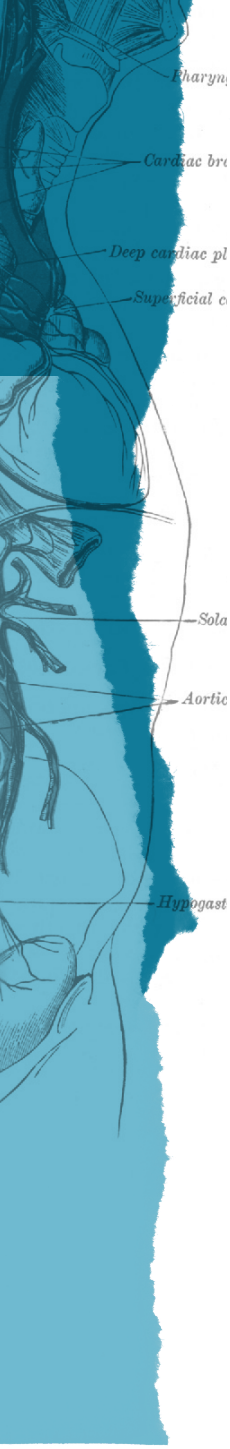

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Roll-Over Test as Predictive Value of Pre-eclampsia*

La Prueba de Roll-Over Como Predictor de Pre-eclampsia

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ABSTRACT

Objective: To determine the effectiveness of the roll-over test as a predictor of pre-eclampsia.

Methodology: The studied population had a size of 272, with a sample of 262 pregnant women, between 28 and 32 weeks of gestational age, who obtained pre-natal care at the Guillermo Almenara Irigoyen National Hospital, between January and September of 2017. The ROC curve, and the sensitivity and specificity of the roll-over test to predict pre-eclampsia, were calculated.

Results: The prevalence of the roll-over test in this study was 9%, with a 95% confidence interval (5.43 - 12.22). In this study, the ROC curve was determined (0.725 and 0.734, for the first and second measurements, respectively) and found to be statistically significant at the $p < 0.05$ level. The sensitivity of the roll-over test for a cutoff point of 20 mmHg was 60%, and the specificity of 95% also had a PPV of 37% and a NPV of 98%. Differences between the first and second measurements suggest that the second measurement is more sensitive than the first one.

Conclusions: The roll-over test is a simple, cost-effective test with potential application in initial evaluation of pre-eclampsia in pregnant women with a history of pre-eclampsia and/or other risk factors.

Key words: pre-eclampsia, roll-over test, pregnancy.

RESUMEN

Objetivo: determinar la efectividad de la prueba de presión supina como predictor de pre-eclampsia.

Metodología: La población del estudio fue de 272 y la muestra consistió en 262 mujeres embarazadas entre 28 y 32 semanas de edad gestacional que obtuvieron atención prenatal en el Hospital Nacional Guillermo Almenara Irigoyen entre enero y septiembre de 2017. Se realizó la curva ROC y se calculó la sensibilidad y la especificidad de la prueba de vuelco para predecir la pre-eclampsia.

Resultados: La prevalencia de la prueba de presión supina en este estudio fue del 9% con un intervalo de confianza del 95% (5,43 - 12,22). En este estudio, se determinó la curva ROC (0,725 y 0,734 para la primera y la segunda medición respectivamente) y se encontró que era estadísticamente significativa al nivel de p <0,05. La sensibilidad de la prueba de presión supina para un punto de corte de 20 mmHg fue del 60% y la especificidad del 95% también tuvo un VPP del 38% y un VPN del 98%. Las diferencias entre la primera y la segunda medición sugieren que la segunda medición es más sensible que la primera.

Conclusiones: la prueba de presión supina es una prueba simple y rentable con una posible aplicación en la evaluación inicial de la pre-eclampsia en mujeres embarazadas con antecedentes o pre-eclampsia y / u otros factores de riesgo.

Palabras clave: Pre-eclampsia, roll-over test, embarazo.

INTRODUCTION

Hypertensive disorders during pregnancy, including pre-eclampsia and eclampsia, affect some ten million women, or roughly 5 to 10% of pregnant women worldwide (1), and can result in maternal death in 10-25% of the cases. These rates are not uniform around the world, however, with data showing that, in low-income countries, pregnant women are seven times more likely to develop pre-eclampsia than women in high-income countries (2-6).

Pre-eclampsia is a multi-systemic disorder defined as the onset of arterial hypertension (systolic blood pressure >= 140mmHg and / or diastolic blood pressure >= 90mmHg), associated or not with proteinuria (>= 0.3g in 24h or protein / creatinine >= 0.3), or hypertension associated with target organ dysfunction (7). Pre-eclampsia is not only associated with high levels of maternal mortality, but also impacts fetal and infantile mortality, especially if it is complicated with eclampsia, or in some cases, Hemolysis Elevated Liver Enzymes Low Platelet count (HELLP syndrome), which can affect between 4-12% of those diagnosed with pre-eclampsia, and has a mortality rate as high as 25%[6]. Given high morbidity and mortality factors, it is important to predict if a pregnant woman will develop pre-eclampsia and to proactively treat each patient in a timely manner to avoid complications. This is particularly important in low- and middle-income countries, where reducing the rates of pre-eclampsia and HELLP syndrome may decrease maternal and infant morbidity and mortality rates.

Historically, many attempts have been made to predict pre-eclampsia, using a variety of tools. Currently, clinicians utilize imaging tests that can predict pre-eclampsia, including the Doppler ultrasound of uterine arteries (8). Checking for pre-eclampsia should be done preferentially in the second trimester of pregnancy, but it has been shown that performing tests such as the uterine artery Doppler in the first trimester of pregnancy is useful in predicting pre-eclampsia (7).

Unfortunately, and despite their effectiveness, methods such as the Doppler ultrasound are expensive, and not very accessible to the general population, making them an inconsistent tool to fight pre-eclampsia in vulnerable populations. According to the Pre-eclampsia Foundation, "In areas of the world with little access to care and lower social status of women, traditional health practices are usually inadequate for the early detection of pre-eclampsia." (6) In order to remove economic barriers to good health care, a more accessible, inexpensive, and rapid method of performing pre-eclampsia screening is needed.

The roll-over test is a simple, low-cost, and quick method of testing. Previous studies have suggested that roll-over tests, along with demographic characteristics such as maternal age, BMI, and educational level, can be good predictors of pre-eclampsia without undue burden to the provider, and without significant costs to the patient (9-10). Other researchers have suggested that roll-over tests provide a "practical method for prediction of pre-eclampsia in high-risk women" (11). According to the study by Narváez et al. (12), the use of the roll-over test in populations at high risk of gestational hypertension is recommended.

While high-income countries have mostly discontinued the use of the roll-over test, it is important for medical professionals in low- and middle-income countries to know about it, and to be able to apply this reliable, yet simple test, which helps as a triage to detect mothers at risk of pre-eclampsia. The purpose of this study was to evaluate the effectiveness of the roll-over test as a predictor of pre-eclampsia in pregnant women.

METHODS

This study used a non-probabilistic cohort format to select 272 women obtaining pre-natal services at the Guillermo Almenara Irigoyen National Hospital, between January and September of 2017. The study sample, after exclusions, was comprised of 262 women. This teaching health care facility was selected due to the diverse population it serves, and, also, due to its relationship with

the Almenara Health Network, which provides primary care services through a series of clinics throughout the region.

Two hundred and seventy-two women, between 28 and 32 weeks of gestational age, without previous history of arterial hypertension, were included in the sample. Inclusion criteria for the study included all females seeking pre-natal care between January and September of 2017. Women with hypertension, but without changes in proteinuria, were excluded from the sample. The sample size was calculated using the following formula:

$$n = \frac{p_1(1-p_1) + p_2(1-p_2)}{(p_1 - p_2)^2} 2f(a,b)$$

Where n = is the sample size equal to 212 pregnant women, p_1 is the probability of developing the disease in those exposed = 0.046, since the prevalence is 4.6%. p_2 is the probability of developing the disease in those not exposed, which is calculated considering the relative risk RR [13] equal to $^{RR(p1)}$ = 3.5 (0.046) = 0.161, and f(a,b) = 7.85 which is the estimate of the alpha (a) and beta (b) levels willing to tolerate, which in this case are a = 0.05 and b = 0.80. While the formula indicated a sample size of 212 was needed, during the data collection process, a greater number of patients who met the criteria was obtained. A decision was made to increase the sample size and strengthen the study yielding a total of 272 study participants. However, data analysis was limited to 262 participants, because 10 study participants only had pregnancy-induced hypertension and, thus, did not meet the clinical criteria for pre-eclampsia.

The roll-over test was performed at the 28th to 32nd week interval, with study participants being divided into two groups (positive or negative), based on test results.

An automatic blood pressure monitor, with a universal cuff that covers arm circumferences of 22 - 42cm, was used in the study. Each pregnant woman was given the roll-over test as described in Table 1. After performing the two measurements, the woman was followed until the end of pregnancy and the immediate postnatal period to evaluate the development of pre-eclampsia. The data were analyzed using the SPSS statistical package.

A relative risk (RR), along with a Receiver Operating Characteristic (ROC) curve, was obtained. ROC curves are "frequently used to show the connection between clinical sensitivity and speci-

ficity for every possible cut-off for a test or a combination of tests" (14). In addition, the sensitivity and specificity of the roll-over test was calculated to predict pre-eclampsia (15-17), using protocols suggested by previous authors (18-20). The protocol for this study was approved by the appropriate Institutional Review Boards.

Table 1

Step 1: The patient was placed in the left lateral decubitus position and allowed to rest for five minutes before blood pressure measurements were taken.

Step 2: Blood pressure was taken on the right arm multiple times, until two consecutive measurements were the same.

Step 3: The patient was turned to the dorsal decubitus position and multiple blood pressure measurements were taken until two consecutive measurements were the same.

Step 4: The roll-over test was considered positive if the diastolic blood pressure increased 20 mmHg or more in dorsal decubitus, with respect to that obtained in lateral decubitus, at 1 minute and at 5 minutes.

RESULTS

Results from this study show that 100% of pregnant women, with a history of pre-eclampsia, had a positive roll-over test. Furthermore, the prevalence of the roll-over test in this study was 8.8%, with a 95% confidence interval (5.43 - 12.22).

Table 2 shows pre-eclampsia rates among the study participants. It should be noted that ten participants were excluded from the sample because they did not meet the clinical criteria for pre-eclampsia, as they developed hypertension without pre-eclampsia. The prevalence of pre-eclampsia was 6% (n = 16), with a confidence interval of 95% (3.2 – 9.0).

Table 2. Prevalence roll-over test for patients with pre-eclampsia

Roll Over Test	Frequency (n=262)1	Percentage	CI 95%	
			Low	High
Positive	16	6.1	3.2	9.0
Negative	246	93.9	91.0	96.8

Note: Ten patients were removed from the sample size as they did not have pre-eclampsia and only manifested pregnancy-induced hypertension.

Tables 3 and 4 show results from the roll-over test with a cut-off point of 20 mm Hg in the diastolic blood pressure difference, a sensitivity of 60% (n = 6), and a specificity of 96% (n = 242). The predictive value was positive (PPV) =38%, with negative predictive value = 98%.

In this study, the ROC curve was determined at 0.944 and 0.969 for the first and second measurements, respectively, and it was found to be statistically significant at the p <0.05 level (see Figure 1). The asymptotic significance was p = 0.000, resulting in statistically significant results. In the coordinates obtained in the ROC curve for a cut-off point in the first measurement of 20 mm Hg of diastolic blood pressure difference, there was a sensitivity of 60% and a specificity of 95%, being the highest, compared to the second measurement.

Table 3. Sensitivity and specificity of the test for a cut-off point of the diastolic blood pressure difference of 20mmHg. Pregnant women with pre-eclampsia

Preeclampsia	Roll Over Test + n (%)	Roll Over Test - n (%)	Total (n=262)
Positive	6 (60.0)	4 (40.0)	10
Negative	10 (4.0)	242 (96.0)	252

Table 4. Differences in diastolic values for patients with pre-eclampsia

Differences in diastolic arterial pressure	Area below the curve	Std. Deviation	p value	CI 95%	
				Lower Limit	Upper Limit
First Test	0.944	0.036	0.000	0.873	1.000
Second Test	0.969	0.023	0.000	0.924	1.000

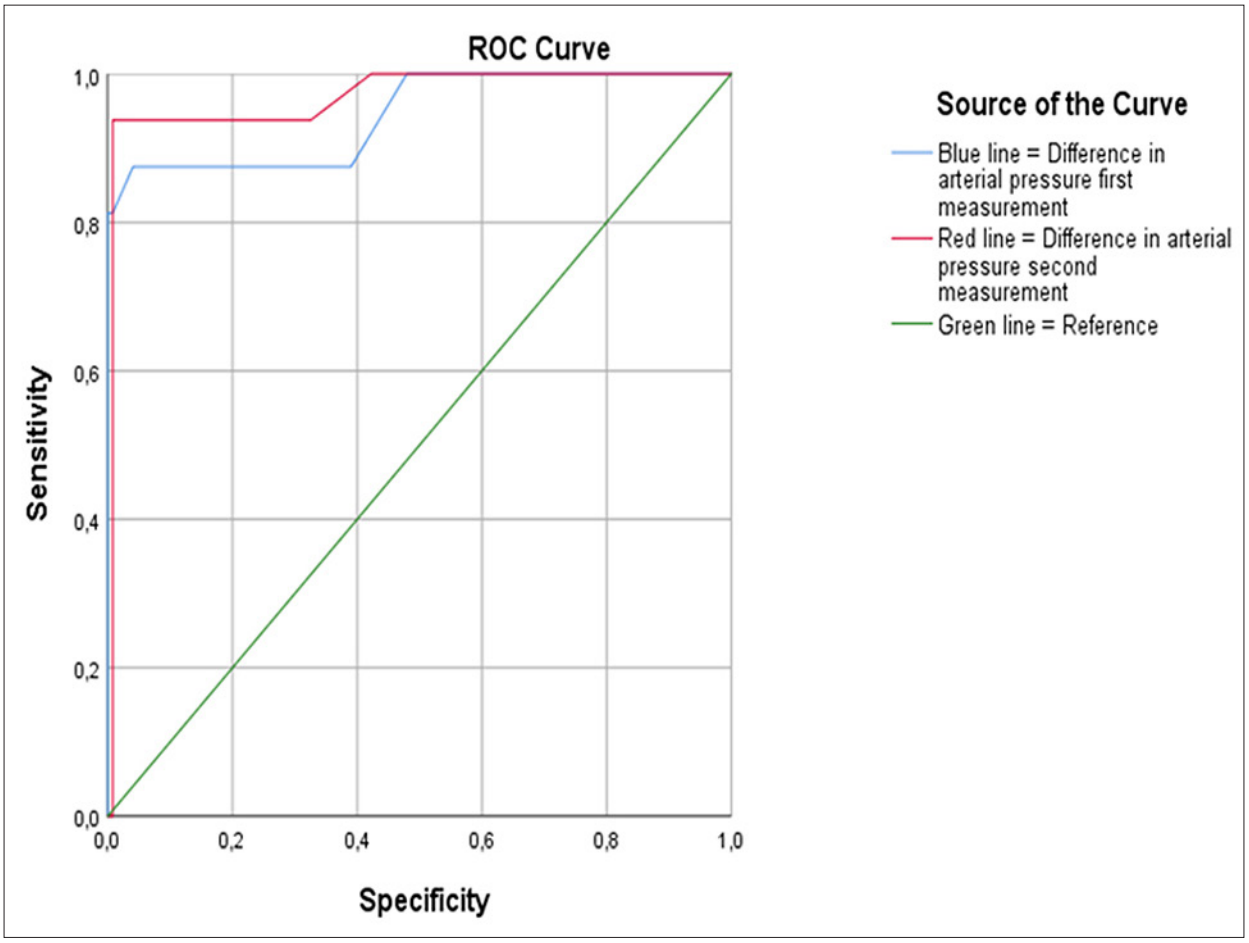

Figure 1. ROC curve showing the area under the curve that reflects the sensitivity and specificity

DISCUSSION

Good health and well-being, along with gender equity, are envisioned as part of the Sustainable Development Goals (21). Given pre-eclampsia's role as one of the diseases that disproportionally contributes to maternal morbidity and mortality around the world, decreasing its impact is of paramount importance, especially in low- and middle-income countries. Decreasing pre-eclampsia's negative outcomes begins with timely diagnosis, assessment of risk factors and clinical criteria for this condition.

In line with previous studies, findings from this study support the effectiveness of the roll-over test as a predictive tool. The predictive value in the study was 38%, compared to findings from Sharma et al. (22) (55%), Marcopito (17) (23%), Mahomed et al. (16) (20%), and Narváez et al. (12) (71%). Differences in findings from the study may be explained by the sample population, which consisted of both primiparous and multiparous pregnant women, unlike some others, which focused primarily in young primiparous women. Sharma et al (22) included pregnant women at high risk of developing pregnancy-induced hypertension in his study, which would explain the higher predictive value. Similarly, Nárvaez et al. (12) obtained a high predictive value, which indicates that, although the roll-over test is not a perfect predictor, it should be used in populations at high risk of developing pregnancy-induced hypertension resulting in maternal and perinatal mortality. In the present study, the cut-off point for the sensitivity and specificity of the roll-over test was set at 20.0 mmHg, yielding a sensitivity of 0.78. Furthermore, results for sensitivity and specificity were 60% and 96%, respectively, which make the roll-over test an acceptable tool for the diagnosis of pre-eclampsia.

It should be noted, however, that previous studies, such as those of Kaypouret et al. (23), have concluded that the roll-over test alone is not a diagnostic or predictive tool of pre-eclampsia, but its combination with other early diagnostic tests improves the prediction of the disease. These findings are supported by Andersen (24), who concluded that the roll-over test is not sufficiently sensitive or specific as a screening test. On the other hand, Thompson et al. (25) and Ghojazadeh et al. (7) have concluded that the roll-over test is clinically useful when utilized in nulliparous young women, based on a sample of pregnant women of different ages and different parity. Finally, Marshall et al. (26) concluded that the roll-over test is recommended as a routine test for the early diagnosis of pre-eclampsia, due to a high predictive value in their study.

CONCLUSION

Currently, there are very accurate diagnostic methods for the prediction of pre-eclampsia, but they are not always accessible to pregnant women who receive medical care at facilities in low- and middle-income countries. Having a simple and easy testing method that is capable of predicting pre-eclampsia helps ensure that they receive early interventions, thereby decreasing negative health outcomes. The roll-over test is such a tool for both nulliparous and multiparous pregnant women with a history of pre-eclampsia.

Since the roll-over test can be employed in primary care settings throughout the world, and it is a low-cost alternative to other tests, ensuring its efficacy is very important. Results from this study indicated that the roll-over test has a 60% sensitivity and a 95% specificity, and it can, thus, be reliable when utilized in initial evaluation screening for pre-eclampsia.

The roll-over test is a simple, economic, and effective test with potential application in initial evaluation of pre-eclampsia in pregnant women with a history of pre-eclampsia and other risk factors.

This study has the limitations associated with a cohort study, and it also showed data from a single institution; however, it is representative of the Peruvian health care system. Although the sensitivity is moderate, the specificity of the test is high. Multicenter and prospective studies are suggested for future research.

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We describe the specific involvement of the authors below:

Jorge Torres-Coronado: Conception of the research idea, Bibliographic Search, writing of the protocol, writing of the final article, approval of the submission of the final version of the article.

Maria Loo-Valverde: Conception of the research idea, Bibliographic Search, writing of the protocol, writing of the final article, approval of the submission of the final version of the article.

Miguel A. Pérez: Bibliographic search, writing of the final article, approval of the submission of the final version of the article.

Jenette Smith: Bibliographic search, writing of the final article, approval of the submission of the final version of the article.

Jhony A. De La Cruz-Vargas: Conception of the research idea, Bibliographic Search, drafting

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