Trends in acute appendicitis among pregnant women, the risk for cardiac arrest and maternal-fetal mortality

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Abstract

Objective: Acute appendicitis represents a worldwide disease of public health in the worldwide. In the United States, substantial disparities exist by racial characteristics mostly impacting minority populations. In this study we identify socio-demographic trends, and pregnancy complications associated with acute appendicitis and the one without.
Method: We applied a retrospective and examined all inpatient hospital discharges in the United States from January 1, 2002 through December 31, 2014. The compilation of the dataset was performed using the National Inpatient Sample (NIS, formerly the Nationwide Inpatient Sample), the largest publicly available all-payer inpatient database in the U.S. made available by the Healthcare and Cost Utilization Project (HCUP). The study population consisted of pregnancy-related inpatient hospitalization for women 13-49 years of age, which were identified using HCUP-created "NEOMAT" variable. This NEOMAT indicator identifiers maternal diagnosis records of the basis of International Classification of Diseases, Ninth Revision, Clinical Modification (ICD-9-CM) diagnosis and procedure codes for pregnancy and delivery.
Results and Conclusions: We identified a total of 64,799 cases of acute appendicitis during pregnancy, yielding a prevalence of 11/10,000. There was a significant increase in the prevalence of appendicitis over time. While the risk for cardiac arrest was not elevated, that of maternal mortality was five times (OR = 5.16, 95% CI = 2.57-10.38) as high among mothers diagnosed with appendicitis during pregnancy. The combined risk for fetal loss or stillbirth was twice as high among individuals diagnosed with appendicitis (OR = 2.05, 95% CI = 1.85-2.28). Appendicitis during pregnancy increases the risk for cardiac arrest, and maternal mortality by about five-fold. We also found that the risk for fetal loss or stillbirth was doubled.

Introduction

Acute appendicitis is the most common extra-uterine surgical emergency requiring immediate surgical intervention during pregnancy. However, risks for mortality and near-miss conditions (e.g., cardiac arrest) remain poorly understood. This study was conducted to determine the temporary changes in rate of acute appendicitis in pregnant women over time compared to their non-pregnant peers in relation to cardiac arrest, maternal mortality and stillbirth.

Specific Aims

- **Aim 1:** To examine the socio-demographic information as related to women that received a diagnosis of appendicitis versus those that did not
- **Aim 2:** To determine the crude and adjusted odds ratios for the association between appendicitis and maternal and fetal conditions/outcomes

Research Methods

Our analysis covered the period from January 1, 2002 through December 31, 2014 using cross-sectional data from the Nationwide Inpatient Sample (NIS). The NIS, made available by the Healthcare Cost and Utilization Project (HCUP), currently constitutes the largest all-payer, publicly available inpatient database in the US. Each year, to create the sample of inpatient hospitalizations, HCUP employs a two-stage cluster sampling design that first stratifies all nonfederal community hospitals from participating states by five major hospital characteristics: rural/urban location, number of beds, geographic region, teaching status, and ownership. Then, from each unique stratum, 20% of hospitals are selected using a systematic random sampling technique. Joinpoint regression was used to estimate and describe temporal changes in the rates of acute appendicitis during the 13-year study period using the following ICD 9 codes to identify the condition: ICD 9 codes: 540.0, 540.1, 540.9, 541 and 542. Joinpoint regression is valuable in identifying key periods in time marking changes in the rate of events over time.[13, 14] The iterative model-building process began by fitting the annual rate data to a straight line with no joinpoints, which assumed a single trend best described the data. Then a joinpoint – reflecting a change in the trend – was added to the model and a Monte Carlo permutation test assessed the improvement in model fit. The process continued until a final model with an optimal (best-fitting) number of joinpoints was selected, with each joinpoint indicating a change in the trend, and an annual percent change (APC) estimated to characterize how the rate was changing within each distinct trend segment. We also estimated the risk of cardiac arrest, maternal mortality and stillbirth

Results

Table 1: Socio-Demographic Information as related to women that received a diagnosis of appendicitis versus those that did not.

	Rates of exposure	All (N)	Acute Appendicitis	Without Appendicitis
All discharges		57,331,147	63,571 (100%)	57,267,576 (100%)
Age	1: 15-24	19,431,321	25,900 (40.7%)	19,405,421 (33.9%)
	2: 25-34	29,481,536	30,081 (47.3%)	29,451,455 (51.4%)
	3: 35-49	8,418,290	7,590 (11.9%)	8,410,700 (14.7%)
Race/Ethinicity	1: NH-White	24,133,336	29,170 (45.9%)	24,104,166 (42.1%)
	2: NH-Black	6,811,860	5,222 (8.2%)	6,806,638 (11.9%)
	3: Hispanic	10,821,579	12,740 (20.0%)	10,808,839 (18.9%)
	4: Other	4,913,028	4,019 (6.3%)	4,909,009 (8.6%)
Discharge status	0: Died	7,215	38 (0.1%)	7,177 (0.0%)
	1: Routine	55,598,635	61,281 (96.4%)	55,537,354 (97.0%)
	2: Transfer	1,555,843	2,083 (3.3%)	1,553,760 (2.7%)
	3: DAMA	157,849	154 (0.2%)	157,695 (0.3%)
Severity	1: Minor loss of function	36,212,548	35,144 (55.3%)	36,177,404 (63.2%)
	2: Moderate loss of function	17,222,044	20,670 (32.5%)	17,201,374 (30.0%)
	3: Major loss of function	3,482,122	5,836 (9.2%)	3,476,286 (6.1%)
	4: Extreme loss of function	137,658	1,493 (2.3%)	136,165 (0.2%)
Risk of Mortality	1: Minor likelihood of dying	56,230,367	58,544 (92.1%)	56,171,823 (98.1%)
	2: Moderate likelihood of dying	642,419	3,056 (4.8%)	639,363 (1.1%)
	3: Major likelihood of dying	126,174	1,042 (1.6%)	125,132 (0.2%)
	4: Extreme likelihood of dying	55,412	500 (0.8%)	54,912 (0.1%)

Table 2: Crude and adjusted odds ratios for the association between appendicitis and maternal fetal conditions/outcomes

Outcome	Crude OR (95% CI)	Adjusted OR (95% CI)
Cardiac arrest	0.55 (0.18, 1.70)	0.51 (0.16, 1.57)
In hospital death	4.81 (2.39, 9.68)*	5.16 (2.57, 10.38)*
Fetal loss or stillbirth	2.03 (1.82, 2.25)*	2.05 (1.85, 2.28)*

OR = odds ratio
CI = confidence interval
Adjusted ORs adjust for age group, race/ethnicity, household income, insurance status, admission day, hospital census region, hospital size and teaching status.
*Denotes statistically significant estimate (CI for the measure of association does not cross 1).

Table 1 is a summary of comparison of socio-demographic characteristics across the five groups considered in this study (i.e., pregnant mothers with acute appendicitis and those did not compared by age, race/ethinicity, discharge status, severity, and risk of mortality). White mothers tend to have a higher incidence of having acute appendicitis compared to others. Besides that, risk of dying in pregnant women have acute appendicitis is higher than others. However, there is no significant different between age, discharge status, and severity between the acute appendicitis and without appendicitis.
Table 2 provides the results of pregnancy complications as a composite outcomes, such as cardiac arrest, in hospital death, and the fetal outcomes (fetal loss or stillbirth). The data shows that mortality rate is significantly high (almost 5 folded increase) among people with acute appendicitis compared to those without. Also, there is a 2-folded increase in risk of fetal loss or stillbirth among pregnant women with acute appendicitis than those of their counterpart.

Results (cont.)

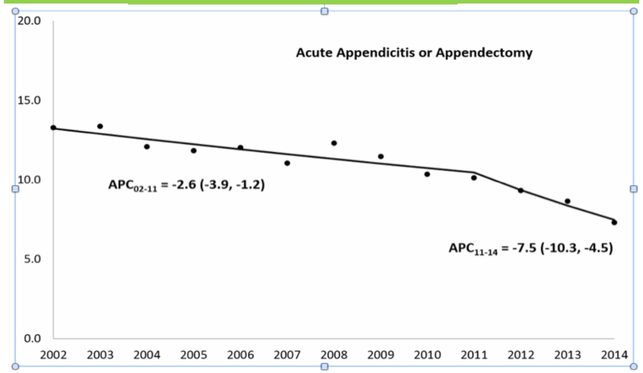

Figure 1: Pregnancy complications
The results of pregnancy complications are presented in Figure 1. Trends in the incidence of acute appendicitis during pregnancy, United States, 2002-2014.

Discussion

- As demonstrated by our findings, acute appendicitis and cardiac arrest in maternal-fetal mortality had a significant increase in the prevalence of pregnancy complications.
- This information is key because it provides opportunities for medical professionals to develop prevention strategies specifically targeted towards acute appendicitis in pregnant women. Further research should be conducted to identify and develop strategies to combat pregnancy complications.

Conclusions

Appendicitis during pregnancy increases the risk for cardiac arrest, and maternal mortality by about five-fold. We also found that the risk for fetal loss or stillbirth was doubled.

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