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Prevalence and Perioperative Complications of Metabolic Syndrome Among Eastern Indian Elective Surgical Patients

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A B S T R A C T

BACKGROUND: Perioperative management of patients with Metabolic Syndrome [1] has always been a challenge for the anesthesiologist. However, limited studies have been conducted to investigate perioperative complications and management strategies for these patients. Metabolic Syndrome is also associated with increased health service costs and longer hospital stays. The aim of this study is to determine the prevalence of Metabolic Syndrome and its impact on perioperative adverse events among Eastern Indian surgical patients.

AIMS: The aim of our study was to determine the burden of Metabolic Syndrome among patients undergoing elective non-cardiac surgery and to observe the various complications associated with them in the perioperative setting. Additionally, we sought to investigate whether Metabolic Syndrome could be associated with these complications.

SETTINGS AND DESIGN : This was a prospective observational study,which was conducted at a single centre tertiary care hospital for approximately 1.5 years.

MATERIALS AND METHODS: The study was conducted on a total of 246 adult patients who were scheduled to undergo elective non-cardiac surgery. Patients who met the diagnostic criteria for Metabolic Syndrome according to the NCEP ATP III guidelines [2] were included in the study. Complications observed in the perioperative period included cardiovascular, pulmonary, renal, neurological, infective, thromboembolic, and mortality. These complications were noted and statistically analyzed.

STATISTICAL ANALYSIS : For statistical analysis, data was entered into a Microsoft excel spreadsheet and then analyzed by SPSS (version 27.0; SPSS Inc., Chicago, IL, USA).using Chi-square test and p-value ≤ 0.05 was considered statistically significant.

RESULTS: In our study, the overall prevalence of Metabolic Syndrome among the 246 patients included was found to be 28%. Hyperglycemia was found to be the most common comorbidity, accounting for 60% of the total 70 cases. The study also showed a statistically significant difference in patients with Metabolic Syndrome, who had higher incidences of perioperative cardiac complications, pulmonary complications, and surgical site infections.

CONCLUSION : In our study, it was found that almost one in three of the 246 patients suffered from Metabolic Syndrome. Females had a higher prevalence compared to males. Our results indicate that Metabolic Syndrome represents a significant risk factor for the development of perioperative complications in the context of surgery.

Keywords: Metabolic Syndrome; Perioperative Complications

INTRODUCTION

The Metabolic Syndrome [1], also kn own as insulin resistance syndrome or syndrome X, is characterized by a cluster of metabolic abnormalities including abdominal obesity, elevated blood pressure, elevated blood glucose levels, low HDL-

C levels, and elevated triglyceride levels. The National Cholesterol Education Program and Adult Treatment Panel III have defined criteria for Metabolic Syndrome, requiring the presence of three or more specific factors[2]. The prevalence of Metabolic Syndrome varies globally, with the highest prevalence reported among Native Americans. However, prevalence rates are increasing among younger populations due to rising obesity rates. In India, the prevalence of Metabolic Syndrome is particularly high, with rates exceeding 40% in some reports [3].

The presence of Metabolic Syndrome increases the complexity and risk of anaesthetic management for surgical patients. Patients with Metabolic Syndrome are at higher risk for developing perioperative complications, including coronary artery disease, congestive heart failure, cerebrovascular disease, sleep apnea, pulmonary dysfunction, renal dysfunction, deep venous thrombosis, and wound infections [4]. Due to the different presentations and risk profiles of the syndrome's components, perioperative management requires assessing the cumulative risk of each component separately [4].

Anaesthesia for patients with the Metabolic Syndrome is technically challenging [6]. Airway management and intravenous access can be difficult. Atelectasis and oxygen de-saturation occur quickly with apnea [5]. Peri-operative care for patients with MetS includes indications for preoperative testing; use of aspirin, beta-blockers, statins, heparin, and angiotensin-converting enzyme inhibitors; anaesthetic strategies like regional anaesthesia; postoperative CPAP by mask, prevention of pulmonary embolism and indications for advanced respiratory monitoring. Since there are few data to support an evidence-based approach to gl,lmobal anaesthetic management, the focus is to mitigate the clinical features of the syndrome that generate the greatest perioperative risk.

There is a paucity of data concerning the anaesthetic management of patients with MetS, and only a few observational (mainly retrospective) studies have investigated the association of MetS with perioperative outcomes [7-9]. Metabolic Syndrome has also been related to increased health service costs, prolonged hospital stay, and a greater need for post-hospitalization care compared with patients with a non-MetS profile. This study was designed to estimate the prevalence of Metabolic Syndrome and it's impact on the occurrence of perioperative adverse events among Eastern Indian elective surgical patients.

MATERIALS AND METHODS

This study was conducted in the Surgery Operation Theatre and Department of Anaesthesiology of R.G. Kar Medical College & Hospital in Kolkata over a period of approximately 1 year and 6 months from January 2020 to July 2021. The study population consisted of patients of both genders between the ages of 18 to 80 years who were posted for elective non-cardiac surgery. A pilot study comprising of 50 patients meeting the inclusion criteria was conducted due to the scarcity of available data on the prevalence of Metabolic Syndrome among Eastern Indian elective surgical patients. The prevalence rate of Metabolic Syndrome was found to be 20% among them (10 out of 50).

To determine the sample size, the formula N = {[(Zα /2)^2] x P x Q}/(L^2) was used, with a Zα of 1.96 considering a 95% confidence level, an expected proportion of cases of Metabolic Syndrome among Eastern Indian elective surgical patients of 31, a margin of error of 5, and a sample size of 246 (rounded off to the nearest whole number). There was no control required in this study, which was a prospective observational descriptive study.

The inclusion criteria were age between 18-80 years and patients undergoing elective non-cardiac surgery, while the exclusion criteria were patient refusal, pregnant and breast-feeding women, critically ill patients, and age <18 years or > 80 years of age. The method of data collection included history taking and physical examination of the patient, clinical assessment of the patient, review of investigations, pre-operative clinical evaluation of patients, intraoperative vitals such as heart rate, peripheral oxygen saturation, noninvasive blood pressure, blood or colloid transfusions, and 3-day postoperative mortality and major complications such as cardiovascular, pulmonary, renal, neurological, thrombo-embolic and wound infection.

The study parameters were gender, fasting blood sugar, waist circumference MAP, serum triglyceride level, serum HDL, and non-invasive blood pressure. Laboratory investigations included routine investigations such as complete blood count, blood sugar, serum urea and creatinine, lipid profile, chest X-ray PA view, and ECG 12 leads with long lead II. Special investigations such as coagulation profile, echocardiography, serum electrolytes, liver function test, and thyroid function test were conducted in particular cases when required.

The study tools used included an informed consent form, case record form, proforma for history taking, multi-parameter monitor (IntelliVueMP30 Anaesthesia, Philips), anaesthesia work station (GEC are station model no-620), measuring tape, and associated supportive tools such as alcohol swab, tourniquet, adhesive tapes, gloves, IV cannula, IV infusion set, blood transfusion set, Ringer lactate, Normal saline, emergency drugs viz. adrenaline, atropine, phenylephrine,

mephentermine, preservative-free IV lignocaine, amiodarone, syringes (2ml, 5 ml, 10ml), 3-way connector, Foleys catheter, Uro-bag, nasal prong, and facemask for oxygenation.

Patients were informed about the study in their native language, and were made aware that their participation was optional and would not affect their treatment at the institute. Written consent was obtained in the patient's language before the study. Patients who did not meet the inclusion criteria were excluded after a proper pre-anaesthetics assessment. Clinical measurements and laboratory blood work were performed along with routine pre-anaesthetic checkups according to the consent form. Patients who met three out of five criteria in accordance with NCEP ATP III guidelines were considered to have Metabolic Syndrome. The study observed and noted patients diagnosed under the NCEP ATP III criteria for having Metabolic Syndrome and complications including cardiovascular, pulmonary, renal, neurological, infective, thromboembolic, and perioperative mortality. The study monitored heart rate, electrocardiogram tracer, non-invasive blood pressure, peripheral oxygen saturation, and temperature according to ASA guidelines. The study considered 3-day post-operative mortality and major perioperative complications, including cardiovascular, pulmonary, renal, central nervous system, wound infection, and thromboembolic complications. Patients who required mechanical ventilation within 48 hours before surgery were excluded from pulmonary complication analysis, while patients with acute or chronic renal failure preoperatively were excluded from renal complication analysis. Patients with preoperative paraplegia, hemiplegia, quadriplegia, cerebrovascular accident with neurologic deficit, and coma were excluded from central nervous system complication analysis.

STATISTICAL ANALYSIS

Data was entered into a Microsoft excel spreadsheet and then analyzed by SPSS (version 27.0; SPSS Inc., Chicago, IL, USA).using Chi-square test and p-value ≤0.05 was considered statistically significant.

In this study, out of 246 patients ,141(57.3%) patients were Male and 105(42.7%) patient were Female.In this study, out of the 70 patients who presented with Metabolic Syndrome, 43(61.4%) patients were Female and 27(38.6%) patient were Male.

Table 1 depicts the incidence of hypotension in the study population. Applying the Chi square test, it was found that there is significant statistical difference (p-value 0.015926). Metabolic Syndrome doubles the odds of intraoperative hypotension (OR=2.07).

HYPOTENSION	Metabolic Syndrome		TOTAL	P value=0.015926 $\chi 2$ (CHI SQUARE) =5.810979 ODDS RATIO =2.067499
	YES	NO		
YES	27	41	68	
NO	43	135	178	
TOTAL	70	176	246	

Table 2 describes the distribution of colloid or blood transfusion required in the study population. Applying the Chi square test, it was found that there was no significant statistical difference (p-value 0.629789).

Blood or colloid transfusion	Metabolic Syndrome		Total	P value= 0.629789 CHISQUARE $\chi 2$ =0.232346 Odds Ratio =1.164444
	YES	NO		
YES	20	45	65	
NO	50	131	181	
TOTAL	70	176	246	

Table 3 describes the incidence of acute myocardial infarction in the study population. Applying the Chi square test, it was found that there was no significant statistical difference (p-value 0.7410687).

ACUTE MYOCARDIAL INFARCTION	Metabolic Syndrome		TOTAL	P value=0.015926 χ2 (CHI SQUARE) =5.810979 ODDS RATIO =2.067499
	YES	NO		
YES	3	6	9	
NO	67	170	237	
TOTAL	70	176	246	

Table 4 describes the incidence of cardiac arrest in the study population. Applying the Chi square test, it was found that there was no significant statistical difference (p-value 0.850556).

CARDIAC ARREST	Metabolic Syndrome		TOTAL	P value= 0.850556 χ2 (CHISQUARE) =0.035498 ODDS RATIO= 1.26087
	YES	NO		
YES	1	2	3	
NO	69	174	243	
TOTAL	70	176	246	

Table 5 describes the distribution of pulmonary complications in the study population. Applying the Chi square test, it was found that there is significant statistical difference (p-value 0.047305). Metabolic Syndrome increases the odds of pulmonary complications like unplanned intubation and/ or ventilator support within 3 postoperative days by 1.83times.

PULMONARY COMPLICATIONS (UNPLANNED INTUBATION/ VENTILATOR SUPPORT >24 H)	Metabolic Syndrome		TOTAL	P value = 0.047305 χ2 (CHISQUARE) =3.934512 ODDS RATIO = 1.829268
	YES	NO		
YES	25	41	66	
NO	45	135	180	
TOTAL	70	176	246	

Table 6 describes the distribution of renal complications in the study population. Applying the Chi square test, it was found that there was no significant statistical difference (p-value 0.21877). But, metablic syndrome doubles the odds of requiring dialysis within 3 postoperative days (OR=1.96875)

REQUIRING DIALYSIS WITHIN 3 DAY POST-OPERATIVELY	Metabolic Syndrome		TOTAL	P value =0.21877 χ2 (CHISQUARE)= 1.5124176 ODDS RATIO=1.96875
	YES	NO		
YES	6	18	14	
NO	64	168	232	
TOTAL	70	176	246	

Table 7 describes the distribution of Surgical Site Infection in the study population. Applying the Chi square test, it was found that there is significant statistical difference (p-value 0.0094). Metabolic Syndrome increases the odds of Surgical site infection by 3.72 times

SURGICAL SITE INFECTION	Metabolic Syndrome		TOTAL	P value =0.01294 χ2 CHISQUARE= 10.9411137 ODDS RATIO=3.727272
	YES	NO		
YES	15	12	27	
NO	55	164	237	
TOTAL	70	176	246	

Table 8 describes the incidence of thromboembolic complications in the study population. Applying the Chisquare test, it was found that there was no significant statistical difference (p-value 0.30648). Metabolic Syndrome increases the odds of thrombo embolic complications like deep vein thrombosis or pulmonary embolism in 3 immediate postoperative days by 1.74 times.

DEEP VEIN THROMBOSIS/PULMONARY EMBOLISM	Metabolic Syndrome		TOTAL	P value = 0.30648 χ2 (CHI SQUARE) =1.04578 ODDS RATIO = 1.739583
	YES	NO		
YES	6	9	15	
NO	64	137	231	
TOTAL	70	176	246	

Table 9 describes the 3 day post op mortality in the study population. Applying the Chi square test, it was found that there is significant statistical difference (p-value 0.041454). Metabolic Syndrome doubles the odds of mortality within 3 postoperative days.

3 DAY POST OPERATIVE MORTALITY	Metabolic Syndrome		TOTAL	P value= 0.041454 χ2 (CHISQUARE)=4.157357 ODDS RATIO= 2.127273
	YES	NO		
YES	15	20	35	
NO	55	156	211	
TOTAL	70	176	246	

DISCUSSION

Metabolic Syndrome (MetS) is defined by an accumulation of risk factors that include cardiovascular disease, diabetes, chronic high blood pressure, obesity, and hypercholesterolaemia which results in an increased risk of developing serious chronic diseases[1]. From various studies we can see The prevalence of MetS among adult population in India is around 30%.[2] Similar reviews published from other low middle income countries in Middle East, South East Asia and Latin American region also reported that almost one third of general population have MS [10,11]. This recent upsurge in the prevalence of MS among low middle income countries including India might be directly linked with rapid economic development and urbanization in the country. This rapid industrialization can influence drastic changes in lifestyle patterns and nutrition

In this prospective observational study, our aim was to find out the prevalence of Metabolic Syndrome in patients posted for non-cardiac surgery and to determine their peri-operative complications namely cardiovascular, renal, pulmonary, surgical site infections, thromboembolic complications including 3 day post operative mortality.

In our study, the overall prevalence of Metabolic Syndrome among 246 patients included in this study came to 28% (70 out of 246).Out of which 61% was female and 39% male, although number of males were more in the total study, patients with Metabolic Syndrome showed a female preponderance, hyperglycemia was the most common comorbidity accounting to 60% of the total 70 cases, which were in accordance with similar studies .

D.S Prasad et al [12] 2011 in a population based cross sectional study with multistage random sampling technique consisting of 1178 adults found out age standardized prevalence rates were 33.5% overall, 24.9% in males and 42.3% in females .

Yasmee Khan et al [13] in their study found out the overall prevalence of Mets to be 40.9% (26.2% of total males and 59% of total females. Among the participants of 111 cases of Mets hyperglycemia was the most common 71.5%. Their studies were in accordance with our findings regarding showing the prevalence of Metabolic Syndrome about one third of the total population and with a female preponderance . This was probably for the reason of taking NCEP ATP III criteria for diagnosis of Metabolic Syndrome as well having the study setting and study population of the Indian subcontinent.

The results of our study show that in the context of surgery Metabolic Syndrome represents a risk risk factor for the development of perioperative complications . In our study cardiovascular , renal ,pulmonary, thromboembolic, surgical site infection and post-operative mortality were taken into account. Cardiac complications namely Intra operative hypo/hypertension came statistically significant (p value = 0.015926) with an odds ratio of 2.067 which is consistent with the deterioration of the cardiovascular response reported in patients with Metabolic Syndrome subjected to stressful events[14] similar study of Jose P et al [15] showed intraoperative hypo/hypertension to be statistically significant in association with Metabolic Syndrome (OR=3.31CI 1.7-6.4 p<0.005).

Although other cardiac complications like intra op AMI , cardiac arrest could not be associated with Metabolic Syndrome In our study , Glance LG et al [16] (2010) in their population based study showed a 2 fold higher risk of Cardiac Adverse effects (OR 1.7 95% CI).This may be due to limited sample size of our study .

For pulmonary complications we looked for unplanned intubation or post operative ventilatory support for greater than 48 hours, which was significantly associated with Metabolic Syndrome (p value 0.04 OR 1.83), which was in accordance with similar studies ,Bhayani NH et al (2012) showing patients with Metabolic Syndrome were at a greater risk of developing pulmonary complications (OR-1.5, 95% CI, p=.04). This may be attributed to the impairment of lung function with abdominal obesity, exerting a mechanical effect ,as well as metabolic effect of the truncal adiposity which shows a higher expansion of adipokines and inflammatory markers [17,18].

In our study the presence of Metabolic Syndrome was significantly associated with increased 3 day postoperative mortality (p value 0.04 OR 2.13) ,due to the limited number of follow up days in our study ,mortality beyond the third post operative day could not have been included , but the results in our study were in accordance with similar studies which followed mortality for a longer post operative period Tee MC et al (2016) (p<.001) [19] Infective complications comprising of surgical site infection was significantly associated with Metabolic Syndrome (p value .012 OR 3.72) , similar studies of Shariq OA et al [20] in their population based study showed a significant association with Metabolic Syndrome (OR = 1.46 (95% CI, 1.32–1.60) with that of superficial surgical site infection , In our study Pearson correlation was done and cases with Mets having impaired fasting blood glucose were associated with having surgical site infection (r 0.163 p .01), this may be attributed to the impaired insulin sensitivity in these patients and poor wound healing in patients with diabetes with alterations in the normal stem cell factor and keratinocyte physiology [21,22] Other complications of neurological renal and thromboembolic origin were not associated with Metabolic Syndrome in our study , this may be due to small sample size and limited days of post operative monitoring pertaining to our study. Therefore, the identification of subjects with Mets warrants a holistic management of coexisting risk factors as there are concerns of an increased peri-operative risk because of the co-morbidities associated with the syndrome ,posing a challenge to the anaesthesiologist in the perioperative setting.

CONCLUSION

The prevalence of Metabolic Syndrome is high, affecting almost one-third of adults, with females having a higher prevalence compared to males. Our study established a significant correlation between Metabolic Syndrome and the development of perioperative complications in elective surgery. These findings highlight the importance of identifying Metabolic Syndrome by anaesthesiologists in the perioperative setting to develop effective preventive and interventional

strategies. Such strategies can modify the peri-anaesthetic and surgical risk associated with patients of Metabolic Syndrome, ultimately improving patient outcomes.

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