (26.4 %)	16 (23.8 %)	2 (2.9 %)	
Suppurative	23 (26.4 %)	24 (35.8 %)	2 (2.9 %)	2 (2.9 %)
Gangrenous	41 (47.2 %)	16 (23.8 %)	5 (7.4 %)	
TOTAL	87 (100 %)	67 (100 %)		

Post-operative length of stay as well was significantly shorter in US group as a result of the virtuous cycle triggered by a faster diagnosis and a faster indication to surgery, ultimately resulting in a timely interruption of the inflammatory process.

Moreover, false negative ratio after an US assessment was practically nil, with none of the children discharged undergoing surgery in the following two years.

Conclusions. Our study allows to conclude supporting the concept that, given the described unquestionable benefits, US should be employed in a widespread manner in the initial assessment of all children presenting with suspected acute appendicitis, directly in the ED, being a useful device able to differentiate between common causes of abdominal pain in children and thus expediting an appropriate clinical management [15].

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TREATMENT OF UMBILICAL GRANULOMA IN NEONATES

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ЛЕЧЕНИЕ ФУНГУСА ПУПКА У ГРУДНЫХ ДЕТЕЙ

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Umbilical granuloma is the most common umbilical abnormality in young infants and neonates. This prospective study was conducted on 21 infants (28–63 days old) with an umbilical granuloma. The treatment, performed in the patient's home, comprised application of common (edible) salt on the lesion twice a day for 5 days. Results were good in all cases. Thus, application of common salt for treating umbilical granulomas is simple and safe.

Keywords: umbilical granuloma, infants, treatment

Фунгус – одно из часто встречающихся заболеваний пупка у новорожденных и грудных детей. Было проведено проспективное исследование 21 ребенка в возрасте 28–63 дней, лечившихся амбулаторно. Лечение проводилось родителями дома путем аппликаций кристаллов столовой соли на фунгус под лейкопластырной наклейкой на 20 минут дважды в день, на протяжении 5 дней. У всех пациентов был получен хороший результат. Таким образом, использование предлагаемой методики показало ее эффективность и безопасность в лечении фунгуса пупка у грудных детей.

Ключевые слова: фунгус пупка, дети, лечение

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Umbilical granuloma is the most common umbilical pathology in newborns and young children [1, 2], developing in about 1 in 500 births [3]. The umbilical granuloma is overgrown tissue that develops during the healing process of the navel, usually in response to a mild infection. It appears as a soft, pink or red lump and is often wet, oozing a small amount of clear or yellow fluid. Umbilical cord granulomas do not contain nerves and thus have no sensation [4]. The umbilical cord is usually separated within 7–10 days after delivery [5]. Normally, the granulation tissue

of an absorbable umbilical stump of a newborn disappears by the second or third week of life. If present after this time, the persistent granuloma requires attention. Methods for treating umbilical granulomas include chemical cauterization with silver nitrate or copper sulfate, cryo-cauterization, electrical cautery, a double-ligature technique, and surgical excision. In addition, in 1972, Schmitt described the drying effect of table salt on umbilical granulomas [6].

Our study aimed to evaluate the therapeutic effect of edible salt on umbilical granulomas in neonates.