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Management of acute appendicitis in a rural population

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Abstract

BACKGROUND: Our system uses a hub and spoke approach to provide surgical care for our rural population. Patients access care anywhere in the system but are transferred centrally for surgical care. We sought to determine if surgical outcome differed depending on where initial care occurred. We chose acute appendicitis (AA) to investigate our care model.

METHODS: We identified patients admitted with the diagnosis of AA. Patients were divided into 2 groups, Bassett Medical Center presentation and satellite center (SAT) presentation. Demographics were compared and, time from system access to surgery, time of surgery, and clinical information associated with care.

RESULTS: There were no differences regarding any clinically relevant factor. SAT patients had longer mean surgery times, 60.7 minutes vs 51.5 (P=.008). Time to surgery, LOS, and complications were similar.

CONCLUSIONS: It is safe to care for AA patients with a hub and spoke approach without putting SAT patients at a disadvantage.

Approximately, 20% to 25% of the U.S. population (60 million people) live in rural America, depending on how *rural* is defined.[1,2] Access to quality care in rural settings presents unique challenges not found in urban populations that can lead to health care disparities.[1,3,4] With this in mind, the delivery of health care in rural settings continues to be a concern to many organizations. Decisions regarding staffing, surgeon availability, and resources must balance the low patient volume with the need to provide quality access to care for all patients. Adding to the difficulty is the relative shortage of rural surgeons. The number of general surgeons per 100,000 people is 4.67 in rural areas compared with 6.53 in urban areas.[5] This has forced health care organizations to develop unique care models that can provide surgical care to rural America.

Traditionally, rural hospitals, frequently Critical Access Hospitals, supported a single general surgeon, or occasionally 2. They provided continuous care support, had limited operating room staff, and often performed surgery off hours. With the changing dynamics of rural health care, this is becoming an increasingly unsustainable model.[2] To combat attrition and surgeon burnout, a variety of models of rural surgical care have been developed.[1,6] The hub and spoke

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approach (HSA) is one such model. This system involves several satellite centers (SAT) which triage and transfer patients to a centrally located main hospital when appropriate. Rather than maintaining a full surgical staff at each location, the main hospital is the only location that must be fully staffed to provide 24 hour surgical care. Our system, Bassett Health Care Network, uses this model.

This study looks to evaluate the appropriateness of the hub and spoke care model in our rural health care network. To this end, we chose to investigate the management of acute appendicitis (AA). Appendectomy for AA is one of the most commonly performed procedures by general surgeons in the United States [7] and it is well understood that the rate of perforation is correlated with time from the onset of symptoms to surgery.[8,9] An effective health care delivery system ensures prompt access to care and timely surgical treatment to minimize complication risk. Some studies have questioned the equality of care in hub and spoke systems.[10,11] This study investigates whether the hub and spoke model of care in our network provides comparable surgical outcomes regardless of where patients access our system. If there is disparity of care in the system, the care model must be revisited.

Methods

Bassett Healthcare Network is an integrated health care system that provides care and services to people living in an 8 county region covering 5,600 square miles in upstate New York. The organization includes 6 corporately affiliated hospitals, and 2 urgent care centers. In an attempt to bring surgical specialty care and general surgery care to remote areas of the large geographical area, surgeons are assigned to clinic in various locations around the network. Non-emergent consults can be addressed on-site; however, surgical emergencies are transferred to the main campus at Bassett Medical Center (BMC) in Cooperstown, NY. BMC is a teaching hospital with a general surgery training program finishing 3 categorical residents each year.

For this study, we identified patients who were admitted with the diagnosis of AA using International Classification of Disease-9 code and Current Procedural Terminology codes. The patients were divided into 2 groups: those who presented to the main campus at BMC, and those who presented to SAT and were subsequently transferred to BMC for definitive treatment. The study period for this retrospective chart review was January, 2011 to May, 2012. The study was approved by the BMC Institutional Review Board.

Continuous variables collected and analyzed included: time between initial presentation and procedure (in hours), length of stay in the hospital, age at time of procedure, operative time (in minutes). They were analyzed using the independent samples *t* test. Categorical variables that were collected and analyzed include sex, whether they received an appendectomy, imaging at presentation, ultrasound at presentation, procedure type, antibiotics given, 30-day readmissions, intraoperative perforations, perforations at presentation, administration of postoperative antibiotics, intraoperative complications, and postoperative complications. Categorical variables were tested using the Chi-square test or Fisher's exact test where appropriate.

Results

We found no clinically significant outcome differences between the 2 groups. About two thirds of our patients started at a SAT, a few of those at physician offices before accessing our system. This reflects our rural population and the modest population centers in our region. Demographic data are what would be expected of this cohort. The male/female ratio was similar in both groups. Mean age in years was 36.1 $\pm$ 19.9 SAT and 33.6 $\pm$ 20.1 BMC, P=.50.

Computed tomography scan was performed in most patients. Although infrequent, ultrasound was used more commonly at BMC than SAT facilities (16.7% vs 3.8%, P=.02). Appendectomy was performed in 123 of the 128 patient charts reviewed. Most patients in each group had laparoscopic appendectomy, with more open appendectomies earlier in the study. There were 5 patients (SAT 4, BMC 1) who did not have appendectomy on arrival. In those 5 patients, symptoms were present 4 to 21 days before presentation. One had abscess formation and 4 had phlegmonous changes. All were successfully treated non-operatively. All had interval appendectomy 6 to 12 weeks later. In only a handful of patients could we not document antibiotic use. (Table 1)

30 -day readmissions were infrequent in each group. In the SAT group 3 patients were readmitted, 1 for fever, 1 for abdominal pain/ileus, and 1 for alcohol intoxication. In the BMC group there were 4 readmissions, 1 patient for back pain and 3 patients for intra-abdominal abscess. Readmissions for abscesses were at postoperative days 8, 9, and 18. Each were successfully treated; 1 with antibiotics only, 1 with aspiration, and 1 with percutaneous drainage.

There were no statistically significant differences in complication rates and no clinically significant differences in the types of complications between the groups. Intraoperatively, there was 1 serosal tear of the cecum in the SAT group. There were no other intraoperative complications. There were 17 postoperative complications in 15 patients in the SAT group and 10 complications in 7 patients in the BMC group. In both groups, the most common complication was some combination of nausea/vomiting/diarrhea. In the BMC group 1 patient developed pulmonary edema, and in the SAT group 1 patient developed respiratory failure with pulmonary edema. One intra-abdominal abscess was treated as an outpatient with antibiotics in both groups. There were no other significant complications. There were no deaths.

The primary focus of this study was differences in care that could arise from differing points of access to our health