

PULSATILITY INDEX AS A PREDICTOR OF SIGNIFICANT ILIAC DISEASE

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ABSTRACT:

Objective: To study the correlation between Pulsatility Index (PI) and the presence of significant (>50%) stenosis of inflow vessels.

Design: Single centre, Retrospective study.

Patients: Between Jan 04 May, 05 all patients who had Doppler arterial studies followed by diagnostic angiograms were analyzed. N=176, 352 limbs.

Results: Using Logistic Regression, Smoking and PI were found to be significant indicators of >50% stenosis of the inflow vessels. $PI < 2$ correlated with > 50% inflow disease ($p < .0001$). Furthermore, $PI < 3$ correlated with > 50% inflow disease ($p < .0001$). These results were verified for Left and Right sides independently.

Conclusions: Pulsatility Index is a good method to detect significant (>50%) inflow disease. Use of Duplex U/S is recommended in all patients undergoing peripheral angiograms/Endovascular procedures to facilitate proper time and resource allocation in cases that might need concomitant intervention either in the Angio suite or the OR.

Keywords: Pulsatility Index, Duplex U/S, Iliac artery.

الملخص العربي:

دليل الخفقان كمؤشر لتضييق الشريان الحرقفي

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الغاية: دراسة العلاقة بين دليل الخفقان ووجود تضيق في الشرايين $< 50\%$ في الشرايين المنبعية (PI).

التصميم: أحادي المركز، استعادي.

المرضى: جميع المرضى الذين أجري لهم فحص موجات الفوصوتية متبوع بقسطرة تشخيصية مابين يونيو 2004 إلى مايو 2005. العدد

167 عدد الأعضاء 352

النتائج: باستعمال 3 تناسق مع $< 50\%$ تضيق الشرايين المنبعية و $PI > 2$ و $PI > 50\%$ في الشرايين المنبعية. حيث أن

هذه النتائج تم التأكيد منها للجهتين اليسرى واليمينية ($P=0.0001$). وجدنا أن التدخين ودليل الخفقان كانا مؤشرين مهمين للاستدلال علي

تضييق (LOGISTIC REGRESSION).

الخلاصة: دليل الخفقان هو طريقة جيدة لتقصي وجود تضيق $< 50\%$ في الشرايين المنبعية. استعمال فحص الموجات الصوتية ينصح به

لجميع المرضى الذين ينوي إجراء القسطرة التشخيصية أو علاجية لهم وذلك لتنسيق الوقت المحدد والمواد المطلوبة في حالة وجود تضيق

شديد في تلك الشرايين المنبعية.

الكلمات المفتاحية: دليل الخفقان، سونار الأوعية الدموية، الشريان الحرقفي.

INTRODUCTION:

Clinical examination alone as a predictor of significant femoral inflow disease is not very reliable ^{1, 2}. Duplex ultrasound has been used to assess femoral inflow. One parameter used was pulsatility index (PI). PI, however was not validated as a good predictor of inflow disease.³. In this study we attempt to validate the use of PI as a predictor of inflow disease and try to establish a correlation between PI value and significant femoral inflow disease. Figure1, Pulsatility Index is measured by:

$$PI = (V_{max} - V_{min}) / V_{max \text{ mean}}$$

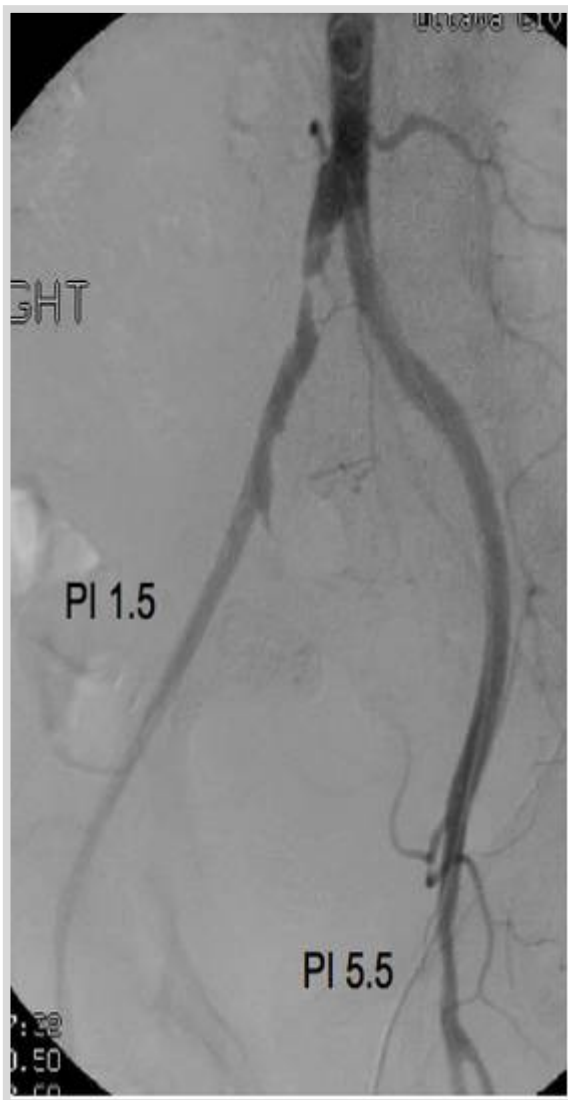


Figure1. Example of a study patient with a significant inflow disease and a low PI.

OBJECTIVE:

To study the correlation between PI and the presence of significant (>50%) stenosis of inflow vessels. The Inflow vessels were defined as: Common iliac, External Iliac and common femoral artery.

DESIGN:

Single centre. With Retrospective analysis of prospectively collected Data.

INCLUSION CRITERIA:

All patients who had Doppler arterial studies followed by diagnostic angiograms between Jan 04 - May 05 were entered into the study. A total of one hundred and seventy six patients were entered (N=176). All of those patients had there Doppler done within 3 months prior to the angiograms.

PATIENT DEMOGRAPHICS:

The mean age was 67.7 years (Range: 35-96) years. A hundred and seventeen were males (67.6%) and fifty six were females (32.3%). Sixty six were diabetics (42.3%). Seventy eight were hypertensive (50.3%). Eighty one were smokers (55.8%).

RESULTS:

Ultrasound interrogation was done in a vascular lab by certified technicians. A 10 mhz ultrasound probe was used and placed over the femoral artery at the area of best signal obtained. Of one thousand seven hundred and twenty eight patients' file checked, Four hundred and sixty patients met the inclusion criteria of which only a hundred and seventy six patients had pre-Cath Doppler studies within 3 months. Using logistic regression and a PI cut-off below 2 and a cut-off point below 3. We have found that in the first group a PI cut-off point below 2 was a statistically significant predictor of inflow disease with a $P < .0001$ and an Odds Ratio of 23.853. Of note; smoking came out as a significant predictor for inflow disease as well $P < .0348$ and an Odds Ratio of 2.88, Table 1.

Table1. Logistic Regression Model of the Primary end point – Right (PI cut-off point = 2)

Variables		®	Wald Chi-Square	p-Value	Odds Ratio	95% Confidence Interval of Odds Ration	
Full Model							
Age		-0.02	0.49	0.4819	0.984	0.941	1.029
PI-Rt	<2 vs. >=2	1.58	22.00	<.0001	23.422	6.27	87.491
Sex	F Vs. M	-0.27	0.93	0.3355	0.587	0.198	1.737
DM	No Vs. Yes	0.16	0.42	0.5185	1.369	0.528	3.553
HTN	No Vs. Yes	-0.10	0.18	0.6731	0.821	0.328	2.054
Smoker	Yes Vs. No	0.45	2.66	0.1026	2.453	0.835	7.203
Model of Significant Variables							
PI-Rt.	<2 Vs. >=2	1.59	26.66	<.0001	23.853	7.155	79.52
Smoker	Yes Vs. No	0.53	4.46	0.0348	2.88	1.078	7.69

In the Second group; we tried a higher PI cut-off at below 3. Again, both a PI cut-off below 3 and smoking came out significant predictors for significant inflow disease with $P<.0001$ and $P<.0161$ respectively, and Odds Ratios of 26.84 and 3.806 respectively, Table 4. An ROC curve was plotted as in, Figure 2.

Table2. Logistic Regression Model of the Primary End point – Left (PI Cut-off point =2)

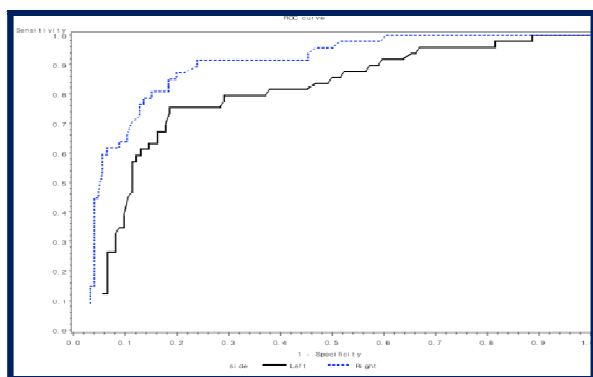
Variables		®	Wald Chi-Square	p-Value	Odds Ratio	95% Confidence Interval of Odds Ratio	
Full Model							
Age		0.00	0.01	0.9397	0.998	0.955	1.044
PI-Lt	<2 vs. >=2	0.97	13.99	0.0002	6.943	2.515	19.169
Sex	F Vs. M	-0.08	0.09	0.7637	0.855	0.308	2.372
DM	No Vs. Yes	0.34	1.91	0.1665	1.956	0.756	5.059
HTN	No Vs. Yes	0.39	2.87	0.0900	2.164	0.887	5.282
Smoker	Yes Vs. No	0.94	10.48	0.0012	6.508	2.094	20.224
Model of Significant Variables							
PI-Lt	<2 Vs. >=2	1.13	20.7	<.0001	9.632	3.63	25.555
Smoke r	Yes Vs. No	0.90	13.29	0.0003	6.076	2.303	16.037

Table3. Logistic Regression Model of the Primary End Point – Right (PI Cut-off point=3)

Variables		®	Wald Chi-Square	p-Value	Odds Ratio	95% Confidence Interval of Odds Ration	
Full Model							
Age		-0.03	1.21	0.2708	0.973	0.925	1.022
PI-Rt.	<3 vs. >=3	1.79	30.74	<.0001	35.84	10.114	127.002
Sex	F Vs. M	-0.31	1.07	0.3008	0.542	0.17	1.729
DM	No Vs. Yes	-0.06	0.05	0.8263	0.887	0.304	2.578
HTN	No Vs. Yes	-0.03	0.01	0.9149	0.947	0.348	2.579
Smoker	Yes Vs. No	0.64	3.93	0.0475	3.571	1.014	12.579
Model of Significant Variables							
PI-Rt.	<3 Vs. >=3	1.65	35.94	<.0001	26.847	9.157	78.717
Smoker	Yes Vs. No	0.67	5.80	0.0161	3.806	1.282	11.307

Table4. Logi stic Regression Model of the Primary End Point –Left (PI Cut-off Point 3)

Variables		®	Wald Chi- Square	p-Value	Odds Ratio	95% Confidence Interval of Odds Ration	
Full Model							
Age		0.00	0.04	0.8457	1.005	0.958	1.054
PI-Lt.	<3 vs. >=3	1.16	20.72	<.0001	10.107	3.733	27.364
Sex	F Vs. M	-0.09	0.10	0.7511	0.842	0.29	2.443
DM	No Vs. Yes	0.30	1.40	0.2371	1.825	0.673	4.944
HTN	No Vs. Yes	0.38	2.44	0.1182	2.118	0.826	5.431
Smoker	Yes Vs. No	1.05	11.36	0.0007	8.221	2.415	27.985
Model of Significant Variables							
PI-Lt.	<3 Vs. >=3	1.29	28.02	<.0001	13.238	5.087	34.449
Smoker	Yes Vs. No	0.97	13.87	0.0002	6.962	2.508	19.328

**Figure2.** ROC Curve

Sensitivities and specificities were calculated and were as follows: For Cut point at PI=2; sensitivity: 0.47, Specificity: 0.95. For Cut point at PI=3; Sensitivity: 0.70. Specificity: 0.89 of note, these resulted were verified for right and left sides independently.

CONCLUSIONS:

Pulsatility Index is a good method to detect significant (>50%) inflow disease. Use of Duplex U/S is recommended in all patients undergoing peripheral angiograms/ Endovascular procedures. It might also facilitate proper time and resource allocation in cases that might need concomitant intervention either in the Angio suite or the OR. Pulsatility Index is a valuable tool in following up post intervention patients. Future research recommended to determine a linear correlation between PI and degree of stenosis.

DISCUSSION:

While the efficacy of PI was established in various clinical scenarios 4, 5, 6, the actual validity in detecting upstream significant inflow disease was not established. Some of the technical difficulties that might arise are: the concomitant effect of downstream disease on PI 1 and the exact location where the artery is interrogated for PI in addition

to operator variability. Yet the simplicity and reduced cost of this utility renders it as an ideal pre-interventional and follow up assessment method to detect femoral inflow disease. Furthermore, a strength point of this study is the number of patients involved and the direct angiographic validation of all studied subjects.

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