

ORIGINAL ARTICLE

MATERNAL CARDIAC OUTPUT AS A PREDICTOR OF PREECLAMPSIA-ECLAMPSIA SYNDROME

GASTO CARDÍACO MATERNO COMO PREDICTOR DEL SÍNDROME DE PREECLAMPSIA-ECLAMPSIA

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ABSTRACT

Introduction and Objectives: Hypertension is the most common medical complication of pregnancy, and it can leave permanent sequelae such as neurological, hepatic, hematological or renal disorders. Every three minutes a woman dies due to preeclampsia. During pregnancy, cardiac output suffers an increase of 40%. This increase is secondary to an increase of approximately 30% of systolic volume. The research objective was to predict the onset of preeclampsia-eclampsia syndrome by identifying alterations in cardiac output.

Methods: An observational, descriptive, longitudinal,

analytical study of prospective cohort was performed, in which by echocardiography, the cardiac output in 31 pregnant women between weeks 11 and 13.6 of gestation was determined as the only value, and through prenatal monitoring, the presence or absence of preeclampsia-eclampsia syndrome was observed.

Results: The follow-up of 31 pregnant women was achieved, to whom cardiac output was measured, with the following findings: a prevalence of disease of 12.9% with 64.5% of patients correctly diagnosed, with a sensitivity of 75%, positive predictive value of 23%, specificity of 62% and negative predictive value of 94% with a relative risk of 4.1 (95% confidence interval, 0.48 to 35.6). **Conclusions:** It is possible to establish cardiac output measurement as screening study to predict the onset of preeclampsia syndrome from prenatal care, thus contributing to the decline in maternal death.

Key words: Pre-eclampsia, cardiac output, prediction

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RESUMEN

Introducción y objetivos: La hipertensión es la complicación médica más común del embarazo, y puede dejar secuelas permanentes como: alteraciones neurológicas, hepáticas, hematológicas o renales. Cada tres minutos muere una mujer debido a la preeclampsia. Durante el embarazo el gasto cardíaco sufre un incremento de hasta 40 %. Este incremento es secundario al aumento de aproximadamente 30 % del volumen sistólico. El objetivo de la investigación fue predecir la aparición del síndrome de preeclampsia-eclampsia mediante la identificación de alteraciones del gasto cardíaco. **Método:** Se realizó un estudio observacional, descriptivo, longitudinal y analítico, de cohorte prospectiva, donde se determinó, por ecocardiografía, el gasto cardíaco en 31 embarazadas, entre las semanas 11 y 13,6 de gestación como único valor; y mediante

seguimiento prenatal, se observó la aparición o no del síndrome de Preeclampsia-Eclampsia. **Resultados:** Se logró el seguimiento de 31 embarazadas a las que se le midió el gasto cardíaco, y se encontró una prevalencia de la enfermedad de 12,9 % con un 64,5 % de pacientes correctamente diagnosticados, con una sensibilidad de 75 %, con valor predictivo positivo de 23 %, especificidad de 62 % y valor predictivo negativo de 94%, con un riesgo relativo de 4,1 (intervalo de confianza 95 %, 0,48-35,6). **Conclusiones:** Es posible establecer la medición de gasto cardíaco como estudio de escrutinio para predecir la aparición del síndrome de Preeclampsia desde el control prenatal, y contribuir así a la disminución de la muerte materna.

Palabras clave: Preeclampsia, gasto cardíaco, predicción

INTRODUCTION

Maternal mortality is a public health problem; its causes are directly related to accessibility, timeliness of interventions, costs and quality of obstetric and perinatal services. Most deaths were in the hospital, almost all originated by: hypertensive disorders of pregnancy, childbirth and postpartum, and bleeding. It is therefore necessary to develop more efficient prenatal programs, with a maternal and infant risk focus¹.

The use of esophageal Doppler to monitor cardiac output in a noninvasive way was first described in 1971, and was subsequently refined by Singer in 1989. With the Doppler technique the velocity of blood flow through the aortic valve or in the descending aorta can be measured². The studies that have reported Doppler echocardiography in pregnancy have suggested a strong relationship between this and thermodilution techniques, as described by Lee in 1988. It has been said that the estimate of aortic area intersection is the most common source of error³.

In order to adapt to the needs of the fetus, the cardiovascular system undergoes significant adaptations during pregnancy. This causes a hemodynamic load in patients with underlying heart disease and is associated with significant morbidity and mortality⁴.

The factors affecting cardiac output in normal pregnancy remain controversial; it increases significantly in the third quarter and remains until the end of pregnancy. Increases in the mother are related to maternal body surface and weight of the fetus at birth⁵.

Pregnancy in high geographic regions, with respect to sea level, is characterized by decreased cardiac

output due to the existence of a lower heart rate, lower stroke volume and reduced expansion of maternal intravascular space compared with nonpregnant women⁶.

In pregnancies complicated by preeclampsia, alterations in maternal cardiac output occur several months before the clinical onset of hypertensive disorders. The number of women who develop preeclampsia is higher during the first quarter⁷.

One of the targets of the United Nations Development Goals by 2015 is to reduce maternal mortality by three quarters. Ninety-nine percent of maternal deaths occur in developing countries, therefore, the World Health Organization calls for such research to identify risk factors for these deaths. The objective of this research was to identify risk factors in a hospital study in Mexico⁸.

METHOD

Patients with pregnancies between weeks 11 and 14 of gestation, according to inclusion and exclusion criteria, were identified in the peripheral units. A questioning on the antecedents, as well as a full blood count, and an electrocardiogram were performed.

Patients were studied in a quiet and air conditioned environment. The measurements were performed with the patient in semifowler and semisupine left side position, and with at least 10 minutes of rest. Blood pressure was measured with a mercury sphygmomanometer, according to the recommendations of the Working Group.

The measurement of cardiac output was performed

using a Philips echocardiographic transducer of 3.5 MHz, two-dimensional and pulsed, continuous wave and color flow Doppler model, for this the following formulas were used:

Cardiac output (CO) = Ejection volume (EV) x Heart rate (HR)

EV = valve area (cm²) (VA) x velocity time integral (VTI)

There were 3 measurements, which were averaged, and as a cutoff point, the long axis for the measurement of VA was used and 5-chamber apical for VTI. The left ventricular systolic function in M mode was measured on the long axis of the ventricle and was presented as a percentage. Patients were followed up according to the official Mexican standard of pregnancy, childbirth and puerperium, in the consultation area of critical care obstetric service, since the purpose was to study the patient and be as little invasive as possible, without letting sensitivity aside. Thus arose the possibility of measuring maternal cardiac output at the end of the first quarter, and relate its changes with the onset of preeclampsia-eclampsia syndrome.

According to the type of study the efficacy of the test was determined, and its sensitivity and specificity

as well as its predictive values were sought.

RESULTS

A total of 31 patients were studied, who underwent measurement of cardiac output by ultrasound, and an average of 6.1 L/min (3.49 to 8.8 L/min) in the first quarter was obtained, with mean gestational age of 12.9 weeks (11.2 to 13.6). The studied patients had a mean age of 29.9 years (19 - 40), with a number of pregnancies of 2.13 (1-5). An average for body mass index of 25.8 (19-42) was obtained, 4 patients developed hypertensive disorders, accounting for 12, 9 % of the study population (Table 1).

According to previously established parameters for gestational age, 18 measurements within the normal range (58 %) were performed, of which only one patient developed the syndrome of preeclampsia (5.8 %). In the remaining 13 (42 %) a cardiac output outside the normal range was found, 3 (25 %) developed the syndrome (Table 2).

Statistical analysis was performed (Table 2) using a computer program, a sensitivity of 75% with positive predictive value of 23%, specificity of 62% and negative predictive value of 94%, with an odds ratio (OR) of 4.1 (95% confidence interval, 0.48 to 35.6) were found. 64.5% of patients were correctly diagnosed.

Table 1. Results of variables in the Study Group.

Variable	Mean	CI 95% lowest	CI 95% highest
Cardiac output	6,1 L/min	3,4 L/min	8,8 L/min
Gestational age	12,9 weeks	11,2 weeks	13,6 weeks
Maternal Age	29,9 years	19 years	40 years
Pregnancies	2,1 pregnancies	1 pregnancy	5 pregnancies
Body mass index	25,8	19	42

Table 2. Diagnostic test results (95% C.I.).

Diagnostic test result	True diagnosis or reference criterion		Total
	Positive	Negative	
Positive	3	10	13
Negative	1	17	18
Total	4	27	31

Table 3. Diagnostic performance parameters

Parámetro	Value	Lower limit	Upper limit
Prevalence of disease	12,90%	4,22%	30,76%
Patients correctly diagnosed	64,52%	45,38%	80,17%
Sensitivity	75,00%	21,94%	98,68%
Specificity	62,96%	42,47%	79,92%
Positive predictive value	23,08%	6,16%	54,02%
Negative predictive value	94,44%	70,62%	99,71%
Positive likelihood ratio	2,03	0,96	4,29
Negative likelihood ratio	0,4	0,07	2,22

DISCUSSION

This study sought to demonstrate the relationship between the level of cardiac output in early pregnancy and subsequent development of preeclampsia-eclampsia syndrome. In previous studies in other parts of the world, interesting considerations about this theme have been informed. This study can serve as a basis of the pilot sample in our population.

In 2008, the London study showed that the increase in cardiac output, between weeks 11 and 13.6, is strongly predictive for preeclampsia-eclampsia syndrome, when it is elevated. Unfortunately, a cutoff value that allows analyzing appropriately such elevation is not detailed.

The study suggests the need to standardize the normal levels of cardiac output for gestational age, associated with weight and height, to deal with the differences that the body mass index or body surface area of each individual exert over its proper interpretation. The significant range of variation presented by our patients, with similar clinical courses, makes us consider that a primary objective to take into account for the measurement of cardiac output in the study of this disease in pregnancy is to establish the normal levels in our population, so they serve as a reference point for future studies.-.

CONCLUSIONS

The assessing of cardiac output value in the pregnant patient may be an important tool for the study of gestational disease, but it is necessary to establish normal values for each stage, using a method for the standardization of the anthropometric variables of each patient.

It is possible now to measure cardiac output as a screening study to predict the onset of preeclampsia-eclampsia syndrome in the usual prenatal control since the relative risk of developing this disease when cardiac output is high is 4 times higher.

The preclinical phase of preeclampsia remains the primary objective in the effort to predict and/or prevent the onset of this syndrome, but no standardization has been achieved for describing the same natural evolution in all patients.

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