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# AUTOMATIC MONITORING GADGET FOR BLOOD PRESSURE IN EXPECTING MOMS USING SUPINE PRESSOR EXAMINATIONS

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**Abstract:** Although prior research has frequently disregarded the effects of the pregnant uterus's mechanical constriction of the left renal vein, preeclampsia poses major health hazards to both mothers and infants. This work used two different approaches: first, it investigated the relationship between elevated blood pressure and renal damage and constriction of the left renal vein in mice. Secondly, it developed an automated version of the supine pressor test (SPT) to help pregnant women determine their preeclampsia risk. The results of the study conducted on mice suggested that acute renal failure and a considerable rise in blood pressure could be brought on by persistent renal vein stenosis. From a human perspective, the research noted that when non-pregnant women switched from sleeping on their left side to resting on their back, proving that expectant mothers were capable of doing the SPT on their own. In conclusion, this study provides a promising technique for the early diagnosis of preeclampsia in pregnant women and illuminates possible underpinnings of the condition.

**Index Terms: Supine Pressor test, Mechanical compression, Renal necrosis, Blood pressure increase, Renal vein constriction, Preeclampsia, Early diagnosis**

## I.INTRODUCTION

Preeclampsia is a condition marked by hypertension during pregnancy. It carries severe hazards to the health of both the mother and the fetus, with alarmingly high rates of mortality from linked complications. Preeclampsia is not always easily predicted by current diagnostic techniques, such as measuring blood pressure and looking for other related symptoms, even though it is a common and severe condition. According to newly available data, the gravid uterus's mechanical compression of the left renal vein may be a previously unrecognized role in the development of preeclampsia. Due to venous outflow restriction caused by this compression, the renin-angiotensin-aldosterone system is activated, which may result in hypertension. In order to close this knowledge gap, this work uses a mouse model to examine the consequences of renal vein stenosis in order to gain a clearer understanding of the mechanisms behind preeclampsia. At the same time, the research aims to improve diagnostic capacities by using the supine pressor test (SPT), an automated method that may be used to forecast the risk of preeclampsia. This study intends to equip pregnant women with accessible and efficient tools to monitor their risk of developing preeclampsia, especially in areas with limited healthcare resources, by clarifying the significance of renal vein constriction and enhancing diagnostic accuracy. This multimodal strategy has the potential to improve clinical management options to lessen the negative effects of preeclampsia for both mothers and babies, as well as to advance our understanding of the pathophysiology of the condition. Through establishing a connection between fundamental research and practical application, this work supports the continuous endeavors to lower the prevalence of preeclampsia worldwide and enhance the health of mothers and newborns.

## II. EXISTING ARCHITECTURE

The goal of the design shown in the study "Toward Automation of the Supine Pressor Test for Preeclampsia" is to expedite the supine pressor test (SPT) procedure for estimating the risk of preeclampsia in expectant mothers. By automating the SPT, this architecture seeks to improve accessibility and convenience for patients as well as healthcare professionals. It probably entails integrating location sensors and wearable blood pressure monitoring devices with algorithms to evaluate the data gathered throughout the test. The intention is to design an easily navigable system that expectant mothers can use on their own to track their risk of preeclampsia, with the option for remote monitoring and medical professional intervention. This architecture aims to improve preeclampsia early identification and management through automation of the SPT, ultimately improving results for maternal and fetal health.

**LITERATURE REVIEW**

TABLE 2.1 LITERATURE REVIEW SUMMARY

| Published Year | Author Name | Title Of The Paper | Remarks |
|---|---|---|---|
| 2019 | Hamna J. Qureshi et.al | Toward Automation of the Supine Pressor Test for Preeclampsia. | The results demonstrated that venous stenosis can result in high blood pressure and kidney injury. Even though additional research will be needed to determine the efficacy of an automated SPT, our ultimate goal is to develop and disseminate a combination device and data system that can be used in a range of settings, ultimately improving maternal and fetal health worldwide. |
| 2020 | Kazuomi Kario et.al | Simultaneous self-monitoring comparison of a supine algorithm-equipped wrist nocturnal home blood pressure monitoring device with an upper arm device | The impact of blood pressure monitoring during sleep disruption should be examined in a follow-up study. The blood pressure readings from the wrist HBPM device and the ABPM device were not compared over night. |
| 2019 | Glenda Puco et.al | Electronic System for Detection and Control of Preeclampsia in Pregnant Women | When it comes to accuracy, noninvasive techniques-based blood pressure monitoring equipment is not as good as noninvasive approaches. Because invasive methods are only used in very restricted conditions, it has not been possible to compare the data collected using invasive procedures versus non-invasive alternatives. |
| 2019 | DaliaYousif et.al | Autonomic Dysfunction in Preeclampsia : A Systematic Review | The majority of the studies in this review is limited in scope by its case-control design, and data from prospective trials have yielded inconsistent findings about the predictive value of several ANS tests for early diagnosis of PE. Another limitation is the methodological variation found in studies regarding the different definitions of preeclampsia and the features of the PE group that is encompassed. |
| 2019 | Iuliana Marin et.al | Early Detection of Preeclampsia based on-Machine Learning approach | One potential problem with the material is that it uses simulated data. Even if the employment of an artificial arm resembles real-life scenarios, differences may exist between simulated and real patient data. This could impact the generalizability and real-world application of the recommended early detection solution. It is understood that this is a problem, and it will be resolved in the future by validating the system using real data from a medical clinic. Until then, it is uncertain how completely applicable the system will be in practical settings. |

## III. METHODOLOGY

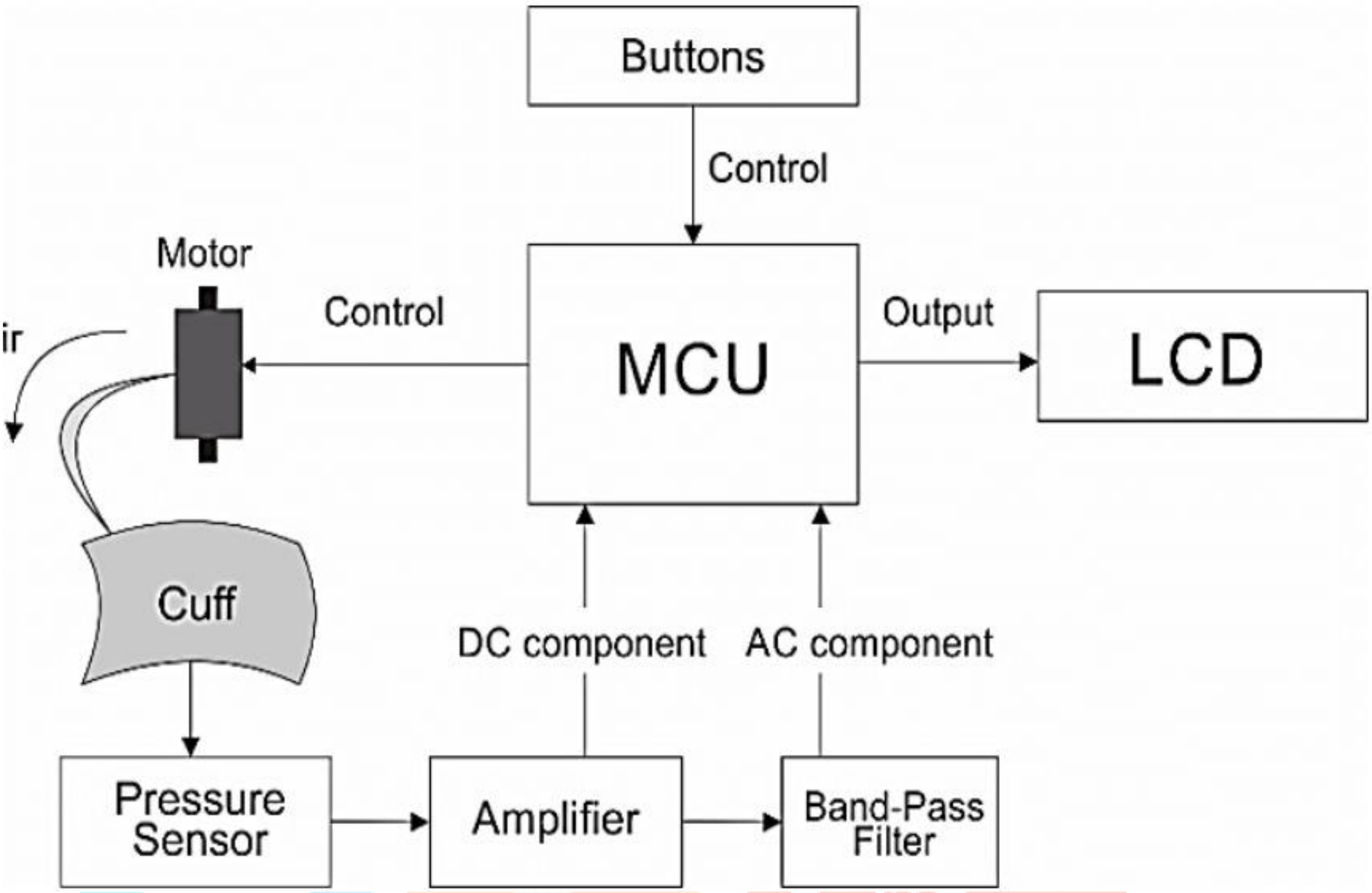


Figure: Block Diagram of Automatic Monitoring Gadget for blood pressure in Expecting Moms using Supine pressor Measurings

The process of taking a blood pressure reading begins with the cuff being inflated. This is done by a motor that is controlled by the control unit. Blood flow is momentarily impeded as the brachial artery in the arm is compressed by the expanding cuff. A pressure sensor tracks the variations in blood pressure brought on the cuff inflation throughout this procedure. The sensor then transforms these oscillations into an electrical signal that includes a pulsing AC component and a steady DC component that indicate variations in blood pressure. A band-pass filter eliminates the DC component so that only the AC component can flow through, isolating the pulsing component. The AC signal's amplitude is then increased by an amplifier, which is required because of the sensor's weak output. After this enhanced AC signal is received, the Microcontroller Unit transforms it into a digital format that can be processed by a computer. The blood pressure reading is shown for interpretation on the LCD when the digital signal has been delivered there.

The cuff is inflated as the first stage in the process of taking a blood pressure reading. The brachial artery in the upper arm is compressed by this arm band, which is filled with air by a motor operating under the direction of the control unit. This causes the artery to constrict, temporarily limiting blood flow. These changes in pressure are then sensed by the pressure sensor, which is the main part of the system. This sensor converts the physical pressure variations inside the cuff into useful information by using a weak electrical signal. Strain gauge sensors are widely used among the different kinds of pressure sensors that are accessible; they work by using changes in resistance to pressure. A Band-Pass Filter is used to improve the raw electrical signal from the sensor by allowing only a certain frequency range to pass through and removing undesired components, most notably the steady-state DC component. This filter gives priority to the variable AC component, which is essential for accurately transmitting blood pressure data. The sensor's electrical signal is weak by nature, therefore to boost the AC component—think of it like enhancing a gentle whisper for clarity—an amplifier is required. As the brains of the system, the Microcontroller Unit is entrusted with critical tasks after obtaining the improved AC signal. This includes Analog-to-Digital Conversion , which transforms an amplifier's continuous analogue electrical signal into discrete digital values that a computer can understand. The MCU also does signal processing, which may involve using algorithms to extract blood pressure data and improve overall accuracy by lowering noise. The processed blood pressure measurements are then shown on a Liquid Crystal Display , which provides an easy-to-read and clear representation of the data that was analysed. Systolic and diastolic readings are often displayed on an LCD for ease of understanding.

**IV. RESULTS**

Figure 1 Figure 2

All fifteen consecutive blood pressure readings in the supine and left lateral recumbent positions in non-pregnant women are shown in Figure 1 (a)
All ten consecutive blood pressure readings in the left lateral recumbent and supine positions in pregnant women are shown in Figure 2 (b).

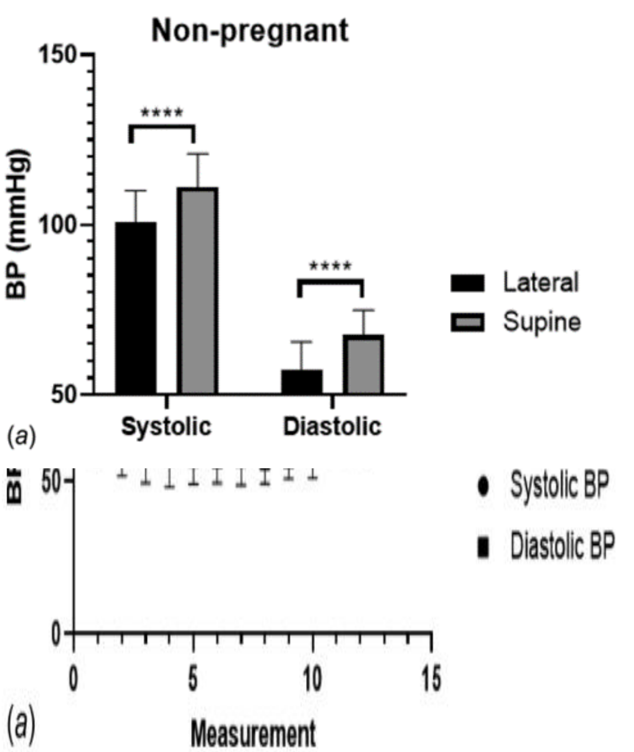


Figure 3

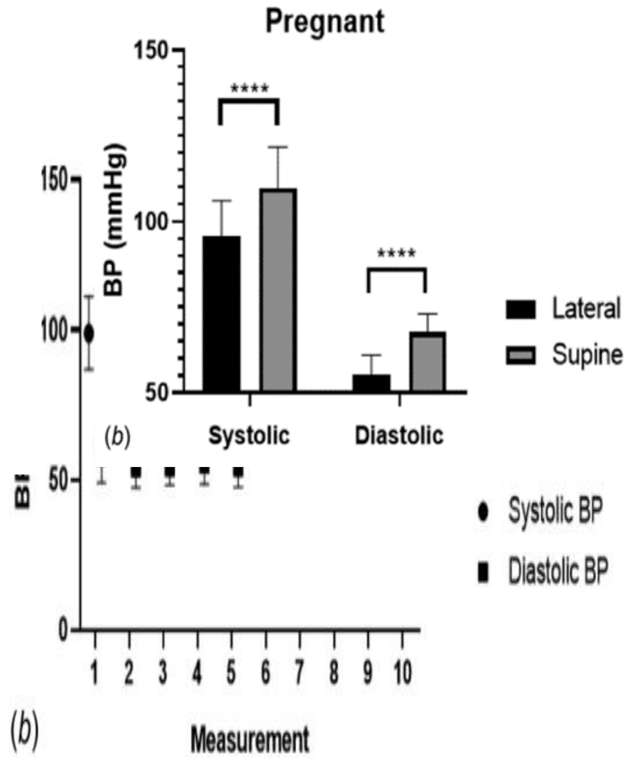


Figure 4

Figure 3: Non-pregnant women's BP comparison in both postures.
Figure 4: Comparison of pregnant women's blood pressure in different positions

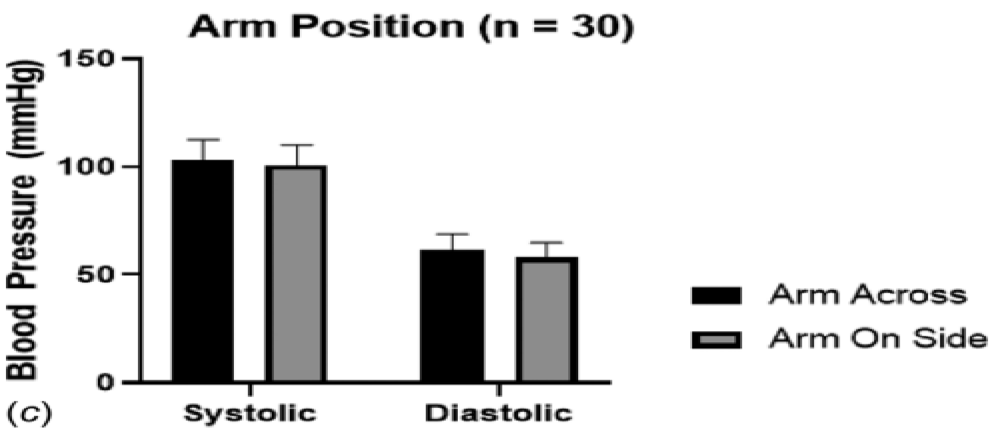


Figure 5: When an arm is placed across the chest in the left lateral recumbent posture, the blood pressure readings are usually greater than when the arm is positioned along the side of the body.

**DESCRIPTION OF THE RESULTS**

There was a significant rise in the subjects' blood pressure upon moving from the left lateral to the supine position. 50 people in all, with an average age of 22.8 ± 3.8 years, were included in the study; 68% of them had mean BMIs of 22.32 ± 3.41 kg/m², within the healthy range of 18.5–24.9 kg/m². Blood pressure readings stabilised after about five minutes, usually after two readings (Fig. 1). The first two readings obtained in the left lateral recumbent position were excluded from the average measurement in order to guarantee the inclusion of only steady postexercise data ( Fig. 3). When moving from the left lateral recumbent to the supine position, the average increase in blood pressure for nonpregnant women was 10.6 ± 5.7 mmHg for the systolic and 10.4 ± 6.0 mmHg for the diastolic values (Fig. 3). There was a statistically significant difference in blood pressure levels between the two postures, as seen by this rise ($p < 0.001$).When pregnant women move from the left lateral to the supine position, their blood pressure rises. The women included in this study segment were 31.5 ± 4.7 years old on average, 29.7 ± 6.6 weeks gestational age, 2.4 ± 2.3 gravidity, and 1.2 ± 2.1 parity. Pregnant subjects showed an average increase in systolic blood pressure of 14.0 ± 4.0 mmHg and diastolic blood pressure of 12.5 ± 4.8 mmHg when switching from the left lateral recumbent position to the supine position (Fig. 4), when all five measurements were taken in both body positions. Women naturally rested at an angle of 72.6 ± 6.3 degrees from the bed to their back when in the left lateral recumbent position. It's interesting to note that pregnant women's blood pressure changed between positions more than non-pregnant women's did, by 3.4 mmHg and 2.1 mmHg, respectively. The only finding that was found to be statistically different between pregnant and nonpregnant women ($p < 0.05$) was the increase in systolic blood pressure between postures.Nearly all 25 expectant mothers (88%) concurred that following the instructions was simple. Furthermore, the majority of participants (92%) concurred that using the BP device during the treatment was comfortable for them. The majority of pregnant participants in the study—96%—agreed that taking their blood pressure on their left side was comfortable, whereas only 52% of them said that taking their blood pressure on their back was comfortable .When asked which position they preferred to sleep and rest in, all of the women said that they usually slept on their sides.

## IV. CONCLUSION

In summary, this contributes to the development of an automated SPT that expectant mothers may utilize for tracking, early identification, and ultimately, preeclampsia prediction. According to our research, women could essentially complete this test on their own with the help of descriptive visual instructions. Additionally, there is a notable baseline increase in blood pressure of 10-15 mmHg when moving from the left lateral recumbent posture to the supine position. Furthermore, we used an animal model to study the pathogenesis of left renal vein stenosis, confirming a link between renal vein obstruction and hypertension. The findings showed that elevated blood pressure and renal damage can arise from venous stenosis. Our goal is to eventually build and distribute a combined device and data system that can be deployed in a variety of situations, eventually benefiting maternal and fetal health globally, even if more study will be required to assess the effectiveness of an automated SPT. Only the typical blood pressure range may be covered by e-device accuracy. We created a patient-specific technique in this study to calculate blood pressure using the same oscillometric cuff pressure waveform. The basic concept is to use a physiologic model to represent the waveform, and then to use the best possible fit between the model and the waveform to estimate the patient-specific model parameters. Using gold standard invasive BP as a reference, we showed that this technique can significantly enhance accuracy over the state-of-the-art in patients with widely varied PP. Further research with a bigger and more varied sample size could be beneficial to properly evaluate the method's strengths and weaknesses in comparison to other approaches. With more effective testing, the patient-specific approach might enhance automatic cuff blood pressure monitoring.

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