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Hypertension and Masked Hypertension in a Small Town in Central Italy Revealed Using Ambulatory Blood Pressure Monitoring: A Descriptive Observational Study

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Authors' contributions

This work was carried out in collaboration between all authors. Author DL designed the study, wrote the protocol, and wrote the first draft of the manuscript. Author GI managed the literature searches. All authors read and approved the final manuscript.

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Case Study

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ABSTRACT

Objective: To evaluate the anamnestic prevalence of hypertension and the number of subjects with high blood pressure independently by clinical history; quantify how many subjects are in our population with masked hypertension.
Design: Descriptive observational study with simple random sampling of residents in Santarcangelo di Romagna.
Setting and Participants: From February 2011 to February 2013 we carried out the prospective evaluation of 127 participants: 59 females and 68 males, whose average age was 64 years (range 51 - 80). We performed office blood pressure, ambulatory blood pressure monitoring (ABPM) and

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recorded clinical history.
Results and Conclusion: Our population was made of 62 cases with anamnesis of high blood pressure (the anti-hypertensive treatment works only in 79% cases) and of 65 persons without anamnestic hypertension. In this sub-population in 9 cases the office measurement performed before ABPM was normal, but ABPM found high values of blood pressure night time, and an increased average value, condition compatible with a MH diagnosis. The implications are that there is a substantial number of people in the general population who has untreated hypertension and an increased risk of cardiovascular disease that requires serious consideration. The results obtained in this work, in our opinion, suggest a more intensive use of ABPM in the management of patients with high blood pressure or without hypertension but with organ damage difficult to explain, particularly in diabetics and smokers.

Keywords: Blood pressure monitoring ambulatory; ABPM; hypertension; masked-hypertension.

1. INTRODUCTION

Cardiovascular disease represents the first cause of death globally in developed world and in developing regions. Hypertension is involved in cardiovascular and cerebrovascular disease. Worldwide 16,5% of all death can be attributed to high pressure [1,2,3]. An early and correct identification of hypertensive subjects is one of the main objectives in the management of public health. Ambulatory Blood Pressure Monitoring (ABPM) is a powerful tool for analyzing the blood pressure variability over 24-hour [4] and has improved the ability to quantify the antihypertensive effect of drugs or not-pharmacological measures [5]. The measurement of blood pressure obtained by ABPM establish the risk of cardiovascular events more accurately than casual measurement at the office [6,7,8]. It is more reproducible than office measurements [9] and correlates with subclinical organ damage more closely than office values. Moreover, it is useful for identification of patients with white-coat [10,11] or masked hypertension (MH) [12]. On the other hand ABPM has exclusion criteria (contrary to the normal office BP measurement) and is an expensive method of investigation, the use of which requires time and training. ABPM provides various blood pressure measurements, but while hypertension by office blood measurement is defined for value higher than 140/90 mmHg, the hypertension by ABPM is defined by higher values than 130/80 mmHg in 24 hours. Masked hypertension is characterized by normal blood pressure values in the office but elevated blood pressure outside. Its prevalence is approximately 15% [13] and is not usually diagnosed by routine medical examinations, but carries an adverse prognosis both in terms of organ damage and cardiovascular events.

2. OBJECTIVES

This study is aimed to evaluate the anamnestic prevalence of hypertension in comparison to the number of people with actually high blood pressure, and to quantify how many subjects are in our population with masked hypertension.

3. MATERIALS AND METHODS

In order to obtain a representative population of residents from 50 to 80 year-olds in Santarcangelo di Romagna (7110 people) we calculated the need of 96 elements with a confidence of 95% using the formula $n= [1.96^2 \times EP \times (1 – EP)] / AA^2$ with n = sample size , EP = Expected Prevalence, AA = Absolute Accuracy [14]. We choose 300 people (expecting a lower feedback return) performing a simple random sampling and offered them, by mail, enrollment in a study with a free evaluation of blood pressure by ABPM, a method not commonly used by General Practitioners (GP). We got a feedback return of 127 people (that is higher than required representative threshold) between February 2011 and February 2013 and carried out the prospective evaluation on 59 females and 68 males, whose average age was 64 years (range 51 – 80; SD = 8,45). After recruitment the investigators performed in all patients, who did not meet any of the exclusion criteria (atrial fibrillation, intolerance to ABPM, inability to communicate and comply with all study requirements, pregnancy, night/shift work employment, unstable angina pectoris, heart or kidney failure) ABPM and recorded clinical and pharmacological history. During the medical history interview has been reported the presence of 62 hypertensive people (in all cases there was a good adherence to prescribed medication). The diagnosis of hypertension was made by the GP or by Cardiologist or after an hospitalization in

internal medicine where was used a mercury or a digital sphygmomanometer, depending on the availability of the instrument. In this study was used a DIASYS INTEGRA II (Novacor UK Ltd) programmed for 24 hours measurements, clinically validated [15]. Each participant was received in the morning in a room with comfortable temperature, and blood pressure measurement was performed by a physician on the non-dominant arm where was placed the cuff of ABPM. ABPM was programmed to perform a measurement every 15 minutes during waking and every 30 minutes during the night (were performed about 82 measurements over 24 hours). Waking and sleep time was noted for each participant (night time was defined asking the time when he lies down in bed and the time he gets up in the morning). We used a cuff for obese people and another for non-obese. The readings of ABPM data were performed by a physician well trained, who routinely performs the procedure for the Italian National Health Service, comparing the results with the criteria of the study PAMELA (8). In order to compare office blood pressure levels to ABPM levels, a weighted mean is calculated using the formula: mean 24 hour ABPM = (mean daytime value X hours of walking + mean night time value X hours of sleeping) / 24 [16].

4. RESULTS

We obtained two sub-groups (with no statistical difference): with (62 people, Table 1) and without (65 people, Table 2) an anamnestic diagnosis of hypertension.

Table 1. People with anamnestic hypertension

	Total	Female	Male
Known hypertensive	62	28	34
Mean 24 hour ABPM <130/80 mmHg	49	23	26

In 65 people without anamnestic hypertension there were only 3 diabetics (0 females and 3 males), nobody with a previous myocardial infarction or with a detectable albuminuria and with LDL in the average lower than 100 mg/dl (96,6 mg/dl in females and 95,2 in males).

All 65 people without anamnestic hypertension stated they have their blood pressure levels checked by GP or by Cardiologist at least once a year and get normal values, but we found some differences, as shown in Table 3.

Table 2. People without anamnestic hypertension

	Total	Female	Male
Not hypertensive	65	31	34
Mean 24 hour ABPM >130 and > 80 mmHg	1	0	1
Mean 24 hour ABPM >130 and ≤ 80 mmHg	1	0	1
Mean 24 hour ABPM ≤130 and >80 mmHg	7	2	5

Table 3. BP levels revealed by office measurement performed before ABPM in people without anamnestic hypertension

	Total	Female	Male
BP ≥140 AND ≥ 90 mmHg	8	5	3
BP ≥ 140 AND < 90 mmHg	8	2	6
BP < 140 AND ≥ 90 mmHg	4	0	4
BP <140/90 mmHg	45	24	21

5. DISCUSSION AND CONCLUSIONS

Blood pressure, plasma glucose, plasma lipids and some emerging biomarkers reflecting inflammation and oxidative stress must be taken in account in assessing the overall risk of cardiovascular disease [17]. Most of these parameters, although they may be determined routinely, are often evaluated superficially or not frequently enough in everyday clinical work. It does not ensure sufficient control of the global cardiovascular risk. In our population 21% does not reaches optimal levels of blood pressure, just a little better than as described in literature [18,19]: the anti-hypertensive treatment works only in 79% of anamnestic hypertension (49 cases, Table 1). Our findings may result from adherence to the therapy less than that reported (difficultous to prove) or by the presence of resistant hypertension defined as blood pressure that remains above 140/90 mmHg despite the concurrent use of optimal dose of 3 antihypertensive agents of different classes [20]. Tables 3 and 4 show, in the subgroup of 65 persons without anamnestic hypertension, the office measurement performed before ABPM. In 20 cases it was found an elevated blood pressure (systolic or diastolic or systolic-diastolic hypertension); in the remaining 45 cases, the

recorded values were normal. We can not exclude the presence of the "white coat phenomenon" in 20 cases found with high pressure, but certainly the finding of normal pressure in 45 cases make not impossible the diagnosis of masked hypertension.

Table. 4 People with BP < 140/90 mmHg revealed by office measurements performed before ABPM

	Total	Female	Male
BP < 140/90 mmHg before ABPM	45	24	21
Mean 24 hour ABPM >130 and > 80 mmHg	0	0	0
Mean 24 hour ABPM >130 and ≤ 80 mmHg	0	0	0
Mean 24 hour ABPM ≤130 and >80 mmHg	0	0	0

The term “masked hypertension” (MH) is reserved to define untreated individuals with normal BP in the office and abnormally high pressure out of the medical environment: the cut-off values are 140/90 mmHg for the office or 130/80 mmHg for ABPM [21]. Many factors which could elevate the ambulatory pressure are involved in MH, such as smoking, use of alcohol, low levels of physical activity and mental stress, on the contrary MH is less prevalent with increasing age [22]. One of the most common classifications of MH is [2]): Non-dipper type hypertension in which night time blood pressure is higher than daytime. Morning surge type hypertension (blood pressure is high after wake-up). Workplace hypertension in individuals who have mental stress during the daytime and Smokers. Night time blood pres-sure during sleep reflects the severity of hypertension more accurately than daytime and ABPM is the only way to measure night time blood pressure. Table 2 reports 9 cases (7 males and 2 females) without anamnestic hypertension, with normal blood pressure measured manually before ABPM (mean = 124.4 mmHg systolic SD = 3.5 mmHg diastolic mean = 81.2 SD = 3.4). In all cases ABPM found high values of blood pressure night time, and an increased average value, condition compatible with a MH diagnosis.

The implications are that there is a substantial number of people in the general population who has untreated hypertension and an increased risk of cardiovascular disease that requires serious consideration. In the literature [23], you can find some open questions regarding the management of MH (is it a clinical entity or a statistical phenomenon linked to the variability of blood pressure measurements?) but certainly data from the PAMELA study [8] revealed that MH is not prognostically innocent about the hazard ratio for cardiovascular death. In the Ohasama study [4] risk was significantly higher in partecipants with MH than in participants with sustained normal blood pressure and similar findings were observed for cardiovascular mortality and stroke morbidity among subgroups by sex, use of antihypertensive drugs and risk factor level. MH is also associated with an higher risk of end stage renal disease in patients with chroni kidney disease [24]. The results obtained in this work, in our opinion, suggest a more intensive use of ABPM in the management of patients hypertensive or without hypertension but with organ damage, difficult to explain. Certainly, many issues need to be considered if you decide to use ABPM, not least the economic aspect relating to the purchase of the equipment and the time associated with staff training. We also wish a closer office monitoring by general practitioners (GP) of blood pressure, particularly in diabetics and smokers. To evaluate any results of this approach we planned to repeat this study in a next future to highlight the possible improvement in the managing of hypertension by GP, according to guidelines, using ABPM.

CONSENT

All authors declare that ‘written informed consent was obtained from the Patient (or other approved parties) for publication of this case report and accompanying images'.

ETHICAL APPROVAL

All Authors hereby declare that all experiments have been examined and approved by the appropriate ethics committee and have therefore been performed in accordance with the ethical standards laid down in the 1964 Declaration of Helsinki.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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