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An Observational Study on Prevalence and Perioperative Impact of Arterial Hypertension and Diabetes Mellitus among Adult Surgical Patients

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Abstract

Background: Arterial hypertension and diabetes mellitus is very common co-morbidities among surgical patients and can affect the perioperative management. Health care team even goes ahead with preoperative screening for undetected diabetes many a times. However, how much these diseases affects perioperative anaesthetic management is rarely evaluated. Aim: To assess the prevalence of new, controlled and uncontrolled hypertension, diabetes mellitus and their perioperative impact among adult surgical patients. **Methods:** With approval, this prospective observational study was conducted in a tertiary care teaching hospital of an island of India during December 2016 to May 2017. Total 958 adults of both sexes, planned for elective non-cardiac surgery were included. Arterial hypertension (AHTN) and Diabetes Mellitus (DM) was defined as per JNC-7 and ADA definition. The prevalence of new, controlled, uncontrolled AHTN and DM and their perioperative anaesthetic were assessed. INSTAT software was used for statistical analysis and $p < 0.05$ was considered as significant. **Results:** Total 941 patients' {438 (46.55%) male} with mean ± standard deviation age and weight of 46.26 ± 15.86 year and 59.19 ± 12.02 kilogram were included for analysis. The median ASA physical status and NICE surgical invasiveness grade were 2 for both. The prevalence of AHTN, DM and both were 20.72%, 13.71% and 6.695% respectively; not statistically different among male and female. 64.1% hypertensive and 48.06% diabetic patients had BP > 140/90 mmHg and blood sugar >180 mg% respectively. 20.51% hypertensive and 22.48% diabetic needed change in perioperative management leading to delay in surgery and extra hospital visits and stay. **Conclusion:** The prevalence of AHTN and DM is high among adults and increases significantly with age. Both gender is affected equally. Uncontrolled AHTN and DM are very high and are alarming to initiate measures to tackle these important non-communicable diseases.

Key words: Arterial hypertension, hyperglycemia, elective surgery, anaesthesia.

Clinical trial registration number: CTRI/2018/01/011235.

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Introduction

Arterial hypertension (AHTN) and diabetes mellitus (DM) are two important non communicable, chronic illnesses worldwide. High blood pressure and hyperglycemia is prevalent in nearly one fifth to one fourth of adult population in developing countries like India and Bangladesh.[1,2] Data also suggests that these diseases are becoming more and more prevalent with passing time.[2] For an anaesthesiologist and surgeon, both the disease is very important in perioperative period as they can adversely affect the outcome.[3,4] Both the diseases are also notoriously known for their ability to involve and complicate multiple organ systems. Surprisingly and unfortunately, both the disease may be present in a person as asymptomatic till advanced stage and may present for the first time with complications. The present study was conducted to assess the prevalence of new, controlled and uncontrolled hypertension and diabetes mellitus and their perioperative impact among adult non-cardiac surgical patients. The study will help us to know, anticipate and plan better in perioperative care of such patients.

Materials and Methods

After the approval from the institute research and ethical committee, the present hospital based, cross sectional, observational, sub-group analysis was conducted in a tertiary care teaching hospital of an island of India [CTRI/2018/01/011235]. Data collection was done during December 2016 to May 2017. Patients aged more than or equal to 18 years of age, of both sexes, attending preanaesthetic evaluation clinic (PAEC) were included. The special populations like pregnant women, jail inmates, legally

protected tribe were not included. If any patient attended PAEC for more than one time for different surgery or other reason during the study period, only first day visit / visit for first surgery was only included.

Based on Joint National Commission report 7 (JNC 7), if a patient presented to the PAEC with systolic blood pressure (SBP) > 140 mmHg and / or diastolic blood pressure (DBP) > 90 mmHg (average of two readings minimum 5 minutes apart with rest in sitting position) with no previous documentation and treatment history the patient was diagnosed to be a new AHTN.[5] For this study hypertension was designated as uncontrolled if SBP > 160 mmHg and / or DBP > 100 mmHg while hypertension was designated as uncontrolled with anaesthetic management implications if SBP > 180 mmHg and / or DBP > 110 mmHg.[6]

If a patient presented to the PAEC with hyperglycemia as per the American Diabetes Association (ADA) with no previous documentation and treatment history the patient was diagnosed to be a new case of DM.[7] A previously unknown patient if presented with a HbA1c level between 5.7 to 6.4 %, the patient was designated as prediabetes.[7] For this study DM was designated as uncontrolled if any blood sugar level was > 180 mg% while it was designated as uncontrolled with anaesthetic management implications if any blood sugar level was > 215 mg%.[8] Intraoperative blood sugar monitoring and newly diagnosed diabetics who were started on antihyperglycemic treatment were also counted as significant implication in perioperative anaesthetic management.

Demographic, physical status, surgical category, clinical/medical history, the numbers of new, controlled and uncontrolled cases were counted. Serum creatinine level was noted as abnormal (high) if the value was > 1.2 mg% and the patient was designated to have renal injury/failure.

The present study was planned for a hypothesized frequency of DM and AHTN of 20% with absolute precision of 3% for a large population. The sample size was calculated using online statistical tool OpenEpi (Open Source Epidemiologic Statistics for Public Health; http://www.openepi.com) for a 95% confidence level which gave us a sample of 683. Considering non randomized nature of sampling and design of the study, a design effect of 1.4 was also taken making the final sample size for the study as 957. Data from a total of 958 patients file were collected.

Data were presented in absolute number, percentage scale. Prevalence data were calculated for male and female separately too and compared with national and international level data. Impacts of perioperative anaesthetic and patient management were also noted. If the evaluating anaesthesiologist asked for a consultation / referral, retesting or further investigating based on the blood sugar report and/or the blood pressure level it was considered as impactful. However, an impact was considered as significant only if the impact outcome or abnormal test result leading to the impact, led to a change in perioperative anaesthetic management like postponing the case, preoperative intensive drug therapy in high dependant unit to control the condition, intraoperative intensive monitoring, or gross deviation from the standard anaesthetic management.

Measures of central tendencies and dispersions were calculated and comparisons of the groups were done using INSTAT software (GraphPad Prism Software, La Jolla, CA, USA). A $p < 0.05$ was considered statistically significant.

Results

Data from 958 adult patients were collected during the study period. 17 patients' data were excluded due to insufficient follow up till the day of surgery and incomplete data and 941 patients' {438 (46.55%) male; 503 (53.45%) female} data were included for analysis. The mean ± standard deviation (SD) age and weight of the entire cohort were 46.26 ± 15.86 (range 18-95) year and 59.19 ± 12.02 (range 31-106) kilogram respectively.

Table 1: Distributions of controlled and uncontrolled AHTN and DM. (AHTN- arterial hypertension, DM-diabetes mellitus).

Disease category	Number (%)
Controlled AHTN	
Newly detected	10 (5.13)
Known case	161 (82.56)
Uncontrolled AHTN	
Newly detected	6 (3.08)
Known cases	18 (9.23)
Total cases	195
Controlled DM	
Newly detected	16 (12.40)
Known cases	89 (68.99)
Uncontrolled DM	
Newly detected	1 (0.78)
Known cases	23 (17.83)
Total	129
Pre-diabetes	5
Both AHTN and DM	63

The median American Society of Anesthesiologists (ASA) physical status was II and underwent NICE (National Institute for Health and Care Excellence) grade 2 (median) surgical procedures.

Two hundred sixty one (27.74%) patient had either or both of AHTN and DM; 63 (6.695%) had both the comorbidity. There were also seven patients with HbA1c / blood sugar (BS) in pre-diabetes range; two were diagnosed as new diabetes on further investigation. The prevalence of controlled and uncontrolled AHTN and DM for new and known cases is shown in [Table 1]. The patients who had AHTN and DM were in the age range of 27 to 85 (median 60) year and 33 -106 (median 60) kilogram of weight. Female were slightly more with male female ratio of 0.933 in the cohort. The demographic, ASA physical status and NICE surgical category wise distribution is presented in [Table 2].

Table 2: Demographic, physical and surgical grade distributions. (SD- standard deviation, ASA- American Society of Anesthesiologists, NICE-National Institute for Health and Care Excellence, IQR- interquartile range).

Parameters	Number (%)
Age (year) mean ± SD	58.31 ± 11.50
Age groups	
18-40 years	24 (9.20)
41-65 years	166 (63.60)
> 65 years	71 (27.20)
Male	126 (48.28)
Female	135 (51.72)
Weight (Kg) mean ± SD	61.26 ± 11.96
ASA physical status (median /(IQR)	3 / (3 – 2)
II	105 (39.93)
III	139 (52.85)
IV	19 (7.22)
V	0
NICE grade (median /(IQR)	2 / (3 – 1)
1	119 (45.25)
2	61 (23.19)
3	77 (29.28)
4	6 (2.28)

Table 3: Hypertensive and diabetic patients and their co-relation with non-hypertensive and diabetic patients (control). (AHTN- arterial hypertension, DM- diabetes mellitus, SD- standard deviation, N-total number, n-number).

Parameters	Control [N= 680]	All AHTN [N = 195]	Two tailed p / RR (95% CI)	All DM [N = 129]	Two tailed p / RR (95% CI)	Both [N = 63]	Two tailed p / RR (95% CI)
Age (year) mean ± SD	41.67 ± 14.88	59.15 ± 11.34	< 0.0001	58.05 ± 11.21	< 0.0001	60.38 ± 10.24	< 0.0001
Weight (kg) mean ± SD	58.41 ± 11.97	60.47 ± 11.56	0.032	62.43 ± 12.13	0.0005	61.20 ± 11.27	0.075
Obesity {n(%)}	21 (3.09)	14 (7.18)	0.020 / 2.32 (1.20 – 4.48)	9 (6.98)	0.041 / 2.259 (1.059 – 4.82)	5 (7.94)	0.0609 / 2.57 (1.003 – 6.58)
Renal failure {n(%)}	1 (0.147)	9 (4.62)	< 0.0001 / 31.38 (3.99 – 246.33)	5 (3.88)	0.0005 / 26.35 (3.10 – 223.86)	7 (11.11)	< 0.0001 / 75.55 (9.44 – 604.69)
CAD {n(%)}	2 (0.294)	21 (10.77)	< 0.0001 / 36.61 (8.65 – 154.85)	12 (9.30)	< 0.0001 / 31.62 (7.16 – 139.70)	10 (15.87)	< 0.0001 / 53.96 (12.08 – 241.01)

Table 4: Blood pressure and sugar level based distribution of patients and their perioperative impacts. (*medication management, #postponement of elective surgery along change in medical management, AHTN- arterial hypertension, DM- diabetes mellitus, BP- blood pressure).

Category of AHTN and DM	Number (%)	Consultation@	Management Change@
Arterial Hypertension [N = 195]			
BP < 140/90 mmHg	70 (35.89)	0	0
BP > 140/90 – 159/100	84 (43.08)	16 (19.05)	10* (11.90)
BP 160/100 – 179/109	17 (8.72)	8 (47.06)	6* (35.29)
BP > 180 / 110	24 (12.31)	24 (100.0)	24# (100)
Diabetes mellitus [N = 129]			
Blood sugar < 180 mg%	67 (51.94)	0	0
Blood sugar > 180 - 250 mg%	38 (29.46)	20 (52.63)	15* (39.47)
Blood sugar > 250 - 399 mg%	22 (17.05)	12 (54.56)	12* (54.56)
Blood sugar > 400 mg%	2 (1.55)	2 (100.0)	2# (100.0)

The prevalence of AHTN and/or DM was not statistically higher among male than female (28.77% versus 26.84%; relative risk 1.07, 95% confidence interval 0.87 – 1.31; p 0.512). With the increasing age, the prevalence of AHTN and/or DM increased incrementally. The prevalence of AHTN and/or DM in 18 – 40 year, 41 – 65 year and above 65 year age groups were 6.03%, 39.15% and 59.66% respectively (chi-squared test for independence, value 181.64; p < 0.0001). The prevalence of these co morbidities was found to be highest in 7th decade of life [Figure 1].

The prevalence of renal failure and coronary artery diseases, mean age in the patients with both the comorbidity were slightly higher than either of hypertensive and diabetic group but the differences were not statistically significant (all p > 0.05) [Table

3]. One fifth of both male and female patients were suffering from AHTN. The prevalence of DM was also higher in male than female by 2.11% but the differences were statistically insignificant for AHTN, DM and for both [Figure 2].

Only 35.89% patients with AHTN had blood pressure (BP) < 140/90 mmHg while 51.94% diabetic had BS < 180 mg%. Two (1.55%) diabetic and 12.31% hypertensive patients were in the range of postponement of elective surgery [Table 4].

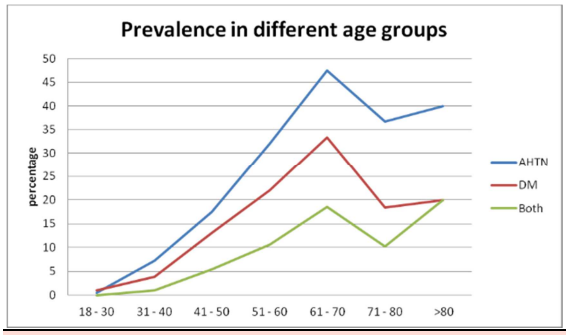

Figure 1: Prevalence across different age groups. (AHTN- arterial hypertension, DM- diabetes mellitus).

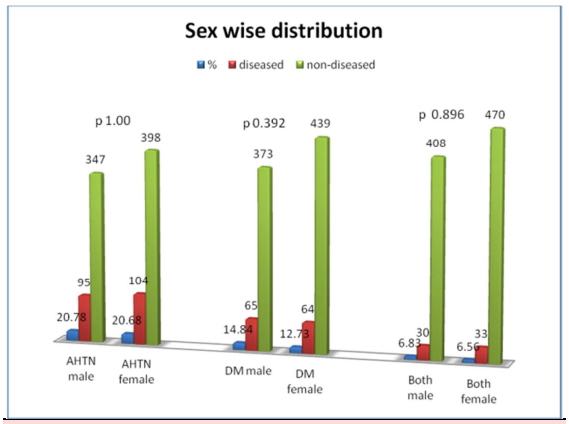

Figure 2: Sex wise prevalence and differences. (AHTN- arterial hypertension, DM- diabetes mellitus)

Discussion

The AHTN and DM is a global problem and their prevalence is increasing.[2,9] The finding of the present study too indicates that. The Indian National Family and Health Survey (NFHS) – 4 have shown that a good number of people are suffering from high BP (13.6% in male and 8.8% in female).[10] Similarly, 13.9% male and 8.6% female were having hyperglycemia.[10] In the present cohort, one of every five patient was having AHTN, which is far higher than the NFHS – 4 reported prevalence. This may be partly due to the population studied and geographical variation. We have included any patient aged > 18 years while the survey enrolled patients aged 15 – 49 years. The mean age of the patients of the present study was 59.15 years which is even higher than the highest aged patient in the survey. The present study findings resembles with the findings of a Chinese study, which showed a prevalence of 29.2% and 24.1% in male and female respectively.[11] Data from USA also showed near similar prevalence (i.e. age-adjusted prevalence of hypertension among persons aged ≥18 years was 29.6%).[12]

Similar results were also noted with regard to DM. Although the prevalence of DM in male patients was nearly similar; the prevalence of was higher for female patients in the present study (12.73% versus 8.6%) as compared to prevalence of hyperglycemia reported in NFHS-4. This is again probably because of inclusion of younger patients in NFHS – 4. Ten hyperglycemic reading was false positive (came out to be normal fasting, postparandial and HbA1c in repeat testing) and were not calculated in diabetic category in the present study. The prevalence of diabetes among the present cohort was however higher than reported in USA population (i.e. 13.71% versus 8%).[13]

The present study showed that the incidence of the disease increases with age. With the advancement of health, more and more people are ageing. More importantly many of these elderly need to undergo surgical procedures. A significant proportion of the populations need to undergo one or the other forms of surgical procedures or interventions at one or more points of life. In the present study, 27.2% patients were in geriatric age group. These indicate that AHTN and DM are very important co-morbidity in older patients.

Both the disease has significant impact in the perioperative management of surgical patients as uncontrolled condition can cause morbidity and even increased mortality.[3,4] However both anaesthesiologists and surgical specialists are more related to the acute care of these patients. As far as the anaesthesia services (both in operation theatre and intensive care) are concerned; anaesthesiologists are capable of controlling both the condition (i.e. high BP and hyperglycemia) relatively faster even if there are derangements. However, it is a good practice to keep the BP within 20% of baseline during perioperative period. Therefore there is a considerable difference between controlled BP and hyperglycemia from medical and anaesthesia point of view. Elective surgery should be delayed for severe hypertension (diastolic BP >115 mm Hg or systolic BP >200 mm Hg) until BP is < 180/110 mm Hg.[6] Similarly, although hyperglycemia has its own effect in surgical patients, elective non-cardiac surgery is usually not postponed if BS is < 400 mg%.[8,14]

Elective surgical patients usually follow a standard path (i.e. preanaesthetic evaluation followed by surgery) and get time for preoperative optimization and medication management. The present study has shown that 125 (64.10%) patients BP was > 140/90 mmHg, but 24.62% patients were referred to physician. Forty (83.33%) had impacts in terms of medication changes. Similarly, 48.06% patients had hyperglycemia of > 180 mg%, but 20.93% patients required perioperative drug modification (mostly bridging with Insulin) and only 1.55% patient needed

postponement of elective surgery from anaesthesia point of view.

The uncontrolled AHTN and DM were alarmingly high (64.1% hypertensive had BP > 140/90 mmHg and 48.06% diabetic had BS >180 mg %) in present cohort. Although the problem (i.e. inadequate control) has been shown to be present in… value is better than the finding from China, it cannot be acceptable.[11] It not only led to repeated investigations, consultations, hospital visits and increased length of preoperative hospital stay, but also an average delay in elective surgery by 3.93 days.

The present study finding highlights few important aspects. Firstly, the prevalence of AHTN and DM is very high in the population studied; even uncontrolled AHTN with very high BP is very common. Secondly, despite free availability of almost all medications (free supply from the government in the study area and hospitals), the BS levels were also not well controlled and good number of patients were having hyperglycemia above renal threshold level (i.e. 170 to 200 mg %).[15] This indicates that these patients needs care beyond free medicine supply like counseling for adherence to medication, regular follow up compliance etc at grass root level. Thirdly, neither all high levels of BP and hyperglycemia changes perioperative anaesthetic management nor all consultation with physicians yield a significant impact. Both anaesthesiologists and surgeon need to be more rational in utilization of services to reduce unnecessary referral, delay and inconvenience to the patient, especially elderly. Fourthly, a good number of DM was new cases which suggest that a screening for detecting DM may be useful. However, the fact that the NNT for detecting a new DM is 55 (1.806% new cases), which is relatively large; such screening should target more focused population in terms of age group rather than blanket preoperative screening. Fifthly, the present study even indicates that national survey like NFHS should be conducted with all adult patients rather than a truncated one so that better planning for preventive measures can be done in future.

The present study is however limited with the fact that, it was single centre; conducted in a subgroup of hospital patients serving a relatively and geographically isolated population of an island. A multicentre study with population of different geography will give us a better idea for formulation of national plan for health care delivery. However, the present finding can serve well as a base of further studies both locally, nationwide or even globally.

Conclusion

The prevalence of AHTN and DM is high among adults and increases significantly with age. Both male and females are affected equally. Uncontrolled AHTN and DM are very high and are alarming to initiate measures to tackle these important non-communicable diseases at grass root level.

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