

# What do you do with a normal appearing appendix?

## A national study of Pediatric Surgeons

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### ABSTRACT

**الأهداف:** قد يواجه الجراحون الزائدة الدودية تبدو طبيعية جداً لدى مريض مصاب بالتهاب الزائدة الدودية المشتبه به سريريًا. الغرض من هذه الدراسة هو تحديد ممارسة جراحي الأطفال في المملكة العربية السعودية عند حدوث ذلك، وتحديد الأسباب الكامنة وراء اتخاذهم للقرار.

**المنهجية:** قمنا بإرسال مسح إلكتروني إلى جميع جراحي الأطفال في المملكة العربية السعودية. وشملت نقاط البيانات التي تم جمعها التركيبة السكانية، وتفضيل التصوير خلال الفترة المحيطة بالجراحة، والممارسة الشخصية عند علاج الزائدة الدودية الطبيعية جداً أثناء العملية لدى الأطفال الذين يعانون من الأعراض.

**النتائج:** تم الحصول على إجمالي 105 استجابات مما أدى إلى معدل استجابة قدره 33.8%. غالبية المشاركين، 88 (87.1%) سيزيلون الزائدة الدودية بينما 13 (12.9%) ستركونها في مكانها. السبب الأكثر شيوعاً لإزالة الزائدة الدودية كان احتمال الإصابة بالتهاب الزائدة الدودية المجهرية/الإندو 71 (34.8%)، بينما كان السبب الأكثر شيوعاً لترك الزائدة الدودية في موضعها هو احتمال استخدام الزائدة الدودية للحصول على فوائد ترميمية في المستقبل 11 (50%). الأغلبية العظمى 87 (86.1%) شعرت أنه لا توجد مبادئ توجيهية كافية بشأن إزالة الزائدة الدودية التي تظهر طبيعية في وقت الجراحة للاشتباه في التهاب الزائدة الدودية الحاد.

**الخلاصة:** غالبية جراحي الأطفال في المملكة العربية السعودية يجرّون عملية استئصال الزائدة الدودية عندما تظهر الزائدة الدودية طبيعية جداً أثناء العملية لدى المرضى المشتبه في إصابتهم بالتهاب الزائدة الدودية الحاد. هناك نقص واضح في المبادئ التوجيهية المنشورة للأطفال والدراسات الكبيرة لتوجيه هذا الأمر لعمل المسار الصحيح.

**Objectives:** Surgeons may encounter a grossly normal appearing appendix in a patient with clinically suspected appendicitis. The purpose of this study is to determine the practice of pediatric surgeons in Saudi Arabia when this is encountered, and determine the reasons behind their decision making.

**Methods:** An electronic survey was sent to all pediatric surgeons in Saudi Arabia. Data points collected included demographics, peri-operative imaging preference, and personal practice when managing an intra-operative grossly normal appendix in symptomatic children.

**Results:** A total of 105 responses were obtained yielding a response rate of 33.8%. The majority of respondents, 88 (87.1%) would remove the appendix while 13 (12.9%) would leave it in situ. The most common reason for removing the appendix was the possibility of microscopic/Endo appendicitis 71 (34.8%) while the most common reason for leaving the appendix in situ was the possible usage of the appendix for reconstructive benefits in the future 11 (50%). The overwhelming majority 87 (86.1%) felt that there were no sufficient guidelines on removal of the normal appearing appendix at the time of surgery for suspected acute appendicitis.

**Conclusion:** The majority of pediatric surgeons in Saudi Arabia would proceed with an appendectomy when an intra-operative grossly normal appendix is seen in patients suspected to have acute appendicitis. There is a clear lack of published pediatric guidelines and large studies to guide the correct course of action.

**Keywords:** appendicitis, negative appendectomy, pediatric surgery

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Acute appendicitis remains the most common cause of abdominal pain in pediatric patients.<sup>1</sup> Although there are large practice differences in the laboratory and radiological workup of children with suspected appendicitis, laparoscopic appendectomy is still the surgical management of choice.<sup>2,3</sup> Prior to the era of laparoscopic appendectomy, the majority of patients undergoing open appendectomy had their appendix removed even if it looked grossly normal intra-operatively in order to avoid future diagnostic dilemmas. This practice led to removal of histologically normal appendixes (negative appendectomy) with rates reaching 57% in the literature from that time period.<sup>4</sup> However, now with laparoscopic appendectomy, surgeons often find themselves in a difficult situation when they encounter a grossly normal appearing appendix in a patient with clinically suspected appendicitis and no other intra-operative pathology is found. This raises a valid question: what do you do with the appendix?

One reason to support removal of a normal appearing appendix is the false negative rate of gross diagnosis which is reported to be as high as 76%.<sup>5</sup> After all, assessment with the naked eye intra-operatively is not as diagnostic as histopathology. On the other hand, surgeons also strive to avoid negative appendectomies. In an attempt to address this confusion, several adult guidelines have been set forth to address the normal appearing appendix found during laparoscopy. The Society of American Gastrointestinal and Endoscopic Surgeons (SAGES) recommend individual decision making depending on the clinical scenario,<sup>6</sup> while the World Society of Emergency Surgery (WSES) 2020 guidelines recommended the removal of the appendix in this situation.<sup>7</sup>

There are no pediatric guidelines that address the management of a normal appearing appendix found at the time of laparoscopic appendectomy, which is surprising given the high incidence of acute appendicitis in this patient population.<sup>8</sup> However, several studies have attempted to address surgeon decision making. One recent study surveyed Canadian pediatric surgeons and revealed that 100% of them would remove the normal appearing appendix.<sup>8</sup> The purpose of this study is to determine the current practice of pediatric surgeons in Saudi Arabia when a grossly normal appendix is found

intra-operatively in patients with clinically suspected appendicitis, and to determine the reasons behind their decision making.

**Methods.** This cross sectional, quantitative, observational study took place at King Saud University, Riyadh, Saudi Arabia. This study examined all pediatric surgeons in Saudi Arabia from June to September 2023.. An electronic, self-administered 15 item questionnaire was created using a validated survey by Logie et al<sup>8</sup> as a template (**Appendix 1**). The survey was distributed via e-mail to all pediatric surgeons registered with the Saudi Commission for Health Specialties which is the licensing body for all healthcare professionals in Saudi Arabia. A reminder email was sent 2 weeks after the initial email. The study included all pediatric surgeons in Saudi Arabia and excluded incomplete survey responses. The survey included consent for participation, demographics, level of training and expertise, peri-operative imaging preference, personal practice when managing an intra-operative grossly normal appendix in symptomatic children, and the reasons behind their decision. Participation was voluntary and no compensation for response was offered. Institutional Review Board (IRB) approval E-23-7733 was obtained prior to the distribution of the survey. The data was analyzed using basic thematic analysis. Counts and percentages were used for categorical variables.

**Results.** A total of 105 responses were obtained from all pediatric surgeons currently working in Saudi Arabia yielding a response rate of 33.8%. Four respondents were excluded due to partial completion of the survey giving a total of 101 responses that were analyzed. The majority of respondents were consultant pediatric surgeons 58 (57.4%), while 12 (11.9%) were still in training as residents and fellows. Only 35 (34.6%) of respondents received their pediatric surgical training in Saudi Arabia while the majority were trained internationally 66 (65.4%). Fifty seven respondents (56.4%) had greater than 10 years of practice as pediatric surgeons while the remainder had less than that or were still in training. The majority of respondents practiced at high volume centers with over 25 appendectomies a year 61 (60.4%) **Table 1**.

**Workup and management of appendicitis.** When asked on the preferred method of appendectomy, 73 (72.3%) of respondents preferred the laparoscopic technique. As for pre-operative imaging, 66 (65.3%) would obtain an ultrasound, 4 (4%) would obtain a CT, while 30 (29.7%) would obtain no imaging at all if the history and physical exam support the diagnosis of appendicitis.

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**Management of the normal appearing appendix.**

When a normal appearing appendix is found at the time of laparoscopic appendectomy, and no other intra-abdominal pathology is found, 88 (87.1%) would remove the appendix while 13 (12.9%) would leave it in situ. The most common reason for removing

the appendix was the possibility of microscopic/Endo appendicitis 71 (34.8%) followed by avoidance of future confusion as to whether the patient had their appendix removed 51 (25%) **Table 2**. The most common reason for leaving the appendix in situ was the possible usage of the appendix for reconstructive benefits in the future 11 (50%). Furthermore, 65 (64.3%) admitted to have previously removed a pathologically normal appendix (negative appendectomy). The overwhelming majority 87 (86.1%) felt that there were no sufficient guidelines on removal of the normal appearing appendix at the time of surgery for suspected acute appendicitis.

**Table 1 -** Demographic data of Pediatric Surgeons.

| Demographic                                     | n (%)     |
|---|-----------|
| Total   | 101       |
| <b>Gender</b>                                   |           |
| Male  | 79 (78.2) |
| Female  | 22 (21.8) |
| <b>Age</b>                                      |           |
| 25-35   | 18 (17.8) |
| 36-45   | 35 (34.6) |
| 46-55   | 31 (30.7) |
| 56-65   | 11 (10.9) |
| >65   | 6 (6.0)   |
| <b>Current position</b>                         |           |
| Consultant in Pediatric Surgery                 | 58 (57.4) |
| Specialist in Pediatric Surgery                 | 31 (30.7) |
| Pediatric Surgery Fellow                        | 2 (2.0)   |
| Pediatric Surgery Resident                      | 10 (9.9)  |
| <b>Country of training</b>                      |           |
| Saudi Arabia                                    | 35 (34.6) |
| Egypt   | 12 (11.9) |
| Canada  | 12 (11.9) |
| Syria   | 6 (5.9)   |
| United Kingdom                                  | 5 (4.9)   |
| Others  | 31 (30.7) |
| <b>Years of practice as a Pediatric Surgeon</b> |           |
| Currently in training                           | 12 (11.9) |
| <5 years  | 14 (13.9) |
| 5 - 10 years                                    | 18 (17.8) |
| 11 - 20 years                                   | 29 (28.7) |
| >20 years                                       | 28 (27.7) |
| <b>Appendectomies per year</b>                  |           |
| 0-25  | 40 (39.6) |
| 26-50   | 33 (32.7) |
| 51-75   | 12 (11.9) |
| 76-100  | 6 (5.9)   |
| >100  | 10 (9.9)  |

**Discussion.** The decision to perform a surgical procedure on any patient can be challenging, perhaps even more so in children. Patients and their care givers place their trust in us to make the correct decisions regarding their care. As surgeons we occasionally encounter unexpected intra-operative findings and are expected to proceed according to what is in the best interest of the patient. In these circumstances we utilize the best available evidence as well as published guidelines to guide our decision making. Yet, there are currently no clear pediatric guidelines to follow when the surgeon encounters a normal appendix intra-operatively in a patient who is clinically suspected to have appendicitis and no other pathology is found as agreed upon by 86.1% of our respondents. While some may extrapolate the adult guidelines and apply them to pediatric patients, we must point out that the pediatric population is unique. Most notably is their young age and chance of developing appendicitis in the future which is reported to be 8.6% lifetime risk.<sup>6,7,9</sup> Furthermore, the appendix is of great reconstructive value that could be used in the future. It is this dilemma that has led us and other authors to ascertain how pediatric surgeons are managing the normal appearing appendix.

One international survey published in 2012,

**Table 2 -** Reasons for removal of a normal appearing appendix

| Reasons for proceeding with appendectomy when an intra-operative grossly normal appendix is seen in pediatric patients suspected to have appendicitis and no other pathology was found | n (%)     |
|--|-----------|
| The possibility of microscopic /Endo appendicitis  | 71 (34.8) |
| To prevent future appendicitis   | 28 (13.7) |
| To avoid future confusion for the patient as to whether they had their appendix removed  | 51 (25.0) |
| It improves symptoms post-op   | 19 (9.3)  |
| The operative consent dictated that you were going to remove the appendix  | 12 (5.9)  |
| Patient/parent preference based on the consent discussion beforehand   | 9 (4.4)   |
| Obligation to do something since the child is already in surgery   | 3 (1.5)   |
| This is how I was trained  | 11 (5.4)  |

asked members of the American Gastrointestinal and Endoscopic Surgeons (SAGES), the French Society for Endoscopic Surgery (SFCE) and the Italian Society for Endoscopic Surgery (SICE) about intra-operative decision making and 64% to 73% agreed they would remove the appendix even if it was normal during a laparoscopy for patients with suspected appendicitis.<sup>10</sup> Another study surveyed members of the Association of Laparoscopic Surgeons of Great Britain and Ireland (ALSGBI) and found that 61% of surgeons would remove a macroscopically normal appendix.<sup>11</sup> The only study that specifically looked at practice of pediatric surgeons surveyed members of the Canadian Association of Pediatric Surgeons (CAPS) and found that 100% of pediatric surgeons would remove the appendix in this situation.<sup>8</sup> Our current study revealed that 87% of pediatric surgeons in Saudi Arabia would also remove the normal appearing appendix at the time of surgery.

According to an international survey, the most common reason for surgeons to remove the normal appearing appendix was ‘for possible endoluminal appendicitis’ (49%) followed by ‘to prevent future appendicitis’ (37%). The third most popular reason (15%) was ‘to avoid future confusion for the patient as to whether or not he or she has an appendix’.<sup>10</sup> As for Canadian pediatric surgeons, The most common reasons cited for removal of a normal appearing appendix were: the possibility of endo/microscopic appendicitis (39/54, 72.2%), avoiding future diagnostic confusion (28/54, 51.9%), and patient preference/terms of the consent discussion (21/54, 38.9%).<sup>8</sup> Our respondents had the same rationale with 71 (34.8%) opting to remove the appendix due to the possibility of microscopic/Endo appendicitis which is histologically defined as “neutrophils within mucosa and mucosal ulceration” followed by avoidance of future confusion as to whether the patient had their appendix removed 51(25%).<sup>12</sup> This is interesting as there is a debate regarding the entity of microscopic appendicitis with some authors considering it a mild appendicitis that is sometimes a self-limiting disease.<sup>13</sup> Another little known entity is neuroimmune appendicitis which is “neuroproliferation in the appendix, in association with an increase in neurotransmitters substance P and vasoactive intestinal peptide, causing acute right abdominal pain in the absence of an acute inflammation of the appendix.”<sup>14</sup>

On the other hand, there are several studies that support keeping the normal appearing appendix during laparoscopy for patients with suspected appendicitis. In one recent study, it was found that only 4.17% of all appendixes left in situ in patients with suspected appendicitis but grossly normal appendix had a

microscopically proven appendicitis found when the patients came back with the same complaint and had an appendectomy.<sup>15</sup> Another study from Denmark in 2019 analyzed 271 cases of patients suspected to have acute appendicitis but appendix was left in situ due to the grossly normal appearance with median follow-up of 5.6 years, and only one case had microscopically proven appendicitis after a repeated laparoscopy.<sup>16</sup> Another study in 2001, evaluated 109 diagnostic laparoscopies in patients with suspected appendicitis but the appendix was left in place due to the grossly normal appendix, only one case had microscopically proven appendicitis after a medical follow-up of 4.4 years.<sup>17</sup> A report by Champault et al<sup>18</sup> recommends not removing the macroscopically normal appendix due to the potential complications and the 4.5% morbidity. According to our current study, 13 (12.9%) of surgeons would not remove the appendix due to its potential future reconstructive benefit 11 (50%) and to avoid unnecessary risk of post operative complications 5 (22.7%). The main reconstructive usage is the Mitrofanoff appendicovesicostomy which urologists utilize the appendix to create continent and catheterizable conduits to the anterior abdominal wall.<sup>19</sup> This technique was first described in 1980 and since then has been utilized in patients requiring intermittent catheterization for various conditions with reported case series outlining its durability.<sup>20</sup>

One of the main strengths of this study is that it included responses from pediatric surgeons of all levels of training and expertise. Specifically, we had responses from residents, fellows, specialists, as well as consultants in the field. Furthermore, 28 (27.7%) of respondents had over 20 years of experience as a pediatric surgeon. Another point is the diverse international pediatric surgery training background of our respondents who trained in over 19 countries worldwide and currently in practice in Saudi Arabia.

**Study limitations.** As with other survey studies, the main limitation of this study is the low response rate of 33.8%. However, the response rate for physician targeted surveys is notoriously low at 23-36% and our rate falls within this range. This was a descriptive survey duplicated from a validated and evaluated prior study however is still vulnerable to bias such as non-response.<sup>8,21</sup> The survey was distributed to surgeons currently practicing in Saudi Arabia however maybe applicable to other populations.

In conclusion, the majority of pediatric surgeons in Saudi Arabia would proceed with the appendectomy when an intra-operative grossly normal appendix is seen in patients suspected to have acute appendicitis when other causes are excluded. Based on this study we

cannot advocate for removal nor keeping the appendix as there is a clear lack of published pediatric guidelines and large studies to guide the correct course of action. However, we do recommend that both options be discussed with the patient and care givers as part of the informed consent process.

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**Appendix 1** - Self administered questionnaire.

|   |  |
|---|--|
| What is your Gender?  | A) male<br>B) female   |
| What is your age?   | A) 25><br>B) 25-35<br>C) 36-45<br>D) 46-55<br>E) 56-65<br>F) 65<   |
| What is your current position?  | A) Consultant in Pediatric Surgery<br>B) Specialist in Pediatric Surgery<br>C) Pediatric Surgery Fellow<br>D) Pediatric Surgery Resident<br>E) Retired Pediatric Surgeon   |
| Where did you complete your Pediatric Surgery training?   |  |
| In which region of Saudi Arabia are you currently practicing?   | A) Central (Riyadh and Qasim )<br>B) Western (Mecca, Medina, Jeddah )<br>C) Eastern ( Dammam, Khafji, Al Hasa )<br>D) Northern (Tabuk, Jouf, Hail )<br>E) Southern (Asir, Najran, Jizan )  |
| How many years have you been practicing as a pediatric surgeon ?  | A) Currently in training<br>B) Less than 5 years<br>C) 5 - 10 years<br>D) 11 - 20 years<br>F) more than 20 years   |
| In your individual practice, approximately how many appendectomies do you perform per year ?  | A) 0-25<br>B) 26-50<br>C) 51-75<br>D) 76-100<br>E) >100  |
| What is your preferred method of appendectomy?  | A) Open<br>B) Laparoscopic   |
| Do you prefer to have pre-operative imaging even when the physical and history support a diagnosis of appendicitis?<br>If Yes then what kind of imaging do you obtain?  | A) No, I don't prefer preoperative imaging<br>B) Yes, Ultrasound<br>C) Yes, CT<br>D) Yes, Plain radiograph<br>E) Other   |
| You are performing a laparoscopic appendectomy for suspected acute uncomplicated appendicitis and the appendix appears structurally normal. You do not find any other obvious cause for the patient's symptoms.<br>Do you remove this appendix? | A) Yes<br>B) No  |
| Why would you choose to remove this appendix ? Check all that apply.  | A) I would not remove the appendix<br>B) The possibility of microscopic /Endo appendicitis<br>C) To prevent future appendicitis<br>D) To avoid future confusion for the patient as to whether they have had their appendix removed or not<br>E) It improves symptoms post-op<br>F) The operative consent dictated that you were going to remove the appendix<br>G) Patient/parent preference based on the consent discussion beforehand<br>H) Obligation to do something since the child is already in surgery<br>I) This is how I was trained |
| Why would you choose NOT to remove this appendix ? Check all that applies   | A) I would remove the appendix<br>B) Based on the scenario there is no evidence that the appendix is causing the patient's symptoms<br>C) Unnecessary risk of postoperative complications<br>D) Possible use of the appendix in reconstructive benefit in the future<br>E) This is how I was trained   |
| Do you feel that there are sufficient guidelines on the topic of whether or not to remove a normal-appearing appendix during laparoscopy for suspected acute appendicitis ?   | A) Yes<br>B) No  |
| In your individual practice, have you ever removed an appendix that pathology later deemed to be normal ( negative appendectomy )?  | A) Yes<br>B) No  |