Seasonal variations in Acute Surgical admissions: A four-year audit of Surgical admissions

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ABSTRACT

Objective: To evaluate the number of patients admitted to hospitals as emergency cases under general surgery with regards to variations with seasons and case load of commonest surgical emergencies.

Study Design: Observational Descriptive study

Place and Duration: At York NHS Foundation Teaching Hospital and Scarborough District Hospitals, United Kingdom from 1st January 2013 to 31st December 2016.

Methodology: The Network Services York NHS Foundation Trust was requested to provide the data-base which included the data of the patients admitted to York Teaching and Scarborough District Hospitals. The data retrieved included all elective as well as emergency admissions among which the elective admissions were excluded from the analysis. Four major surgical diagnoses, which include acute appendicitis, cholecystitis, pancreatitis and diverticulitis were reviewed. Spring, summer, autumn and winter were defined as seasons. Patient admissions were categorized into 12 months and in 4 seasons. Edward's test was performed for 12-month seasonal statistical analysis and goodness of fit test was applied to verify four seasonal variations.

Results: A Total of 74,529 patients were admitted in both the hospitals, which include elective and emergency patients. Out of them 30,029 (40.29%) were admitted as acute surgical patients including all surgical sub-specialties with a significant monthly variation as $p<0.001$. Acute surgical admission trend in summer was 26.34% while it was 24.02% in winter. There was 2.32 % higher admission in summer as compared to winter. Among four major surgical diagnoses, acute appendicitis was 28.10% $p<0.001$, acute cholecystitis was 26.71% $p<0.001$, acute pancreatitis was 24.44% with $p<0.001$ and acute diverticulitis was 20.75% with $p<0.001$.

Conclusion: A steady cyclical trend in acute surgical admissions, with more admissions during summer months were observed.

Keywords: Hospital admissions, Emergency admissions, Surgical Admissions, Seasonal variations, Acute appendicitis, Cholecystitis, Diverticulitis, Pancreatitis

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INTRODUCTION

Seasonal variation is well established phenomena in medical conditions; however, its influence on acute surgical admissions cases remains unclear. Acute inflammatory diseases and abdominal pain are not uncommon causes of hospital admissions in the world. Some of them need urgent surgical treatment while other may need surgery after some time. There are few cases where patients, admitted under other specialties need surgical procedures. The medical diseases showing cyclical pattern is well established and has been discussed in the medical literature. Multiple studies have shown these patterns in the onset of several diseases like rupture of aortic aneurysms,[1,2] cardiac arrest, pulmonary embolism[3,4], epistaxis[5] and cerebrovascular accidents[6,7]. Numerous studies have confirmed the evidence of seasonal variations in the incidence of psychiatric illnesses. According to a study, which was done in 1838 by Jean-Étienne Dominique Esquirol, showed summer months were busier as compared to winter time in admitting the patients in mental hospitals[8]. Surgical literature has tried to explain different etiologies factors related to seasonal pattern in surgical acute inflammatory diseases[9]. Few studies, which were done in the past showed controversial seasonal variation results, for acute appendicitis and acute cholecystitis[10-12]. The seasonal variation information can be used to predict the need for hospital resources and the presence of human resources during the peak season, for optimizing patient care, whereas the data can be used in the clinical research[13-16].

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Keeping in view the above-mentioned rationale, we have conducted this study with an objective to evaluate the number of patients admitted to hospitals as emergency cases under general surgery with regards to variations with seasons and case load of commonest surgical emergencies.

METHODOLOGY

The data for this descriptive observational study was collected from York Teaching Hospital Information Technology Department and Scarborough District Hospitals, United Kingdom from 1st January 2013 to 31st December 2016. No human or animal subjects were involved in this research, only the diagnosis of the patients, who were admitted in the hospital were used in the methodology for data analysis. The data provided the information about patient's age, gender, admission date, year, discharge date, death date, admission method, primary procedure, primary diagnosis and hospital code. Only patients with emergent admissions were included. We used the term 'acute surgical diagnoses' (ASD) to refer, non-elective acute appendicitis, acute cholecystitis, acute pancreatitis and diverticulitis. We restricted our analysis to these four common gastrointestinal inflammatory diseases. The diagnostic codes for surgical admissions were filtered out to get actual 'acute surgical diagnoses' (ASD) for analysis.

Operational Definitions: The number of days for every month was adjusted with 'standardized months. The seasons were defined as per meteorological data[17] as: Winter (December to February), Spring (March to May), Summer (June to August) and Autumn (September to November)

Data Interpretation and Analysis: We analyzed all admissions from the data, which included elective and emergency admissions. The data was filtered, and all the elective, day-cases and other sub-specialties were excluded. The admissions which include (ASD) was analyzed on monthly and seasonal basis. Microsoft Excel 2010 was used to calculate age group, admission months, admission seasons and length-of-stay in hospital. All the number of patients were grouped in months and seasons. The number of days in every month was adjusted with 'standardized months. We assumed that all the months of a year are of 30 days. The ratio between the total numbers of cases per month of a particular month was multiplied with 30. For statistical analysis, we used Edward's test for monthly frequency of admissions, which was verified by using Goodness-of-fit test also. To evaluate the seasonal variations the later test was used by grouping the data in four seasons.

Edward's Test: In 1961 J. H. Edward published statistical test, designed for seasonality[18]. Later there were few modifications done by several others statistician, but all of them use sine- and cosine-waves to estimate the observed pattern. The test is based on a trigonometric contextual.

Goodness-of-Fit Test: It is simple and an easier method to calculate seasonal trends. Karl Pearson[19] introduced the concept in 1900, which can be applied to several statistical researches. It requires a sample from a population with an unknown distribution function F(x) and a certain theoretical distribution function F0(x).

RESULTS

A total of 74,529 patients were admitted in both the hospitals, which include elective and emergency patients. Out of them 30,029 were admitted as acute surgical patients including all the surgical sub-specialties, like orthopedics, vascular surgery, etc. with a significant seasonal variation as p<0.001. Total acute surgical admission trend in summer was 7,910 (26.34%) while it was 7,213 (24.02%) in winter. There was 2.32 % higher admission in summer as compared to winter. Out of a total of 5,306 (ASD), appendicitis was 1,491 (28.10%) p<0.001, cholecystitis was 1,417 (26.71%) p<0.001, pancreatitis were 1,297 (24.44%) with p<0.001 and diverticulitis were 1,101 (20.75%) with p<0.001.

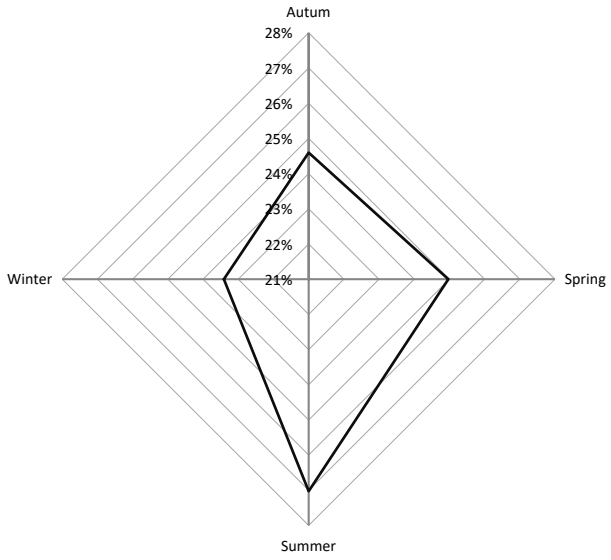

Figure-1: Seasonal variations on monthly basis (N=30029)

Table-I: Seasonal variations of (ASD) and subgroups (N=30,029)

	Edward Test		Goodness of fit	
	T	p – value	χ^2	p – value
(ASD)	331.77	<0.001	121.84	<0.001
Appendicitis	107.29	<0.001	36.83	<0.001
Cholecystitis	84.33	<0.001	49.34	<0.001
Pancreatitis	62.56	<0.001	81.81	<0.001
Diverticulitis	81.15	<0.001	40.35	<0.001

Monthly Analysis: In order to see the seasonal variation on monthly bases, the data was reviewed by adding all the admissions on 12 months calendar, from January to December.

Table-II: Seasonal variations of ASD and subgroups (N=30029)

	n (%)	Autumn n (%)	Spring n (%)	Summer n (%)	Winter n (%)	χ^2	p – value
(ASD)	5,306 (100.00%)	1,305 (24.59%)	1,325 (24.97%)	1,434 (27.02%)	1,242 (23.40%)	8.93	0.030
Appendicitis	1,491 (28.10%)	370 (28.35%)	354 (26.71%)	402 (28.03%)	365 (29.38%)	12.80	0.005
Cholecystitis	1,417 (26.70%)	356 (27.27%)	365 (27.54%)	379 (26.42%)	317 (25.52%)	8.11	0.043
Pancreatitis	1,297 (24.44%)	326 (24.98%)	337 (25.43%)	355 (24.75%)	279 (22.46%)	4.78	0.188
Diverticulitis	1,101 (20.75%)	253 (19.38%)	269 (20.30%)	298 (20.78%)	281 (22.62%)	11.28	0.010

The total number of acute surgical diagnoses (ASD) were 5,306, which includes 2,896 (55%) females and 2,410 (45%) males. The data also showed that the influx of the patients was 15%, highest on Mondays and 11%, least on Saturdays. Length of stay in the hospital for 3,822 (72%) patients were less than a week, whereas 1,073 (20%) stayed more than a week. The total number of admissions of (ASD) were at the peak in August with 537 (10%), followed by July with 459 (9%). The least number of admissions were in December with 395 (7%). It was also analyzed that the number of admissions starts to rise from March onwards. Edward test was applied to see the seasonal variations on monthly bases. Fig 2 shows the result after applying Edward test on monthly basis. It was also confirmed by applying goodness-of-fit. Total number of 'acute surgical admissions' as a group and the four diagnoses were plotted in months and the data was analyzed by both the tests.

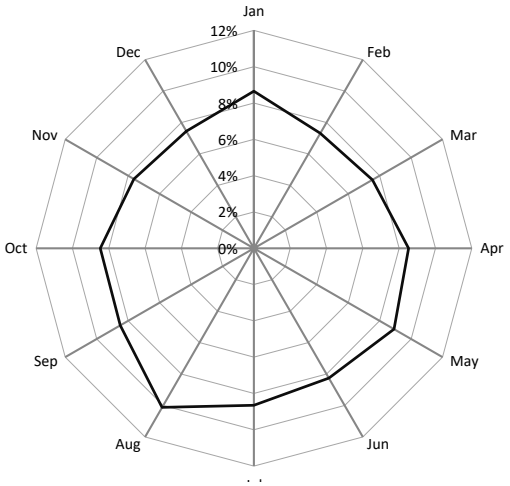

Figure-2: Seasonal variations of (ASD) (N=30029)

Seasonal Analysis: To check the seasonal variation the data was analyzed by arranging the total number of 'acute surgical admissions' as a group and the four diagnoses, on four seasons. It showed that the number of admissions in summer were 1,434 (27%) as compared to winter where the admission was 1,242 (23%). The total number of deaths were 300. The peaks deaths were during Saturdays, Sundays and Tuesday in springs and summers seasons. The least deaths occurred on Sundays and Wednesdays in winters and autumns seasons. Admissions were grouped in four age groups i.e. <18 years, 19 – 35 years, 36 – 65 years and >65 years. The analysis showed that nearly 200 patients were admitted more in summer as compared to winters, with highest numbers of admissions 650 were of 36 – 65 years of age group and least numbers of admissions 40 were of <18 years age group. It was clear from this analysis that the hospitals were busier in the summer times as compared to winters in all the years. Goodness of fit test was applied to see the seasonal variations on four seasons. Total number of admissions and the four diagnoses were grouped in four seasons and the data was analyzed.

DISCUSSION

The data we collected for analysis, showed that four major diagnosis was admitted more in the summer season as compared to winter. To analyse the seasonal variations simultanously, the data was collected from both the hospital for the same time period. Total acute admission were 74,529, with 1 : 2.84 contribution ratio. Male to female ratio was 3.5 : 1. The mean age was 58.89. We observed a clear seasonal variations in acute appendicitis, cholesystitis, pancreatitis and diverticulitis. It is important to mention that data collected from one of the place is for retired persons. Major laparoscpic procedures performed, includes appendicetomy (n=1,236), cholecystecomy (n=352) and diagnostic laparoscopy (n=22). Whereas open precedures includes Hartmann's procedures (n=72) and hemicolectomies (n=40), while two pancreatic necrocetomy were performed. Computed tomography and magnetic resonance cholangiopancreatography were (n=870) and (n=427) respectively.

Other studies have investigated the seasonal trend of acute appendicitis in different parts of the world. One such study done in U.S. found that acute appendicitis was higher in summer with 11.3%, than in winters[20]. Same results were seen in California, where July, August, and September, were at the peak, whereas the lowest rates occurred in December[21]. The summer months appeared to have a highest incidence of acute appendicitis and winter the lowest in New Jersey[22] and in Ontario, Canada[23]. No seasonal variation for acute appendicitis was found in Wales[24]. Acute cholecystitis is not an uncommon cause of acute abdomen. More than 95% of patients who are diagnosed with cholelithiasis have acute cholecystitis as its complication. While comparing our studies with past evidence, we find it noteworthy to highlight the fact that the results of our study are in sync with a similar study in Taiwan. It was a 13 year-long study involving 1,92,833 patients who underwent cholecystectomy. There was a notable increase in cholecystectomies during summers[25]. In the same vein, the findings of Hosseini et al also concur with the results of our study. Hosseini et al too concluded through their study that the summer season is a definite aggravating factor for gallstones and subsequent cholecystitis[26].

Acute pancreatitis has high morbidity, if not identified early it can be fatal and even death can occur. A recent study for a period of nine years, was done in one of the German hospitals, to evaluate acute pancreatitis with seasonal variation. Total of 263 cases were observed with no correlation between acute pancreatitis and month or season[27]. Our study showed high admissions with acute pancreatitis in March, May, July, and August. It was also noted that the pattern was evident with cholelithiasis and chronic alcoholic patients. In our study monthly analysis of subgroups showed variations with $p<0.001$ for acute appendicitis, cholecystitis, pancreatitis and diverticulitis, whereas seasonal variation did not show a significant trend for acute pancreatitis (χ^2 =4.78, p=0.188). Diverticulitis is a common disease with association to elderly patients, the etiology is not fully understood, but studies have shown association with obesity[28], physical activity[29], nonsteroidal anti-inflammatory drug[30] and dietary intake like nut and seed impaction in diverticula[31]. According to Maguire et al[32] high levels of 25-hydroxyvitamin D are associated with a lower incident of diverticulitis. Vitamin D levels are highest in summers and lowest in winters. Study done by Ricciardi et al[33] showed that there is a seasonal pattern in diverticulitis, whereas Warner et al[34] showed no evidence in their study. Our findings confirm the presence of a seasonal pattern in acute diverticulitis admissions. Due to the presence of discrepancies in past studies to see the seasonal variations in diverticulitis, it is clear that we need to do more studies with a larger data to see clearly, if there is any seasonal pattern.

CONCLUSION

The study relieved cyclical trend in acute surgical admissions, with more admissions in summer as compared to winter times. This information may be useful for hospital resource reallocation and staffing.

AUTHOR'S CONTRIBUTION

Yousaf A: Conceived idea, Designed methodology, Manuscript writing
Aziz R: Manuscript writing, Data collection, Literature search
Onos L: Data collection, Data analysis, Literature Search
Soare C: Data collection, Data analysis, Literature Search
Barandiaran J: Data collection, Literature Search, Manuscript writing
Ahmed I: Literature search, Critical Review

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