

# Laparoscopic appendectomy during pregnancy is safe for both the mother and the fetus

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## ABSTRACT

**INTRODUCTION:** The diagnosis and treatment of acute appendicitis during pregnancy is still debated. While laparoscopic appendectomy in general has become the gold standard, this procedure has not generally been implemented for pregnant women.

**METHODS:** We retrospectively reviewed the patient charts of all patients who underwent appendectomy during pregnancy in the period from 2000 to 2012. Open appendectomy (OA) was performed in 25 cases and laparoscopic (LA) in 19.

**RESULTS:** We observed a significantly longer operation time (69 versus 49 min.,  $p = 0.002$ ), but fewer complications, a shorter hospital stay (2.6 versus 5.5 days,  $p = 0.004$ ) and a lower rate of negative appendectomies (16% versus 52%,  $p = 0.02$ ) in the LA group compared with the OA group. The mean gestation age at appendectomy was significantly lower in the LA group. There were no significant differences in gestational age at birth, Apgar score, birth weight or height between the two groups. Five births (11%) were categorised as mildly to moderately preterm. There were no cases of fetal loss.

**CONCLUSION:** Laparoscopic appendectomy is safe for both the mother and the foetus during pregnancy irrespective of gestational age, and the procedure is associated with a low risk of post-operative complications.

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Acute appendicitis is the most common non-obstetrical abdominal surgery condition during pregnancy [1]. Nevertheless, it is a rare condition with an incidence of approximately one in every 1,500 pregnancies [2]. The diagnosis of acute appendicitis in pregnant women is difficult and challenging as abdominal symptoms are common during pregnancy and physiological leukocytosis during pregnancy may be a confounder. Transabdominal ultrasound has a low negative predictive value in acute appendicitis, computed tomography is contraindicated due to radiation hygiene and magnetic resonance imaging is time-consuming and often unavailable. A delay in the diagnosis and intervention is associated with an increased rate of perforation with peritonitis and consequently increased maternal morbidity and risk of fetal loss or prematurity [3, 4].

It is generally accepted that the diagnostic laparoscopic approach is the gold standard for suspected appendicitis. This is also the case in pregnant women, although this is still being debated. The aim of this retrospective study was to evaluate changes in the surgical approach and results of acute appendectomy during pregnancy.

## METHODS

A retrospective charts review was performed on all patients undergoing laparoscopic or open appendectomy during known pregnancy in the period from January 2000 to December 2011. The diagnosis code used was appendectomy (International Classification of Diseases, Version 10 (ICD10) code: KJEA), in women 15-45 years of age. The charts review was based on charts from a single centre covering a population of 288,000. Patients from both surgical and gynaecological departments were included. The gestational age at operation was classified as first, second or third trimester. According to peri-operative findings and the pathology report, each case was classified into the following three categories: normal appendix (pathology report alone), phlegmonous appendicitis and complicated appendicitis, i.e. gangrenous, perforated appendicitis or periappendicular abscess. The following data were registered; operative duration in minutes, conversion of laparoscopic to open surgery, length of hospital stay and any registered post-operative complications within 30 days that required surgical or medical intervention. Procedures that were converted to open surgery were included in the LA with respect to complications in accordance with the principle of intension to treat. From the subsequent birth reports, the following data were registered: gestational age, Apgar score at 1 and 5 min., birth weight and length. Evaluation of prematurity was done according to the WHO classification. None of the patients were registered with any significant co-morbidity.

For the statistical analysis, Fisher's exact test was used for comparison of categorical data between groups, and the Mann-Whitney U-test was used for continuous data. Data were analysed using Stata 13.0 and  $p < 0.05$  was considered significant.

*Trial registration:* not relevant.

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 TABLE 1

Appendix pathology and distribution between trimester and surgical approach. The values are n.

Trimester	Pathology	Appendectomy	
		laparoscopic	open
1st	Normal appendix	0	0
	Phlegmonous appendicitis	5	0
	Complicated appendicitis <sup>a</sup>	3	0
2nd	Normal appendix	2	11
	Phlegmonous appendicitis	5	4
	Complicated appendicitis <sup>a</sup>	0	5
3rd	Normal appendix	1	2
	Phlegmonous appendicitis	3	3
	Complicated appendicitis <sup>a</sup>	0	0
Total		19	25

a) Gangrenous, perforated or abscess.

 TABLE 2

Complications. The values are n.

	Laparoscopic appendectomy (N = 19)	Open appendectomy (N = 25)
Wound infection	1	6
Abscess	0	2
Haematoma	0	1

 TABLE 3

Fetal outcome with Apgar scores, fetal lengths and fetal weights; mean values.

	Laparoscopic appendectomy (N = 19)	Open appendectomy (N = 25)
Apgar score, 1 min.	8.7	8.2
Apgar score, 5 min.	9.7	9.3
Length, cm	48.6	49.3
Weight, g	3,458	3,366

## RESULTS

A total of 47 women were identified. However, two patients later underwent legal abortion and a third were foreign citizens and subsequently no record of the birth could be obtained, leaving a total of 44 patients for further analysis.

Laparoscopic approach (LA) was chosen in 19 (43.2%) cases of which two (11.8%) were converted to

open surgery. Open appendectomy (OA) was performed in the remaining 25 cases (56.8%). The choice of surgical approach was made at the surgeon's discretion and an explanation of the choice was rarely given. The surgeon in charge was a surgical specialist in two of the 19 laparoscopic procedures and five of the 25 open procedures, and the remaining procedures were performed by surgeons in training.

There was a difference in the mean length of gestation at the time of surgery with 16 weeks (95% confidence interval (CI): 12-21; range: 5-35) and 22 weeks (95% CI: 20-25; range: 13-34) for the LA and OA groups, respectively ( $p = 0.01$ ).

In total, 16 (36%) patients had a normal appendix (NA) removed and 28 had a histologically confirmed appendicitis, with phlegmonous appendicitis in 20 cases (46%) and gangrenous/perforated/periappendicular abscess in eight (18%) cases. The distribution of pathology in relation to LA or OA is shown in **Table 1**.

The mean operation time for the LA group was 69 (95% CI: 58-80) min. and for the OA group 49 (95% CI: 40-58) min. ( $p = 0.002$ ). The mean length of stay (LOS) was 2.6 (95% CI: 1.7-3.4) days for the LA group and 5.5 (95% CI: 3.7-7.3) days for the OA group ( $p = 0.004$ ). There were significantly fewer complications (**Table 2**) in the LA group with one out of 19 (5.3%) compared with nine out of 25 (36%) in the OA group, ( $p = 0.03$ ). Of the patients who had post-operative complications, three had a normal appendix, three a phlegmonous appendicitis and four had complicated appendicitis. There were no fetal losses or any infant mortality. Apgar score, birth weight and length are shown in **Table 3**. No significant differences were found between the two groups. There were five (11.3%) preterm births (three in the LA group and two in the OA group), which is higher than the overall 6.1% rate of preterm births in Denmark.

## DISCUSSION

The laparoscopic approach was predominant in the last part of the observation period. In general, only few and relatively minor complications were observed, but a significantly lower number of complications were seen in the LA group. This is similar to the findings reported by Cox et al in a recent study from 2015 which included 1,335 pregnant undergoing appendectomy [5]. In their study, there was no information on pregnancy or fetal outcome. We found a significant difference in LOS. This may be a result of a change in clinical routine during the study period. Another problem is the relatively small number of patients included.

A strength of our study is that all records of the women in fertile age who had undergone an appendectomy were reviewed. The reason was that a significant fraction of the pregnant women were not registered as

being pregnant in the electronic patient system. Therefore, the chosen search strategy secured a complete patient cohort. This has not been documented in previous studies.

A conversion rate of two of 19 (11.8%) is higher than the 1% reported by Walsh et al in a systematic review including 28 articles [6]. However, the difference is not statistically significant due to a limited number of cases. Both conversions were due to insufficient view over the abdominal cavity and not to complications arising during the procedure itself. In the majority of the cases, the reason for choosing a laparoscopic or open approach was not stated. When argued, the size of the uterus was noted as the reason for starting with an open procedure. There was a significant difference in mean gestational age between the two groups which supports the notion that uterine size was a factor in the choice of surgical approach. However, the number of LA procedures was similar to that of the OA group during the third trimester. During the time period, an increase in the number of laparoscopic appendectomies compared with open procedures was observed.

The frequency of NA in our study was higher than that reported by Chandrasegaram et al [7] in their review of appendectomy specimens from 4,670 appendectomies over a ten-year period where NA was found in 16.8% of males and 31% of females, but they provided no information about surgical approach. The incidence of negative appendectomies might be due to the adoption of an early intervention strategy, which is in accordance with the 2011 guidelines for the management of the acute abdomen in pregnancy [1]. As would be expected, most of the NA's are from the OA group where the appendix is traditionally removed. Unfortunately, we were unable to retrieve data about how many patients underwent diagnostic laparoscopy while being pregnant. The aim of the present study was to focus on appendectomy and not on the risk of diagnostic laparoscopy, which carries a much lower risk than appendectomy. Inclusion of this group in the laparoscopic group could be a confounder.

It is generally accepted in the literature that there are some benefits from laparoscopic surgery compared with open surgery [5, 8-11], but there is no general consensus as to whether laparoscopy should be considered the primary approach for pregnant women with acute appendicitis [6, 9, 12, 13].

The present study showed no differences in pregnancy outcome between LA and OA, which is in accordance with the study by Corneille et al [8]. For the fetal outcome, we found no differences between the two procedures when looking at Apgar score, weight, length and gestation age. This is consistent with the findings reported for other series [14-16]. There was a higher num-

ber of preterm births in our material than in the general population, but the small number of patients excludes any firm conclusions. We recorded no cases of fetal loss. Other studies have reported rates of fetal loss in 2-6% range [1, 3, 4, 12].

## CONCLUSION

Laparoscopic appendectomy is safe for both the mother and the foetus during pregnancy irrespective of gestational age, and the procedure is associated with a low risk of post-operative complications. Methodological limitations restrict definitive recommendations, but findings are consistent with the latest guidelines from 2011 [1].

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**CONFLICTS OF INTEREST:** Disclosure forms provided by the authors are available with the full text of this article at [www.danmedj.dk](http://www.danmedj.dk)

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