EVALUATION OF ISOMETRIC EXERCISE TEST AND ROLL-OVER TEST AS METHODS OF PREGNANCY INDUCED HYPERTENSION PREDICTION

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ABSTRACT

Background: The incidence of pregnancy induced hypertension (PIH) which is one of the three main causes of maternal-neonatal morbidity and mortality is 5-7%, and prediction of this disorder is very important in maternal and neonatal health.

Methods: The type of this study is analytical (comparative-prospective) and its purpose is to evaluate the isometric exercise test (IET) and roll-over test (ROT) as methods of PIH prediction. 116 nulliparaes,with study characteristics, after filling a questionaire and physical exam, underwent ROT, and then IET after 5 minutes, between 28-32 weeks of their pregnancy. The samples are followed up regularly until 24 hr after delivery in Mashad university prenatal clinics and hospitals. Statistical analysis was done by SPSS with a: 0.05.

Results: As a result, IET has a higher validity than ROT(sensitivity:78.9% vs. 47.4%, $p<0.0001$, specificity: 94.80 vs. 83.5%, p: 0.007, positive predictive value: 75% vs. 36%, p: 0.0001, negative predictive value: 95.8% vs. 89%, p: 0.046), also validity of IET and ROT together is: sensitivity: 85.7%, specificity: 96.3%, PPV: 66.6% and NPV: 98.8%.

Conclusion: The validity of IET in this study was shown to be higher than ROT, and by use of a very simple and cost-effective IET, we are able to predict PIH with the highest validity and if possible, use both tests in order to raise validity.
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Keywords: Pregnancy induced hypertension, Isometric exercise test, Roll-over test.

INTRODUCTION

Pregnancy induced hypertension involves 5-7% of pregnancies and is one of the three major causes of mother-child death. Early recognition of this syndrome can lead to reduction of it's casualties by appropriate prevention and treatment.[1,9,10,11,12]

This research which is of analytical type (comparative-prospective), has been performed in order to compare the validity of the roll-over test (ROT) and isometric exercise test (IET) in the prediction of pregnancy induced hypertension caused by first pregnancy. 116 women with their first pregnancy and with pregnancy age of 28 to 32 weeks have been enrolled in this study.

Validity of the IET is higher than ROT. According to these results IET is recommended during pregnancy care as a reliable and easy to perform test. However, it is advisable to use both tests, since the validity of these tests together is higher.

PATIENTS AND METHODS

We performed an analytical, comparative and pro-

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spective study on 116 nullipara women. The cases have been followed from 28 to 32 weeks of pregnancy and up to 24 hours after delivery. The cases are selected as a random cluster from pregnant women who were coming to medical health units of Mashad University of Medical Sciences, for routine pregnancy monitoring.

We performed physical exams and filled the questionaire for all of the cases.The cases were chosen according to the following criteria:

*First pregnancy

*Gestational age between 28 to 32 weeks.

*Living in Mashad.

*Body mass index<35.

*Have usual diet.

*No black race.

*Have not been pregnant during or after discontinuing oral contraceptives.

*Doesn't have polyhydamnios, hydatiform mole, immune hydrops and multifetal pregnancy.

*Recorded blood pressure in the first trimester was less than 140/90 mmHg or the diastolic pressure has been recorded less than 75 mmHg in the second trimester or in the beginning of the third trimester.

*30 mmHg or more had not been added to systolic pressure or 15 mmHg or more had not been added to diastolic pressure in the last visit.

*Free of diseases like diabetes, ischemic heart disease, hypertension, valvular or congenital heart diseases, renal, connective tissue or thyroid diseases.

*Have not used diuretics in the current pregnancy.

*Are not users of cigarettes, narcotics and alcohol.

Based on these criteria and previous studies and comparing the ratio, the sample size was calculated.

The investigation was performed on cluster random selected samples, after informed consent was obtained and at the time the individual's history was obtained and physical examination was performed. After satisfaction and first examination, the roll-over test and isometric exercise test were performed with an interval of 5 minutes and the results were recorded. Patients were visited every two weeks until the 36th week of pregnancy and every one week until delivery.

In each visit after 10 minutes of rest in sitting position, weight and systolic and diastolic pressures were controlled (from right arm). The patients were checked for symptoms like headache, visual confusion, epigastric pain and peripheral edema. From the starting time of delivery to 24 hours after, blood pressure was checked and recorded at intervals of 2 hours. In these controls if the blood pressure was higher than 140/90 mmHg or systolic and diastolic pressure had more than 30 and 15 mmHg rising respectively, compared to the last time, pressure was measured after half an hour of rest. If the in-

crease in blood pressure was confirmed, urine sampling for proteinuria was done and in case of proven proteinuria with the diagnosis of pre-eclampsia, necessary medical management was started.

Method of performing isometric exercise and roll-over tests:
Roll-over test

At first the patient rested for 10 minutes, and then her blood pressure was recorded by a mercury manometer; if it was in normal range, the person turned over to the left and blood pressure was checked after 5 min of resting on the left lateral. Then the patient returned to supine position and pressure was checked immediately and after 5 min. In case of an increase of 20 mmHg or more in the diastolic blood pressure, the test was considered positive.[2,8,13,14]

Isometric exercise test

The patient was asked to press an inflated cuff with her maximum power, and then continued it with 50% of her power for 3 min. After that she held the cuff to compress with 25% of her power with her active hand, and her blood pressure was controlled from her other hand. If systolic blood pressure showed more than 20 mmHg rising, the test was considered positive.[8,20]

RESULTS

A total of 105 subjects were studied (mean age 23±4.2). Descriptive statistics for epidemiological variables are presented in Fig. 1.

Mean systolic blood pressure in weeks 12, 16 and 20 was 103.87, 103.62 and 103.07 respectively, and showed a small decrease. Maximum systolic blood pressure was recorded in the 40th week. (119.42 mmHg). Mean diastolic pressure in weeks 12, 16 and 20 was 62.97, 62.76 and 60.20 respectively and it's maximum was in the 40th week (71.73 mmHg).
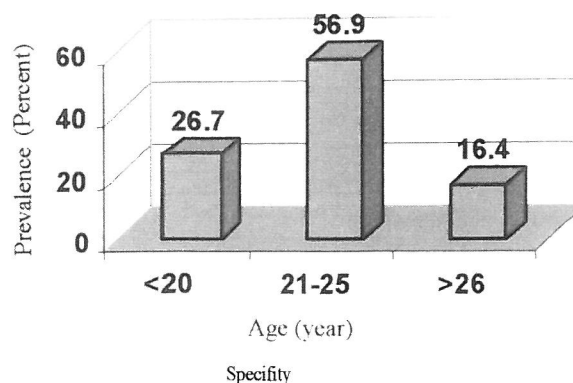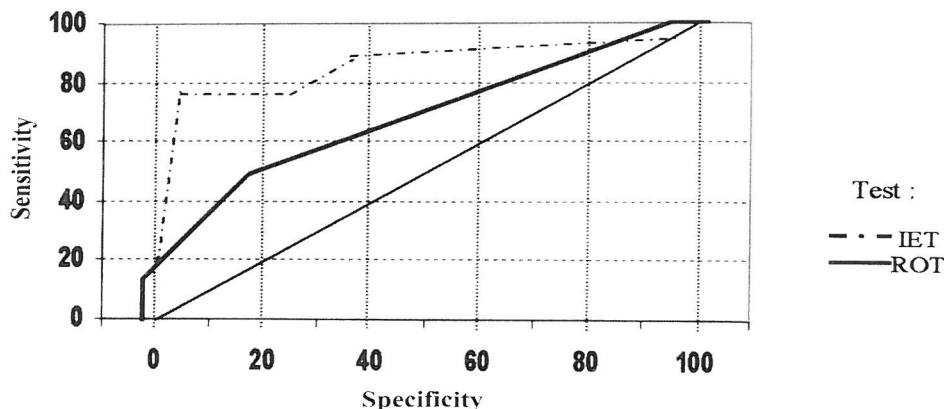

Fig. 1. Age distribution of samples.

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Table I. Means distribution & standard deviation of systolic blood pressure during ROT.

Systolic Blood Pressure / ROT Phases	Mean	Standard deviation	Frequency	Mean Comparison
5 Minutes after turning over to the left	97.46	10.25	116	T: 6.00
15 Minutes after turning over to the left	94.09	9.99	116	DF: 115 P: 0.0001
Just after changing position to supine	104.91	11.55	116	T : 2.03
5 Minutes after changing position	103.53	11.25	116	DF: 115 P: 0.044
Blood pressure difference before & after the test	12.24	9.85	116	

Table II. Mean distribution & standard deviation of systolic blood pressure during IET.

Systolic Blood Pressure / IET Phases	Mean	Standard deviation	Frequency
Before the test	105.86	9.45	116
After the test	111.16	11.35	116
The difference between before & after the test	5.39	7.14	116

Fig. 2. ROC chart for sensitivity and specificity of screening tests.

Maximum peripheral edema (3+)was detected between 34 to 38 weeks.

According to the results of couple T test, there was a meaningful diffference between systolic pressure in minutes 5 and 15 after turning over to the left. Furthermore there was a meaningful difference between systolic blood pressure, just after changing left lateral to supine position and 5 minutes after that (Table I).

The difference between systolic pressure, before and after IET was 5.39mmHg (Table II).

In this study 19 subjects (15.5%) had hypertension which was transient in 13 cases (10.3%) and was pre-eclampsia in 6 cases (5.2%). The blood pressure in 97 cases (83.6%) remained in the normal range (Table III).

The majority of true positive and negative cases were in the IET, and the least cases were in ROT (Table IV).

Maximum validity is for the IET and the minimum validity is for ROT. The ratio comparison test shows a meaningfuul difference between the two tests (Table V and Figure 2).

In 25.8% according to Kappa's statistics, the results of the two tests agreed with each other (Table VI).
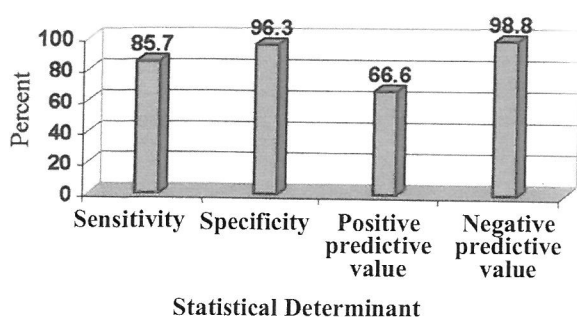
Fig. 3. Validity of combination of ROT and IET in PIH prediction.

False and true negative and positive results for each of the IET and ROT and combination of them is shown in Table VII.

Calculated validity (sensitivity, specificity, positive and negative predictive values) based on positive and negative results for a single case in both tests, is shown in Figure 3.

On the other hand according to Chi-square test, there is no meaningful relation between age of the studied cases, their occupation and level of education, social and economical class, blood group and hematocrit and weight of samples, with an increase in their blood pressure.

DISCUSSION

Hypertension in pregnancy is a cardiovascular complication, which is among the most common and critical pregnancy complications and despite notable advances in pregnancy period care, it is still one of the greatest causes of mortality and prenatal complications for the mother and fetus.[2,16]

The main mother's mortality causes in the US is believed to be pulmonary emboli, pregnancy induced hypertension, bleeding and infection.[2]

In the seventh global assembly of the World Health Organization (WHO) pregnancy induced hypertension was discussed to be one of the greatest global health threatening troubles, and epidemiological studies of these disorders, especially in developing countries, was emphasized.[4]

Table III. Frequency of pregnancy induced HTN disorders.

Frequency / Final diagnosis	Frequency	Percent
Normal blood pressure	97	83.6
Transient hypertension	13	10.3
Preeclampsia	6	5.2
Total	116	100.0

Table IV. False positive and negative, and true positive and negative results in IET and ROT.

Systolic Determinant / Screening test	Positive				Negative			
	False		True		False		True	
	Frequency	Percent	Frequency	Percent	Frequency	Percent	Frequency	Percent
ROT	9	7.75	16	13.8	81	69.8	10	8.6
IET	15	12.9	5	4.3	92	79.3	4	3.4

Table V. Validity (specificity, sensitivity, positive & negative predictive value) of screening tests in PIH prediction.

Statistical Determinant / Screening test	Sensitivity	Specificity	Positive Predictive Value	Negative Predictive Value
ROT	47.4	83.5	36	89
IET	78.9	94.8	75	95.8
Ratio comparison test	5.3	2.7	6.5	2

Table VI. Comparison of IET and ROT results.

ROT / IET	Positive		Negative	
	Frequency	Percent	Frequency	Percent
Positive	9	7.76	16	13.8
Negative	11	9.5	80	68.9
Kappa's statistics (percent)	25.8			

Table VII. False positive and negative and true positive and negative results of both tests.

ROT & IET	Positive				Negative			
	False		True		False		True	
	Frequency	percent	Frequency	percent	Frequency	percent	Frequency	percent
ROT-IET	6	6.7	3	3.4	79	88.7	1	1.2

Generally the incidence of pregnancy induced hypertension is reported to be between 5 to 17%.[1,9,12]

Maternal mortality rate in developing countries is 100 to 200 times more than industrialised countries. From 2485 mother mortality cases in Africa, 1610 cases, and from 4022 cases in one year in Asia, 805 cases have been caused by pregnancy induced hypertension.[5,17]

In Iran during 1992 to 1995 14% of maternal mortalities were related to complications of pregnancy induced hypertension.[6]

In this study, early detection and screening of high risk women is considered to be important, and we tried to find a suitable screening test.

Various tests like platlets count, hematocrit, serum uric acid, average arterial pressure, Roll-over test, Isometric exercise test, doppler ultrasound and angiotensin 2 injection test, have been studied, but there is no general agreement about them.[7,8,18,15,19]

Degani et al (1985) compared roll-over test and isometric exercise test to predict pregnancy induced hypertension, and announced the preference of the isometric exercise test.[8]

Tomoda et al (1991-2) studied the validity of isometric exercise test and showed a sensitivity of 82% and specificity of 68% for it.[19]

Maria et al (1988) studied and compared the roll-over test, IET and average arterial blood pressure measurement tests, and announced the IET as the superior test with 78.95% true positive and 90.5% true negative results.[21] While Niezel et al (1987) did not find meaningful results for the prediction power of this test in pregnancy induced hypertension.[3]

This study was performed considering the results of previous researches, and it was clear that the sensitivity of the screening IET is 78.9% and the sensitivity of ROT is 47.4%, and according to the ratios comparison test (z= 5.3, $p<0.0001$), the sensitivity of IET is meaningfully higher than ROT (Table VI)

Additionally, the specificity of IET is 94.8% and ROT is 83.5% and according to the ratios comparison test (z= 2.7, $p<0.007$) the specificity of IET is meaningfully higher than ROT (Table VI).

The positive predictive value for IET is 75% and for ROT is 36%, and according to ratio comparison test (z= 6.5, $p<0.0001$) the positive predictive value of IET is meaningfully higher than ROT (Table VI).

The negative predictive value fot IET is 95.8%, and for ROT is 89%, and in ratios comparison(Z= 2, $p<0.046$), the negative predictive value of IET is higher than ROT.

Studies by Bleisan et al (1994), which engage reviewing the studies done around this subject, reported a range of 0 to 88% for the sensitivity of the ROT with an average of 61.5%, and 54 to 81% with an average of 61.5% for IET. In addition the specificity has been reported to be in a range of 35 to 100% with an average of 84.5% for ROT, and 96 to 98% with an average of 97% for IET.[7]

As shown in Table V, in this study, in the IET among 20 positive cases, 4.3% were false positive and 12.9% were true positive, and among 96 negative cases, 3.4% were false negative and 79.3% were true negative.

According to this study, if these two tests are used together, sensitivity will be 85.7%, specificity will be 96.3% and positive and negative predictive values will be 66.6% and 98.8% respectively.

These results suggest the utilization of screening IET in prediction of pregnancy induced hypertension as a

valid, simple, cost effective, reasonable and acceptable test for pregnant women and health care workers. Also it is possible to use a combination of IET and ROT to increase the predictive value for pregnancy induced hypertension.

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