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MESTRADO INTEGRADO EM MEDICINA

POSTOPERATIVE PERIOD AFTER ELECTIVE SURGERY IN PATIENTS WITH HIGH BLOOD PRESSURE ON HOSPITAL ADMISSION

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2023

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Junho de 2023

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Acknowledgments

À Dra. Carla Cavaleiro, por me ter orientado no verdadeiro sentido da palavra, nunca me tendo deixado à deriva em nenhum momento. Mais do que orientadora, foi ao longo de todo este trabalho, uma amiga. Uma pessoa que admiro por aliar de forma exímia o profissionalismo com a empatia. Obrigada por me encorajar e guiar nos momentos mais difíceis.

À Dra. Débora Marques, por me ter apoiado sempre de forma tão próxima. Um apoio incansável e essencial na realização da minha tese e na passagem por este desafio que foi o 6º ano.

Resumo

Contextualização: A hipertensão arterial (HTA), por si só, não é considerada um fator de risco peri-operatório importante, não consistentemente associada à morbilidade pós-operatória. Dados relativos à prevalência de HTA à admissão hospitalar (HTA_AH) em doentes submetidos a cirurgia eletiva e impacto nos resultados pós-operatórios são ainda escassos. Os autores têm como objetivo avaliar a prevalência e os fatores de risco para HTA_AH como também avaliar os resultados pós-operatórios.

Métodos: Estudo observacional longitudinal realizado num hospital terciário, português, incluindo doentes adultos admitidos para cirurgia eletiva, de outubro a dezembro de 2019. Dados registados à admissão hospitalar incluíram características sociodemográficas, antecedentes de HTA e tratamento, tabagismo, consumo de álcool, dislipidemia, síndrome da apneia obstrutiva do sono, procedimento cirúrgico e anestésico, pressão arterial (PA) sistólica, PA diastólica, frequência cardíaca e índice de massa corporal, entre outros. HTA definida se PA sistólica ≥140mmHg e/ou PA diastólica ≥90mmHg. Complicações do intraoperatório e pós-operatório até aos 30 meses foram recolhidos e classificadas segundo Clavien-Dindo.

Resultados/Discussão: Dos 402 doentes, 57% eram do sexo masculino com média de idade de 59.9±15.2 anos. HTA_AH presente em 39% dos doentes. Diagnóstico prévio de HTA em 66% e destes 61% a cumprir terapêutica anti-hipertensora. HTA prévia (OR=2.60; IC 95% 1.71-3.95), idade ≥50 anos (OR=2.02; IC 95% 1.21-3.36), dislipidemia (OR = 1.67; IC 95% 1.11-2.49), hábitos etílicos (OR=1.73; IC 95% 1.15-2.60) e diabetes (OR=1.73; IC 95% 1.02-2.94) identificados como fatores preditores de HTA_AH. Hipotensão intraoperatória observada em 92 (59%) dos doentes com HTA_AH. A taxa de mortalidade foi superior (3.9%vs.2.5%) no grupo HTA_AH comparativamente ao grupo sem HTA à admissão hospitalar, excluindo as mortes relacionadas com a evolução de doenças neoplásicas. No grupo HTA_AH observou-se uma frequência 7% superior de complicações durante todo o período de estudo.

Conclusão: A prevalência de HTA_AH em doentes para cirurgia eletiva neste estudo não deve negligenciada, pois as complicações, incluindo mortes, foram mais frequentes nesses doentes durante os 30 meses de seguimento. Os autores identificaram fatores de risco como idade, dislipidemia, tabagismo, consumo de álcool e HTA nos doentes com HTA_AH. O diagnóstico da HTA e a sua otimização através de programas de pré-habilitação no pré-operatório são cruciais, prevenindo morbimortalidade a longo termo nestes doentes que estão expostos a períodos de elevado stress. Todos estes fatores têm um papel importante na morbimortalidade após cirurgias eletivas. A idade é o único

fator de risco não modificável, pelo que na maioria dos fatores podemos atuar preventivamente.

Palavras-chave

Hipertensão, doente cirúrgico, resultados, pressão arterial elevada.

Abstract

Background: High blood pressure (HBP) alone is not considered a major perioperative risk factor not consistently associated with postoperative morbidity. Data regarding prevalence of HBP at hospital admission (HBP_HA) in patients scheduled for elective surgery and its impact on postoperative outcomes are still scarce. The authors aimed to assess the prevalence of HBP_HA, identify its contributing risk factors and postoperative outcomes.

Methods: A longitudinal observational study conducted in a tertiary hospital, in Portugal, including adult patients admitted for elective surgery, from October to December 2019. Data recorded at hospital admission included sociodemographic characteristics, previous diagnose of HBP and treatment, smoking, alcohol consumption, dyslipidemia, obstructive sleep apnea syndrome, surgical and anesthetic procedures, systolic blood pressure (BP), diastolic BP, heart rate, body mass index and others. HBP was defined if systolic BP ≥140mmHg and/or diastolic BP ≥90mmHg. Intraoperative and postoperative complications up to 30 months were collected and classified according to Clavien-Dindo.

Results/Discussion: Of 402 patients, 57% were male with a mean age of 59.9 ± 15.2 yrs. HBP_HA was present in 39% of patients. 66% of them had previous diagnosis of HBP and of these 61% were on antihypertensive therapy. Previous diagnose of HBP (OR=2.60; 95% CI 1.71-3.95), age ≥50 yrs (OR=2.02; 95% CI 1.21-3.36), dyslipidemia (OR=1.67; 95% CI 1.11-2.49), alcohol consumption (OR=1.73; 95% CI 1.15-2.60) and diabetes (OR=1.73; 95% CI 1.02-2.94) were identified as predictors of HBP_HA. Intraoperative hypotension observed in 92 (59%) of patients with HBP_HA.

Mortality rate was superior (3.9%vs.2.5%) in HBP_HA comparing to NHBP_HA group, excluding deaths related with evolution of neoplastic disease. HBP_HA group was 7% more likely to have new complications, during the entire study period.

Conclusion: The prevalence of HBP_HA in patients scheduled for elective surgery in this study shouldn't be neglected thus complications including deaths were more frequent in these patients during 30 months follow-up. The authors identified risk factors, such us age, dyslipidemia, smoking, alcohol consumption and HBP in HBP_HA patients. HBP diagnosis and optimization through pre-habilitation programs during preoperative period are crucial preventing long-term morbi-mortality in this patients who are exposed to periods of greater stress. All these factors have an important role in morbimortality after elective surgeries. Age is the only non-modifiable risk factor, which means we can act preventively on most of the factors.

Keywords

Hypertension, surgical patient, outcomes, high blood pressure.

List of abbreviations

ASA – American Society of Anesthesiologists
BMI – Body mass index
BP – Blood pressure
CI- Confidence interval
HA – Hospital admission
HBP – High blood pressure
HBP_HA – High blood pressure at hospital admission
HTA – Hipertensão arterial
HTA_AH – Hipertensão arterial à admissão hospitalar
IQR – Interquartile range
MAP – Mean arterial pressure
NHBP – Non-high blood pressure
NHBP_HA – Non-high blood pressure at hospital admission
OR – Odds ratio
OSA – Obstructive sleep apnea
PA- Pressão Arterial
RR – Relative risk
SD – Standard deviation

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Esta dissertação/tese de mestrado tem como base um artigo de investigação submetido à Revista European Heart Journal (EHJ) – Quality of Care and Clinical Outcomes. Ainda assim, a sua estrutura e formatação seguem as regras de publicação da unidade curricular “Dissertação/Projeto/Estágio” (consultar *Attachments)*.

Um trabalho baseado neste artigo de investigação foi aceite para apresentação em formato “*poster”* no Congresso da Sociedade Portuguesa de Anestesiologia de 2023 e no Congresso da Sociedade Europeia de Anestesiologia de 2023 (consultar *Attachments*).

Introduction

Outcomes of patients scheduled for non-cardiac elective surgery presenting with high blood pressure on hospital admission (HBP_HA) are still on debate[1].

HBP is a modifiable risk factor of high morbimortality (one of the leading causes of premature death, stroke, myocardial infarction and renal failure) representing the majority (70%) of health costs allocated to chronic diseases treatment [2, 3]. Although scarce, available data related to HBP patients shows that is a common (38%) occurrence for patients to present for surgery with HBP on hospital admission[2, 4].

Anesthetic and surgical interventions lead to hemodynamic changes, exaggerated stress response, hypercoagulability and inflammation[5]. Patients with pre-existing HBP are more predispose to intraoperative hemodynamic instability, hypotension and tachycardia[2]. Additionally, they have an impaired autoregulatory capacity in major organs and systems, such as the brain and kidneys, making them less tolerant to low blood pressure (BP) periods when compared to normotensive patients, and more susceptible to ischemia and end-organ damage[6, 7].

HBP alone is not consistently considered a major perioperative risk factor for morbidity although relationship between pre-operative HBP and intra-operative hemodynamic changes are known to be associated with postoperative morbimortality[1, 2]. The contribution of comorbid HBP to post-operative mortality is unclear despite high estimated prevalence both worldwide and in the Portuguese population, with 30% and 42% respectively[2-4].

HBP is present when values of blood pressure (BP) are equal or greater than 140 mmHg for systolic BP and/or 90 mmHg for diastolic BP are detected in the context of a medical appointment, in at least, two different times, spaced apart[8].

There are several ways to achieve adequate BP control. In low-risk patients, lifestyle changes may be sufficient, with daily physical activity and dietary modifications, but in medium to high-risk patients (the majority of them), it is necessary to combine these non-pharmacological measures with treatment using antihypertensive drugs[8]. Current guidelines, recommend a *"tailor-made"* optimization of antihypertensive pharmacological therapy, however, optimal BP remains unclear due a complex relationship between HBP, cardiovascular disease, age, and many other risk factors, making the decision to postpone or proceed with surgery, when a patient presents with HBP_HA, medically challenging and filled with many questions[5, 6, 9, 10].

Despite lack of clarity on this issue, in the UK, 1% (100 patients per day) of elective surgical patients have surgery delayed for further primary care management of HBP[5].

The primary endpoint of this study is to present 30 months postoperative outcomes in patients scheduled for elective non-cardiac surgery. Identifying modifiable and non-

modifiable risk factors related to the outcome in these patients was our secondary endpoint as well as determining the prevalence of HBP_HA. The goal is to contribute to a clearer, appropriate, safer and evidence-based medical decision to postpone or proceed with elective non-cardiac surgeries in HBP_HA patients[9].

Methods

An observational longitudinal study held in a Portuguese tertiary hospital (Centro Hospitalar Universitário de Santo António) included adult patients undergoing elective, non-cardiac, non-obstetric, non-pediatric surgery between October and December 2019.

This study complies with the Helsinki Declaration. Institutional approval for this study (Ref.ª: 2022.245 (192-DEFI/207-CE)) was provided by the Ethical Committee of CHUdSA/ICBAS, Porto, Portugal.

Pre and intraoperative to 30 months follow-up data was collected through patients' electronic medical records. Pre-operative data included age, gender, previous diagnose of HBP, number of antihypertensive drugs, smoking habits, alcohol consumption, physical activity, dyslipidemia, diabetes, obesity and obstructive sleep apnea syndrome. STOP-BANG score, ambulatory non-invasive ventilation therapy, neoplastic disease, anxiety[11] and depression[12] scale (1-100) were also registered. Patients were classified according to American Society of Anesthesiologists physical status (ASA I-VI)[13]. Hospital admission (HA) systolic BP, diastolic BP, heart rate, weight, height and body mass index (BMI) were included. BP values were considered as the mean of two different measures. HBP was defined as a systolic BP ≥ 140 mmHg and/or diastolic BP ≥ 90 mmHg.

According to previous diagnose of HBP patients were included either in HBP or NHBP group. Participants were classified according to presence or absence of HBP on HA, as HBP_HA or NHBP_HA, respectively.

Intra-operative data included: surgical procedure, type of anesthesia and duration, systolic BP and diastolic BP, mean arterial pressure (MAP) calculated according to [systolic BP + 2 (diastolic BP)] / 3, and hypotension (defined as systolic BP ≤ 90 mmHg and/or diastolic BP ≤ 60 mmHg and/or MAP ≤ 55 mmHg).

Clavien-Dindo classification (I-V)[14] was used to define morbidity and mortality during hospital stay and at 12-, 24- and 30 months follow-up. Morbidity was considered present if a new event of complication occurred, however, each new event could correspond to more than one complication in the same patient. Clavien-Dindo classification was applied to classify only the most serious complication(s) of each event.

Morbidity during 30 months follow-up in patients with HBP_HA, scheduled for elective non-cardiac surgery was the primary outcome of this study. Identifying modifiable or non-modifiable risk factors for HBP_HA in these patients was our secondary endpoint as well as determining the prevalence of HBP_HA.

Descriptive and comparative statistics were performed using software IBM® SPSS® Statistics v.29 (National Opinion Research Center, USA). We presented data as

frequencies and percentages for categorical variables and mean ± standard deviation (SD) or median and interquartile range (IQR) for continuous variables, according to their normality. The relation between risk factors influencing HBP_HA is presented by Odds Ratio (OR) with a corresponding confidence interval of 95% (CI 95%). The relation between prevalence of complications on HBP and NHBP group was determine using relative risk (RR). The same for HBP_HA and NHBP_HA group. All p values less than 0.05 were considered as statistically significant.

Results

HBP_HA was observed in 155 participants (39%), with mean systolic BP of 151.6±11.7 mmHg, and diastolic BP of 81.2±11.9 mmHg. 55% were male with a mean age of 63yrs and 66% presented previous diagnosis of HBP (Table I).

In HBP_HA and NHBP_HA groups, the distribution of procedures according to surgical specialty was similar, with general surgery (includes Esophagogastroduodenal, Extra-digestive and Hepatopancreatobiliary surgery departments) being the most frequent (47%).

Previous diagnosis of HBP was present in 207 (52%) patients, and only 51% of them presented normal values of BP on HA. 12 patients (6%) weren't under any pharmacological therapy. Concerning HBP pharmacological treatment, 195 (94%) patients mentioned taking antihypertensive medication, with 71% (n=138) taking 1 drug, 34% (n=47) 2 drugs, 4% (n=8) 3 drugs and 1% (n=2) 4 drugs.

We identified significant interaction between HBP_HA and previously diagnosed HBP (OR = 2.60; 95% CI 1.71-3.95), age ≥ 50yrs (OR = 2.02; 95% CI 1.21-3.36), dyslipidemia (OR = 1.67; 95% CI 1.11-2.49), alcohol consumption (OR = 1.73; 95% CI 1.15-2.60). The number of patients with diabetes in HBP_HA (21%) was significantly higher ($p<0.05$) comparing with NHBP_NA group (14%), OR 1.73 (95% CI 1.02-2.94) (Table II).

Risk factors without association with HBP_HA ($p>0.05$) in this study were: gender, sedentary lifestyle, smoking habits, presence of neoplastic disease, BMI ≥ 30 Kg/m^2 and STOP-Bang score intermediate-high (≥4 points). Despite 306 patients with an intermediate-high STOP BANG score, only 20 patients had a formal diagnosis of obstructive sleep apnea (OSA) and were under ambulatory non-invasive ventilation therapy.

On the HBP_HA group the median was 50 points (IQR 50) for the anxiety scale (0-100) and on the depression scale (0-100), median of 25 points (IQR 40).

On the NHBP_HA group the median was 50 points (IQR 60) for the anxiety scale (0-100)[11], and on the depression scale (0-100), median of 20 points (IQR 40).

ASA physical status classification II was observed in 61 (39%) of HBP_HA patients followed by ASA III (35%). On the NHBP_HA group ASA II and III patients were 42% and 29%, respectively. In both groups, ASA I and IV were less frequent.

The percentage of anesthetic and surgical procedures with duration ≥ 120 minutes was more prevalent in HBP_HA (38% and 20%, respectively), compared with NHBP_HA group (28% and 19%). General anesthesia was the most frequently observed anesthetic technique in both groups (68% in HBP_HA and 67% in NHBP_HA).

Intraoperative hypotension classified as systolic ≤ 90 and/or diastolic BP ≤ 60 mmHg occurred in 236 patients (59%). 12 died at the end of 30 months follow-up. On HBP_HA group, intraoperative hypotension occurred in 92 (59%) participants.

In the study population, the sum of observed complications events in each evaluation period up to 30 months was 468. Each new event can correspond to more than one complication in the same patient. Clavien-Dindo classification considers only the most serious complication of each event.

The most frequently observed morbidity (Table III), regardless of the time interval evaluated, was grade II (complications requiring pharmacological treatment with drugs other than such allowed for grade I complications).

At time of hospital discharge, 33 patients (10.4%) had experienced at least one complication during their hospital stay (Table III). Of these, 12 were cardiovascular related. Since hospital discharge until 12 months post-surgery, 138 patients (43%) presented new complications, with 22 events in the cardiovascular domain, 4 renal and 11 cardiorenal. A total of 9 deaths occurred in this period. Morbidity assessment between 12 and 24 months after surgery showed 161 patients (51%) with new complications (29 cardiovascular, 7 cardiorenal and 1 renal). 9 deaths occurred. New-found morbidity between 24 and 30 months revealed 136 complications (43%), 30 cardiovascular, 1 renal, 8 both, and 6 deaths.

By 24 months, in all periods of morbidity assessment, morbimortality rates were higher in patients presenting HBP_HA comparing to NHBP_HA (Table III and IV). This finding was not present in the 24-30 months follow-up period (47% and 50%, respectively). A higher number of complications was detected between 12 and 24 months, in both groups. The HBP_HA group presented the highest number of complications (59%) when compared with NHBP_HA (51%).

Analyzing by groups, during 30 months follow-up a total of 187 new complications events occurred in the HBP_HA group (1,5 complications/patient) and 281 in the NHBP_HA (1,4 complications/patient). This provides a RR of 1.07 (HBP_HA is 7% more likely to have a complication during the 30 months of follow-up).

Patients from HBP_HA group are 10% more likely to have a complication during hospitalization and in the first 12 months after surgery (Table IV). Between 12 and 24 months postoperatively, this RR is 20%. However, between 24 and 30 months the patients at higher risk are those NHBP_HA. Over the 30M, HBP_HA group had 9 deaths, in which only 3 had cancer, and the NHBP_HA group had 16 deaths of which 10 having neoplastic condition. Mortality rate is superior (3.9% vs. 2.5%) in the HBP_HA group than in NHBP_HA group excluding deaths related with evolution of neoplastic disease during all periods of evaluation.

Evaluation of morbidity in patients with previous diagnose of HBP (HBP group) is shown in Table V. Over the 30M follow-up, there were 280 complication events in the HBP group (1,8 complications/patient) and 219 in NHBP group (1,4 complications/patient), which means 29% higher risk in HBP group. These complications include cumulative deaths.

Concerning mortality, at 30M, HBP group had 17 (8.2%) deaths while NHBP group had 8 (4.1%) deaths. At hospital discharge the risk of developing a complication event is 300% higher in patients with previous HBP. The risk was 26% higher at 12M follow-up, 16% higher at 24M and 20% higher at 30M in HBP patients. As far as mortality is concerned, during hospital stay, there are 0.6% deaths in HBP patients comparing to none of the NHBP patients. During the first 12 months after surgery, 4.4% of HBP group died comparing to 1.3% of the NHBP. In the next 12 months there were 3.1% and 2.5% mortality, in the respective groups and the last 6 months of evaluation the rates corresponded to 2.5% and 1.3%, respectively. On the other hand, mortality was lower in HBP_HA patients in all periods except during first 12 months of follow-up. During hospital stay and at the time of hospital discharge, no death occurred in HBP_HA group, whereas a mortality rate of 0.5% was present in NHBP_HA group. In the first year post surgery, the mortality rate was 3.3% in HBP_HA group and 2.6% in NHBP_HA; 2.5% in HBP_HA group and 2.6% in NHBP_HA between 12 and 24 months; 1.6% in HBP_HA group and 2.6% in NHBP_HA between 24 and 30 months.

Discussion

HBP values on HA were present in more than one third of the study population (39%), with a predominance of increased systolic BP (values ≥140mmHg) than increased diastolic BP (values ≥90mmHg). Our study population had a mean age of 60 years, and we know isolated systolic hypertension is commonly seen among the elderly, being estimated to be present in 15% of people aged 60 years and above. That's because there is increased deposition of calcium and collagen to the arterial wall in the elderly leading to reduced elasticity of the arterial system. This stiffness causes an elevation in systolic BP and a further decline in diastolic BP leading to an increase in pulse pressure and pulse wave velocity. Isolated systolic hypertension is rarely attributed to secondary hypertension causes such as hypothyroidism/hyperthyroidism, chronic kidney disease, peripheral vascular disease, diabetes mellitus, anemia and others, being in the vast majority of the time a primary hypertension[15].

Prior diagnosis of HBP was also highly prevalent, with the majority (52%) of participants having a formal diagnosis of HBP prior hospital admission. Treatment with antihypertensive medication coupled with dietary and lifestyle modifications is Gold Standard. However, 6% of our patients were not treated. Also, guidelines recommend, multimodal therapy (using more than one pharmacological agent) in order to obtain adequate BP control[8]. The high proportion of hypertensive patients with poor BP control on HA (49%) may be due to frequent use of monotherapy (71%). One of the studies showed that the use of 3 antihypertensives instead of 2 was associated with better control in the population and in any of these groups of patients, they were under more intense pharmacological therapy than the patients in our study population[16].

HBP prevalence is higher in populations undergoing elective surgery compared to the general population[2]. In line with other European countries Portugal has an estimated prevalence of HBP in the adult population close to 42% with only 29% of these cases being controlled[1, 8, 17]. This study showed different results with 52% and 51%, respectively. About half of patients had uncontrolled BP values, this fact can be supported by the institution of antihypertensives in subtherapeutic formulations, by therapeutic noncompliance. 6% of hypertensive patients not being on any pharmacological therapy. This finding is lower than the proportion of HBP patients without pharmacological treatment found in similar studies[7, 16].

Available data related to postsurgical adverse outcomes and HBP is still conflicting and on debate which explains why HBP is currently not considered a major risk factor in the postoperative period[1, 2, 5-7, 9, 10, 18]. Higher morbimortality was observed in our study, not only in patients with previously diagnosed HBP but also in patients with HBP_HA. According to

our expectations, we were able to show an association. HBP group had a 29% higher risk and greater probability of having a complication at 30M.

HBP_HA and HBP groups showed a higher rate of mortality compared to NHBP_HA and NHBP groups. Keeping this in mind, perhaps long-term microvascular complications, known to be associated with chronic HBP, are the main cause of higher morbidity and, higher mortality in these patients. This is supported by findings described in another article, in which target organ damage associated with HBP seems to determine perioperative risk, despite little evidence that elevated BP alone affects postoperative outcomes[1]. Our study allowed us to demonstrate that HBP is an independent risk factor to elevated blood pressure at HA known to increase morbimortality after elective surgeries. Other studies support our findings by demonstrating increased BP as an independent predictor of adverse outcomes, more particularly myocardial injury/infarction, in-hospital death, stroke, heart failure, peripheral artery disease or renal disease, although they are much more specific findings[1, 10].

Several studies consider mainly mortality as the study outcome, but it is important not only assess mortality but also other types of complications, also focusing on morbidity degree[5, 10, 19]. In addition, most studies did not assess morbimortality over time, either because evaluation periods were too short, such as days, or because they only considered outcomes at the end of the entire evaluation period. They were more concerned with assessing the relationship of outcomes to different degrees of HBP, for example[1, 2, 5, 9, 10, 20, 21].

According to Clavien-Dindo classification[14], morbidity was increasingly more prevalent throughout the months of assessment, globally. We focused more on the overall risk of adverse effects and not on the specific type of adverse effect. Over time, more patients presented morbidity of any type, excepting last 6 months of evaluation, and higher morbidity degrees were also detected. Between 24 and 30 months morbidity was neither quantitatively nor qualitatively higher than in the previous evaluation period, with more deaths seen in patients NHBP_HA.

During hospitalization period patients were under close surveillance, as well as it is the earliest period, when many of the long-term complications have not yet had enough time to develop. Therefore, it is easy to understand why it was the time interval in which the lowest morbimortality was verified. Although the only death during hospitalization occurred in a patient NHBP_HA, this is not a finding against our study, since the patient had diagnosed HBP and metastatic irresectable neoplastic disease. This way, it seems like HBP will contribute to a higher postoperative risk during the first 24 months, particularly between 12 and 24 months, once it is the period with greater rate of complications detected, not having such a strong impact after that.

As we can see in results, the total number of new events is higher than the total number of patients in our study population, indicating a large volume of detected complications. The number of accounted events can be composed of several complications in the same period and patient, which, if added together, would give a value much higher than 468.

Optimal perioperative BP remains unclear due to the complex of relationship between HBP, cardiovascular disease, age, and other risk factors[5]. This study shows HBP, as well as age, equal or greater than 50 years, diabetes, dyslipidemia and alcohol consumption as important independent risk factors to elevated BP on HA. Although the majority of the study population were male and this has been described in other studies as a risk factor, no such association could be found in the present study.

In line with other studies, age and dyslipidemia have been considered independent risk factors for adverse surgical outcomes[10, 17]. All these factors have an important influence in morbimortality after elective surgeries, since elevated BP on HA is associated to adverse postsurgical outcomes, in 30M follow-up, in our study. Only age is a non-modifiable risk factor, which shows us that we can act preventively on most of the factors.

A low ASA classification[13] score was present in the majority of patients, similar to other studies, largely due to the elective nature of the surgeries for which they were proposed with a predominance of mild to severe systemic comorbidities, without a clear threat to the patient's life[2, 8]. Other studies that include urgent and emergent surgeries present higher ASA score populations, unlike ours, which have a clear absence of ASA V and VI[4, 11].

Despite our population was sedentary or with reduced levels of physical activity, we included neoplastic patients (32%), who typically present anorexia and weight loss. BMI median is fairly close to normal despite being in overweight range, which is outside the BMI expected in general Portuguese population. 60% of portuguese population is obese or pre obese. In other studies that included patients with cancer the BMI was within the normal range, while in studies that did not include cancer patients the BMI was higher, which supports our findings[2, 5, 9]. Neoplastic disease was not considered an independent risk factor for HBP at HA.

The majority of our study population (76%) had an intermediate to high risk for OSA, according to STOP-BANG questionnaire, despite a low number of patients with OSA diagnose. It is well known OSA is associated with an elevated risk of HBP and cardiovascular disease, but it’s a pathology that frequently coexists undiagnosed and participates in development and progression of cardiovascular diseases, like HBP, and resistance to therapeutical strategies. The gap between the questionnaire results and OSA diagnosis may be due to underdiagnosis or due to high sensitivity and low specificity of the questionnaire used [18, 22, 23] Studies have clearly shown the implication of OSA in the development of the hypertensive state and the benefits obtained by continuous positive

airway pressure on daytime blood pressure and cardiovascular risk. The pathophysiology is related to intermittent hypoxia, which activates sympathetic nervous system and impairs baroreflex and chemoreflex. Consequently, this will elicit cardiac and vascular damage leading to HBP[22, 23]. Thus, the importance of referral to more specific diagnostic tests, such as sleep studies and the need for it to be a more frequent practice. STOP-BANG score wasn't considered an independent risk factor for elevated blood pressure at HA against our expectation.

Pre-operative pathway focuses mainly on physical comorbidities, but evidence suggests that psychological factors, like pre-operative anxiety and depression have an impact on both psychological and somatic surgical outcomes in both the short and long term. This includes increased post-surgical pain, impaired wound healing, poor satisfaction and lower quality of life. Anxiety is one of the most frequently observed psychological reactions among patients awaiting elective surgeries, including non-cardiac surgeries. It is also considered a risk factor for postsurgical mortality. Keeping that in mind, evaluation of anxiety levels should be considered a routine element of preoperative care, using scales based on questionnaires, the Subjective Units of Distress Scale, for example, as we have used[11]. That's why recent update on the Guidelines of the European Society of Anesthesiology recommends incorporating anxiety evaluation into preoperative assessment of the patients. However, there is currently insufficient evidence to be sure that pre-operative psychological interventions are of benefit, or which interventions are most effective[24-26]. Through the anxiety scale[11] we could see that our study population is considered a moderately anxious population, given a median of 50 on a scale of 0 to 100. As for depression[12], with a median of 20 to 25 on a scale from 0 to 100, we can consider the population not very depressed. That said, these are not likely to be variables with a significant contribution to the elevation of BP on HA. One way of limiting anxiety perioperative impact is by measuring BP on primary care[5].

Conflicts of interest

The authors declare no conflicts of interest.

Conclusions

The prevalence of HBP_HA in patients scheduled for elective surgery in this study cannot be neglected thus complications were more likely in these patients during 30 months follow-up. HBP_HA and HBP groups showed a higher rate of mortality compared to NHBP_HA and NHBP groups, respectively during the same period.

The authors identified risk factors, such us age, dyslipidemia, smoking, alcohol consumption and HBP in HBP_HA patients. HBP diagnosis and optimization through pre-habilitation programs during the preoperative period are crucial to prevent long-term morbi-mortality in surgical patients who are exposed to periods of greater stress. All these factors have an important role in morbimortality after elective surgeries. Only age is a non-modifiable risk factor, which shows us that we can act preventively on most of the other factors.

This study contributes to a clearer, appropriate, safer and evidence-based medical decision to postpone or proceed with elective non-cardiac surgeries in HBP_HA patients.

Attachments

Table I. Baseline sample characteristics.

		Total 402 (100%)	**HBP_HA** 155 (38.6%)	**NHBP_HA** 247 (61.4%)
Gender – n (%)				
	Male	228 (56.7)	85 (54.8)	143 (57.9)
	Female	174 (43.3)	70 (45.2)	104 (42.1)
Age (yrs) – mean±SD		59.9±15.2	62.8±13.6	58.07±15.9
Surgical Specialty				
GS	Esophagogastroduodenal	64 (15.9)	23 (14.8)	41 (16.6)
GS	Extra-digestive	73 (18.2)	32 (20.6)	41 (16.6)
GS	Hepatopancreatobiliary	54 (13.4)	17 (11.0)	37 (15.0)
	Urologic Surgery	84 (20.9)	34 (21.9)	50 (20.2)
	Vascular Surgery	33 (8.2)	16 (10.3)	17 (6.9)
	ENT Surgery	14 (3.5)	3 (1.9)	11 (4.5)
	Other	80 (19.9)	30 (19.4)	50 (20.2)
Known HBP				
	Yes	207 (51.5)	102 (65.8)	105 (42.1)
	No	195 (48.5)	53 (34.2)	142 (57.9)
Anti-hypertensive drugs				
	Yes	195 (48.5)	95 (61.3)	100 (40.5)
	No	207 (51.5)	60 (38.7)	147 (59.5)
Heart Rate (bpm) – mean±SD		73.6±12.3	74.1±12.8	73.3±12.0
Systolic BP (mmHg)- mean±SD		133.2±18.4	151.6±11.7	121.7±11.1
Diastolic BP (mmHg)- mean±SD		74.8±11.8	81.2±11.9	70.8±9.8
MAP (mmHg) - mean±SD		94.3±12.1	104.6±8.8	87.8±8.9
Weight (Kg)- median (IQR)		73.2 (16.9)	73.4 (20.02)	73.0 (15.0)
Height (m)- mean±SD		1.7±0.1	1.6±0.1	1.7±0.1
IBM (Kg/m^2)- median (IQR)		25.8 (6.3)	26.8 (6.5)	25.5 (5.7)

bpm- beats per minute; BP- Blood pressure; ENT- Ear, Nose and Throat; GS- General Surgery; HBP- high blood pressure; HBP_HA- high blood pressure at hospital admission; NHBP_HA- non-high blood pressure at hospital admission; IQR – Interquartile Range; MAP- Mean arterial pressure; SD- Standard Deviation.

Table II. Factors contributing to high blood pressure at hospital admission (HBP_HA).

	Total 402 (100%)	**HBP_HA** 155 (38.6%)	**NHBP_HA** 247 (61.4%)	**Odds Ratio** (95% CI)	**p value**
Known HBP					
No	195 (48.5)	53 (34.2)	142 (57.9)	1	< 0.001
Yes	207 (51.5)	102 (65.8)	105 (42.1)	2.60 (1.71-3.95)	
Gender					
Female	174 (43.3)	70 (45.2)	104 (42.1)	1	0.547
Male	228 (56.7)	85 (54.8)	143 (57.9)	0.88 (0.59- 1.32)	
Age					
< 50y	94 (23.4)	25 (16.1)	69 (27.9)	1	0.006
≥ 50y	308 (76.6)	130 (83.9)	178 (72.1)	2.02 (1.21-3.36)	
Smoker– n (%)					
No	207 (51.5)	82 (52.9)	125 (50.6)	1	0.654
Yes	195 (48.5)	73 (47.1)	122 (49.4)	0.92 (0.61-1.36)	
Dyslipidemia– n (%)					
No	218 (54.2)	72 (46.5)	146 (59.1)	1	0.013
Yes	184 (45.8)	83 (53.5)	101 (40.9)	1.67 (1.11-2.49)	
Alcohol consumption– n (%)					
No	215 (53.5)	70 (45.2)	145 (58.7)	1	0.008
Yes	187 (46.5)	85 (54.8)	102 (41.3)	1.73 (1.15-2.60)	
Physical exercise– n (%)					
No	235 (58.5)	98 (63.2)	137 (55.5)	1	0.1249
Yes	167 (41.5)	57 (36.8)	110 (44.5)	1.38 (0.91-2.08)	
Diabetes*- n (%)					
No	323 (80.3)	116 (74.8)	207 (83.8)	1	0.041
Yes	67 (16.7)	33 (21.3)	34 (13.8)	1.73 (1.02-2.94)	
Neoplastic disease**– n (%)					
No	272 (67.7)	105 (67.7)	167 (67.6)	1	0.951
Yes	128 (31.8)	49 (31.6)	79 (32.0)	0.99 (0.64-1.52)	
BMI (Kg/m^2) – n (%)					
< 30	324 (80.6)	123 (79.4)	201 (814)	1	0.618
≥ 30	78 (19.4)	32 (20.7)	46 (18.6)	1.14 (0.69-1.88)	
STOP-Bang risk– n (%)					
< 4 pts	96 (23.9)	30 (19.4)	66 (26.7)	1	0.093
≥ 4 pts	306 (76.1)	125 (80.6)	181 (73.3)	1.52 (0.93-2.48)	

*12 (3%) do not have a definite diagnosis of diabetes (6 in HBP_HA group); ** 2 (0.5%) do not have a definite diagnosis of neoplastic disease (1 in HBP_HA group). BMI- body mass index; HBP- high blood pressure;

HBP_HA- high blood pressure at hospital admission; NHBP_HA- non-high blood pressure at hospital admission.

Table III. Morbidity according to the Clavien-Dindo Classification system.

Morbidity	**Total** 402 (100%)	**HBP_HA** 155 (38.6%)	**NHBP_HA** 247 (61.4%)
From surgery to hospital discharge (HD) - n (%)*	33 (10.4)	14 (11.5)	19 (9.7)
Grade I	1 (0.3)	1 (0.8)	0
Grade II	18 (5.7)	8 (6.6)	10 (5.1)
Grade III			
IIIa	3 (0.9)	0	3 (1.5)
IIIb	4 (1.3)	2 (1.6)	2 (1.0)
Grade IV			
IVa	2 (0.6)	1 (0.8)	1 (0.5)
IVb	4 (1.3)	2 (1.6)	2 (1.0)
Grade V	1 (0.3)	0	1 (0.5)
From HD to 12 months- n (%)**	138 (43.4)	56 (45.9)	82 (41.8)
Grade I	2 (0.6)	1 (0.8)	1 (0.5)
Grade II	79 (24.8)	32 (26.2)	47 (24.0)
Grade III			
IIIa	4 (1.3)	2 (1.6)	2 (1.0)
IIIb	31 (9.7)	13 (10.7)	18 (9.2)
Grade IV			
IVa	8 (2.5)	2 (1.6)	6 (3.1)
IVb	5 (1.6)	2 (1.6)	3 (1.5)
Grade V	9 (2.8)	4 (3.3)	5 (2.6)
From 12 to 24 months- n (%)***	161 (50.6)	68 (55.7)	93 (47.4)
Grade I	1 (0.3)	0	1 (0.5)
Grade II	98 (30.8)	39 (32.0)	59 (30.1)
Grade III			
IIIa	1 (0.3)	0	1 (0.5)
IIIb	38 (11.9)	18 (14.8)	20 (10.2)
Grade IV			
IVa	9 (2.8)	4 (3.3)	5 (2.6)
IVb	5 (1.6)	3 (2.5)	2 (1.0)
Grade V	9 (2.8)	4 (3.3)	5 (2.6)

From 24 to 30 months- n (%)****	136 (42.6)	49 (40.2)	87 (44.2)
Grade I	0	0	0
Grade II	74 (23.2)	26 (21.3)	48 (24.4)
Grade III			
IIIa	1 (0.3)	0	1 (0.5)
IIIb	43 (13.5)	18 (14.8)	25 (12.7)
Grade IV			
IVa	9 (2.8)	2 (1.6)	7 (3.6)
IVb	3 (0.9)	2 (1.6)	1 (0.5)
Grade V	6 (1.9)	1 (0.8)	5 (2.5)

* 285 (89.6%) did not have any type of complication and 84 (33 HBP_HA and 51 NHBP_HA) are missing information regarding outcome; **hospital stay to 12 months, 180 patients without new complications (56.6%) and 84 missing; *** 12- 24 months, 157 patients without new complications (49.4%) and 84 missing; ****24- 30 months, 183 patients without new complications (57.4%) and 84 missing. HBP_HA- high blood pressure at hospital admission; HD- hospital discharge; NHBP_HA- non-high blood pressure at hospital admission.

Table IV. Morbi-mortality (complications) at hospital discharge, 12-, 24- and 30 months follow-up according to the presence of high blood pressure at hospital admission (HBP_HA) or non-high blood pressure at hospital admission (NHBP_HA).

	Morbi-mortality*– n (%)	**HBP_HA** (n=155)	**NHBP_HA** (n= 247)	**RR**
From surgery to hospital discharge (HD)	Yes	14 (11.5)	19 (9.7)	
	No	108 (88.5)	177 (90.3)	1.10**
	Missing information	33	51	
From HD to 12 months follow-up	Yes	56 (45.9)	83 (42.3)	
	No	66 (54.1)	113 (57.7)	1.10**
	Missing information	33	51	
From 12 to 24 months follow-up	Yes	72 (59.0)	99 (50.5)	
	No	50 (41.0)	97 (49.5)	1.20**
	Missing information	33	51	
From 24 to 30 months follow-up	Yes	57 (46.7)	97 (49.5)	
	No	65 (53.3)	99 (50.5)	0.96**
	Missing information	33	51	

HBP_HA- high blood pressure at hospital admission; HD- hospital discharge; NHBP_HA- non-high blood pressure at hospital admission; RR- Relative Risk; * Complications include cumulative deaths; ** p>0.05.

Table V. Morbi-mortality (complications) at hospital discharge, 12-, 24- and 30 months follow-up according to the presence of previously known arterial high blood pressure (HBP) and non-high blood pressure (NHBP).

	Morbi-mortality*– n (%)	**HBP** (n=207)	**N_HBP** (n= 195)	RR
From surgery to hospital discharge (HD)	Yes	24 (15.0)	9 (5.7)	3.0**
	No	136 (85.0)	149 (94.3)	
	Missing information	47	37	
From HD to 12 months follow-up	Yes	78 (48.8)	61 (38.6)	1.26***
	No	82 (51.2)	97 (61.4)	
	Missing information	47	37	
From 12 to 24 months follow-up	Yes	93 (58.1)	79 (50.0)	1.16***
	No	67 (41.9)	79 (50.0)	
	Missing information	47	37	
From 24 to 30 months follow-up	Yes	85 (53.1)	70 (44.3)	1.20***
	No	75 (46.9)	88 (55.7)	
	Missing information	47	37	

HBP - high blood pressure; HD- hospital discharge; N_HBP- non-high blood pressure; RR- Relative Risk; * Complications include cumulative deaths; ** p< 0.01; *** p> 0.05.

Exma. Sra. Ana Lia
Estudante do ICBAS

ASSUNTO: Trabalho Académico - MIM - **"Pós-operatório de doentes propostos para cirurgia eletiva com pressão arterial elevada à admissão hospitalar"** – N/ REF.ª 2022.245(192-DEFI/207-CE)

Conselho de Administração do Santo António na reunião de 15 de fevereiro de 2023 emitiu a seguinte deliberação: "Autorizado" para a realização do estudo acima mencionado, a realizar no Serviço de Anestesiologia desta Instituição e tendo como Investigador Principal Ana Lia, estudante do ICBAS.
O estudo foi previamente analisado pela Comissão de Ética do Santo António|ICBAS, pelo Serviço de Investigação Clínica, pela Direção do Departamento de Ensino, Formação e Investigação do Santo António e pelo Presidente do Conselho de Administração, tendo obtido parecer favorável.

European Heart Journal - Quality of Care and Clinical Outcomes

POSTOPERATIVE PERIOD AFTER ELECTIVE SURGERY IN PATIENTS WITH HIGH BLOOD PRESSURE ON HOSPITAL ADMISSION

--Manuscript Draft--

Manuscript Number:	
Full Title:	POSTOPERATIVE PERIOD AFTER ELECTIVE SURGERY IN PATIENTS WITH HIGH BLOOD PRESSURE ON HOSPITAL ADMISSION
Short Title:	30 months outcome high blood pressure hospital admission
Article Type:	Original Article
Keywords:	Hypertension; surgical patient; outcomes; high blood pressure
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Abstract:	Background Prevalence of high blood pressure at hospital admission (HBP_HA) in surgical patients and its impact on outcomes still scarce. Prevalence of HBP_HA, risk factors and outcomes are evaluated. Methods After institutional approval an observational study was conducted in a tertiary hospital. Adult patients admitted for elective surgery, from October to December 2019. Analyzed variables: sociodemographic characteristics, HBP and treatment, smoking, alcohol, dyslipidemia, obstructive sleep apnea, surgical and anesthetic procedures, systolic blood pressure (BP), diastolic BP, body mass index and others. 30 month outcomes registered using Clavien-Dindo classification. Results/Discussion Of 402 patients, 57% were male with a mean age of 59.9 ± 15.2 yrs. HBP_HA was present in 39% of patients. 66% of them had previous diagnosis of HBP and of these 61% were on antihypertensive therapy. Previous diagnose of HBP (OR = 2.60; 95% CI 1.71-3.95), age ≥ 50 yrs (OR = 2.02; 95% CI 1.21-3.36), dyslipidemia (OR = 1.67; 95% CI 1.11-2.49), alcohol consumption (OR = 1.73; 95% CI 1.15-2.60) and diabetes (OR = 1.73; 95% CI 1.02-2.94) were identified as predictors of HBP_HA. Intraoperative

	hypotension observed in 92 (59%) of patients with HBP_HA. Mortality rate was superior (3.9% vs. 2.5%) in HBP_HA comparing to NHBP_HA group, excluding deaths related with evolution of neoplastic disease. HBP_HA group was 7% more likely to have new complications, during the entire study period. Conclusion The prevalence of HBP_HA surgical patients in this study cannot be neglected thus complications including deaths were more likely in these patients during 30 months follow-up.

CERTIFICADO

Para os devidos efeitos certifica-se que o trabalho

HIGH BLOOD PRESSURE ON PREOPERATIVE HOSPITAL ADMISSION: 30 MONTHS FOLLOW-UP MORBIDITY

elaborado por

Carla Cavaleiro; Lia; Débora Marques; Álvaro Moreira; Humberto Machado

foi apresentado como **Poster** no ***Congresso da Sociedade Portuguesa de Anestesiologia 2023 – Empower Yourself,*** que decorreu a 24 e 25 de março de 2023, no Hilton Porto Gaia.

Vila Nova de Gaia, 25 de março de 2023

ORGANIZAÇÃO

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Dra. Fátima Lima
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All data related to this abstract and the session in which it will be presented are described below:

YOUR ABSTRACT (as submitted)

Presenter:	Débora Costa Marques
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Abstract Title:	**High blood pressure on hospital admission in patients scheduled for elective surgical procedures: risk factors, intraoperative low blood pressure and postoperative morbidity**
Submission Reference:	AS-ESAIC-2023-01184
Presentation Number:	**13AP04-10**

YOUR ONSITE PRESENTATION SCHEDULE (Glasgow, Scotland)

Session Reference:	13AP04
Session Title:	Perioperative Medicine (4)
Session Date and Time:	**Sunday, 4 June 2023 11:30 - 13:00**
Presentation Order:	10
Poster e-Board:	**Poster e-Board 4 (Poster Area)**

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