

Dedicated emergency departments delay surgical treatment of acute appendicitis

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ABSTRACT

INTRODUCTION: A new emergency service has been introduced in Denmark. We aimed to assess the impact of the service change for the care of acute surgical emergencies, specifically a subset of patients treated with an appendectomy.

MATERIAL AND METHODS: This was a retrospective review of all the patients who had an appendectomy in a surgical department during one year prior to and one year after the implementation of a new emergency service. Data collected included patients' demographics and information related to the care such as the number of doctors involved in diagnosing appendicitis, whether preoperative radiological investigation was used, time to operation, morbidity during the first 30 days, including readmission, type of complication and required intervention.

RESULTS: A total of 314 patients had an appendectomy performed during the study period. After the implementation of the new emergency service, there was a significant delay in time to definitive treatment (457 minutes versus 593 minutes, $p = 0.001$). The total number of doctors involved in diagnosing appendicitis increased to a median of three doctors (range 1-6) from a median of two surgeons (range 1-6) ($p < 0.0001$). There was no difference in the number of readmissions or complications.

CONCLUSION: Introducing a new emergency service required an extra doctor for diagnosing appendicitis which delayed the overall time to definitive treatment by nearly 2.5 hours.

FUNDING: not relevant.

TRIAL REGISTRATION: not applicable as this is an audit study.

were treated in relevant departments at the earliest possible time. Furthermore, it was envisaged to secure a good flow of communication between the primary health-care service, the emergency department and the other hospital departments [4].

However, emergency medicine is not currently a formally recognised speciality in Denmark. A plan was drawn up to train emergency specialists. The plan involved obtaining a primary qualification in a speciality (medicine, surgery or, most commonly, general practice) followed by a further two years of training in the field of emergency medicine. The training included courses and supplementary training to prepare doctors for various diseases and injuries encountered in the emergency department. As the new emergency service had been launched while the training was under development, there were concerns that some of the doctors might not be fully prepared to diagnose the wide spectrum of conditions encountered in the new emergency department.

Despite of the implementation of new emergency departments, the referral of patients has yet to be streamlined using the "triage to service" model; no patient is allowed to self-refer to the new emergency department, and emergency general practitioner (GP) services remain the first contact point for any acutely ill patients before referral to the emergency department. In this system, all patients have their complaint attended to by a GP who makes a tentative diagnosis before their arrival at the emergency department [5]. The fact that the patient is seen by an extra physician at the emergency department may actually prolong the period that passes before a definitive treatment is initiated compared to the previous system in which patients were referred by the GP directly to a relevant hospital department.

Our hospital was the first hospital in Western Denmark to pilot the new emergency service. This study aimed to assess the impact of this policy change on the care of acute surgical emergencies with a focus on patients undergoing an appendectomy.

MATERIAL AND METHODS

This study is a retrospective review of all the patients who underwent appendectomy in our department during one year before and after the implementation of the

ORIGINAL ARTICLE

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Dan Med J
2014;61(3):A4791

Appendicitis is one of the most commonly encountered emergencies in general surgery [1]. Accurate diagnosis of appendicitis remains a significant clinical challenge. Missed or delayed diagnosis may lead to significant mortality and morbidity [2].

In 2007, the Danish National Board of Health issued a plan with 24 recommendations to enhance the emergency service in Denmark over a period of 5-10 years [3]. One of the radical recommendations was to make new individual emergency departments. The purpose was to enhance the quality and effectiveness of the initial treatment of acutely ill patients and to ensure that patients

 TABLE 1

Demographic patient data.

	2008	2011	p-value
Patients, n	150	164	
Age, median (range), yrs	36.5 (18.0-90.0)	39.5 (18.0-84.0)	0.63
Male/female, n	83/67	74/90	0.18
BMI, median (range), kg/m ²	26.3 (18.4-53.0)	25.4 (15.5-47.5)	0.02
Body temperature (median, range), °C	37.7 (36.0-40.3)	37.6 (36.2-39.9)	0.24
ASA I + II, n	144	155	0.28

ASA = American Society of Anesthesiologists' physical scoring system; BMI = body mass index.

new emergency service. As the new emergency care department was introduced in the first half of 2009, we reviewed records of all patients who underwent appendectomy during 2008 before the new set-up and during a one-year period in 2011 after the service was established. The new emergency department was staffed by emergency physicians trained in Sweden; and, under their support, first-year junior doctors having graduated from medical school primarily saw patients on arrival at the department.

All cases of appendectomy were reviewed using a prospectively registered operative code database. Children were excluded as the admission procedure had not been changed for this group of patients with the introduction of the emergency department and continues to be direct admission to the paediatric department via a GP.

Patients' demographic data included age, sex, body mass index (BMI), body temperature at the time of admission, and American Society of Anesthesiologists' physical scoring system (ASA) score. Information on the care of patients included the number of doctors involved from admission to definitive treatment, a number that was subdivided between the emergency department and the surgical department. Furthermore, it was recorded whether a preoperative radiological investigation was used (ultrasonography and/or computer tomography (CT)). The date and time when the patient was admitted and evaluated by a surgical resident in the old system or emergency physician in the new system, and the time of surgery (definitive treatment point) were reviewed. The pathology findings of the removed appendixes were categorised as 1. normal, 2. inflamed or phlegmonous, 3. gangrenous and/or perforated, and 4. inconclusive. Finally, we collected data on the number of days patients stayed in hospital, morbidity including readmission within the first 30 days, type of complications and required interventions.

Data analysis

Data are presented as means and standard deviations

for normally distributed data and medians and ranges for non-normally distributed data. Unpaired data were compared using the Mann-Whitney test or Wilcoxon's rank test and categorical data were analysed using Fisher's exact test or the χ^2 -test accordingly. A p-value of less than 0.05 was considered statistically significant. Statistical analysis was performed using GraphPad Prism (version 4.00 for Macintosh, GraphPad Software, San Diego California USA). This study did not require approval by the local ethics committee under Danish law.

Trial registration: not applicable as this is an audit study.

RESULTS

Patient demographics

A total of 314 patients underwent surgery at our department with a diagnosis of appendicitis during 2008 (150 patients) and 2011 (164 patients). There were 157 men and 157 women with a median age of 39 years (range 18-90 years). There were no differences in the baseline demographic data except for body mass index (BMI) (Table 1). The 2008 patients had a median body mass index of 26.3 (range 18.4-53.0) and the 2011 patients a median BMI of 25.4 kg/m² (range 15.5-47.5) with p-value of 0.02.

Diagnosis and treatment of appendicitis

In 2008, patients with a suspected appendicitis were referred directly to the surgical department; thus, no emergency doctor was involved in diagnosing appendicitis. After the implementation of the new emergency service, the number of emergency department doctors involved was a median of one doctor (range 0-4). Whereas the majority of the patients (146 of 164, 89.0%) were seen by one emergency doctor, the second largest proportion of patients were not seen by any emergency doctor (13 of 164, 7.9%). The number of surgical residents involved was a median of two in both 2008 and 2011, but the total number of surgeons involved was higher in 2008 than in 2011 ($p = 0.02$). Thus, the total number of doctors involved in diagnosing appendicitis combining emergency doctors and surgeons has increased with the new set-up. Patients were seen by a median of three doctors (range 1-8) in 2011 compared with a median of two surgeons (range 1-6) in 2008 ($p < 0.0001$).

The majority of the patients (80.7%) were diagnosed clinically (without any radiological investigation) in 2008 and this was similar to the number diagnosed clinically in 2011 (78.7%). The number of patients who had a CT increased by 54% from 0.7% in 2008 to 16.5% in 2011. This difference, however, was not statistically significant ($p = 0.30$). The data are summarised in

Table 2.

The time from admission to operation was a median of 457 minutes (range 83-6,841) in 2008 and 593 minutes (range 159-4,324) in 2011 ($p = 0.001$). The operative time to remove an appendix was a median of 46 minutes in 2008 and 50 minutes in 2011 ($p = 0.07$). The use of laparoscopy alone to remove the appendix rose markedly from 2008 to 2011. Whereas the number of laparoscopic appendectomies was 105 out of 150 (70.0%) in 2008, this number had increased to 140 out of 164 (85.4%) in 2011, and this was a statistically significant difference ($p = 0.003$). Despite this, there was no difference in the spectrum of pathology during the examined time periods ($p = 0.70$); the histology results are summarised in **Table 3**. There was no difference in the total number of days of admission ($p = 0.17$), the number of readmissions ($p = 0.08$) or the number of surgical complications ($p = 0.48$) and medical morbidities ($p = 0.69$) during the first 30 days after the index appendix operation between 2008 and 2011.

DISCUSSION

In order to assess the impact of the new emergency department on the care of the surgical emergency, we investigated the care provided to patients undergoing appendectomy because appendicitis is the most common surgical emergency and normally the first condition encountered by a surgical trainee. An accurate clinical diagnosis of appendicitis is regarded as a basic and fundamental skill learned during the first years of surgical training. It is thus potentially a good benchmark for assessing the level of surgical skill at the new emergency department and the impact of the service change.

The present study showed some interesting outcomes of the implementation of the new emergency service. The time from admission to definitive surgical intervention has increased resulting in an almost two-and-a-half-hour delay to definitive treatment. This may be due to the fact that the number of doctors involved in diagnosing appendicitis in the hospital has increased with the new set-up. In most cases, the emergency doctor involved was an inexperienced physician in the first year of his or her career [6]. This may have contributed to the delay in diagnosis although all emergency cases are primarily seen by a GP before they are referred to the emergency department. The nature of the complaint had therefore already been roughly outlined before the patients arrived at the hospital. Although the aim of the new emergency care was that patients should be seen by senior physicians upon arrival at emergency department [3], a recent study has shown that 76% of the Danish emergency departments which have implemented the new set-up are not covered by senior staff 24 hours a day [7]. This present study suggests that this shortcoming of the new system may have contributed to

a delay to definitive treatment. On the other hand, it is also worth noting that in the new set-up almost 8% of the patients were not seen by any emergency physician. This may reflect that patients were triaged by a nurse and thereby bypassed the emergency department when a diagnosis had been established by GPs. This raises a further question as to whether the new emergency department provides a suitable educational platform for junior doctors in the first year of his or her career. It may be better for junior doctors to be attached to speciality departments during the first year so that they can acquire basic clinical skills that will prepare them for work in the emergency department in future.

Although not statistically significant, there was a trend towards using more CTs within the new set-up. Most of our emergency department's senior staff are emergency specialists with a background in medicine or general practice; thus, they may have been more dependent on imaging to supplement their clinical diagnosis. It may also be speculated that CT may have been used more frequently by inexperienced young doctors who could not detect appendicitis on the basis of clinical examination alone. During the last couple of decades, many attempts have been made to improve the accuracy of diagnosis using various imaging modalities and scoring systems based on clinical and paraclinical grounds. However, a sound clinical evaluation by a surgeon or surgical trainee remains the cornerstone of diagnosis, and it has been advocated that assessment by surgeons supersedes that of other physicians or radiological investigation resulting in lower morbidity and complications [8]. This may be an area that requires fur-

 **TABLE 2**

Diagnosis and treatment.

	2008	2011	p-value
Doctors evaluating the patient before operation, median, n	2	3	< 0.0001
Diagnostic computed tomography, %	10.7	16.5	0.30
Time from admission to operation, median, min.	457	593	0.001

 **TABLE 3**

Emergency department. The values are n.

	2008	2011	p-value
Inflamed/phlegmonous	86	101	0.70
Gangrenous/perforated	51	53	–
Normal	11	9	–
Inconclusive	2	1	–



Emergency department.

ther discussion in order to improve core clinical skills training for emergency physicians in Denmark.

The increased use of laparoscopy may be a factor contributing to the decreased number of readmissions in 2011 as laparoscopic appendectomy is well known to have lower complication rates, shorter hospital stays and reduced surgical site infections compared with open appendectomy [9, 10] which may have offset the delay to definitive treatment. The decreased number of readmissions could also be explained by increased standardisation of post-operative care such as a strict guideline on indication and administration of antibiotics that has led to a better patient outcome. Approximately one third of our patients had a gangrenous or perforated appendix. We could not verify whether the perforation was primary or secondary due to the handling of the fragile appendix. In any case, there is room for improvement in providing an accurate and swift diagnosis and possibly also for better handling of the fragile appendix with laparoscopic instruments.

This was a retrospective study; thus, it was not possible to collect information on how clinical diagnosis was established such as classic clinical pain site and physical examination. It was also not possible to investigate all the time intervals such as the time from the emergency department admission to the surgical consultation and the period from the surgical consultation to definitive operation in the new emergency pathway; such data would have allowed for a more accurate comparison of the old and new system.

CONCLUSION

The implementation of the new emergency service had an impact on the treatment of appendicitis; specifically, it significantly increased the time to operative intervention. The delay to definitive treatment may be due to the extra personnel resource engaged under the new emergency service.

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ACCEPTED: 19 December 2013

CONFLICTS OF INTEREST: none. Disclosure forms provided by the authors are available with the full text of this article at www.danmedj.dk.

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