Single photon emission computed tomography (SPECT) in benign intracranial hypertension

Mohamoud Allam¹, Hosna Moustafa², Rasha Hassan¹, Mohamed Ahmed El-Sayed¹, Nervana El-Faioumy¹, Mohamed Ibrahim Oraby¹
Departments of Neurology¹ and Oncology & Nuclear Medicine², Cairo University

ABSTRACT

This study was conducted on 25 Egyptian patients with symptoms and signs fulfilling the modified Dandy criteria for diagnosis of PTC. All patients were subjected to thorough clinical assessment, including general, neurological, and ophthalmological examination, routine laboratory work up, lumbar puncture to measure CSF pressure, CT brain, SPECT study of the brain and 19 patients underwent MRI of the brain. The aim of this study was to evaluate the CBF using SPECT in PTC patients and to detect any relation between disease severity and CBF changes. Results showed that, SPECT study of the brain was normal in 16% of patients and the other 84% of patients had areas of hypoperfusion. No sites of hyperperfusion were detected. There was a highly significant reduction in global hemispheric CBF in both sides in patients with moderate to severe visual field changes compared to those with normal to mild visual field changes (P value <0.01). Also a highly significant reduction in the global hemispheric CBF in patients with high papilledema grade 3, 4, and 5 compared to those with mild papilledema, grade 1 and 2. Moreover, there was a highly significant negative correlation between grades of field changes, grades of papilledema and global hemispheric CBF in both sides (P value <0.01). Inspite the CBF was lower in PTC patients with high CSF pressure compared to those with lower CSF pressure, there was no significant statistical difference between the two results and no significant correlation was observed between CSF pressure and CBF. There was a significant reduction in the global hemispheric CBF in PTC patients with systemic hypertension compared to those without systemic hypertension (P value <0.05). (Egypt J. Neurol. Psychiat. Neurosurg., 2004, 41(1): 19-34).

INTRODUCTION

Benign intra-cranial hypertension (BIH) was defined for the first time by Dandy as a syndrome characterized by symptoms and signs of raised intra-cranial pressure in the absence of an intra-cranial mass lesion, infection or hydrocephalus in an otherwise healthy and alert patient¹. Although the clinical and laboratory features of pseudotumor cerebri have been clearly delineated, the pathogenesis of idiopathic pseudotumor cerebri remains a mystery².

The mechanism of increased CSF pressure in this disorder is still unclear. Involvement of the venous flow was presumed to be one of the causative mechanisms²,³. Other conditions with
increased venous pressure and cerebral blood volume are additional ambient factors which can initiate the BIH symptomatology. Only few studies have been performed in order to study the cerebral blood flow (CBF) in these patients.

In 1955, some authors found an increase of CBF in three patients with increased intracranial pressure, without discovering any other pathology. Whereas others demonstrated a decrease of the CBF in many BIH patients.

CT and MRI of the brain are used routinely for the diagnosis of BIH, whereas imaging techniques with radiotracers such as positron emission tomography (PET) and single photon emission tomography (SPECT) give insights into physiological processes and variables such as cerebral blood flow, brain metabolism (oxygen, glucose), protein synthesis in brain tissue, regional pH and others. So the purpose of this study was to evaluate the CBF using SPECT in PTC patients and to detect any relation between disease severity and CBF changes.

PATIENTS AND METHODS

Twenty five Egyptian patients (22 females and 3 males) with symptoms and signs confirming with the diagnosis of benign intracranial hypertension according to the Dandy criteria were included in this study. Their ages ranged between 13 and 44 years with a mean age 30.32±7.39.

Exclusion Criteria:
1. Patients with true localizing findings denoting focal brain dysfunction.
2. Patients with traumatic, neoplastic, infectious, structural or iatrogenic cause of intra-cranial hypertension.

Patients were subjected to the following:
1. Complete general and neurological assessment.
2. Measurement of body mass index:

    Obesity was measured according to the body mass index equation:

\[
\text{Body mass index (BMI)} = \frac{\text{Weight in kilograms (Kg)}}{\text{Square of height in meters (m²)}}
\]

    The body weight is considered:
    - Accepted if BMI ranged between 20-26 Kg/m².
    - Overweight if BMI ranged between 27-30 Kg/m².
    - Obese if BMI is more than 30 Kg/m².

3. Ophthalmologic assessment included:
   b. Direct and indirect ophthalmoscopic fundus exam. to assess and grade papilledema. The severity of papilledema was graded from 0 to 5 according to Frisen staging scheme.
   c. Automated perimetry:
      Assessment of visual field carried out using Humphrey Zier 740 automated perimetry in Ophthalmology Department, Kasr El-Aini Hospitals. The field changes were graded from 0 to 4 according to Wall and George.

   Grade 0: Normal visual field.
   Grade 1:
   ● Enlargement of the blind spot.
   ● Mild generalized depression of retinal sensitivity.
Grade 2: • Nasal or inferonasal field defect.
  • Moderate generalized depression of retinal sensitivity.

Grade 3: • Central field defect or large paracentral defect.
  • Marked generalized depression of retinal sensitivity.

Grade 4: • Tubular field

4. Radiological investigations:
   Done for all patients at the diagnostic Radiology Department of Kasr El-Aini Hospital. All patients carried out enhanced CT brain scans, and 19 patients underwent non-contrast MRI of the brain.
   CT and MRI were carefully analyzed regarding ventricular size, venous system abnormalities, and presence of empty sella sign.

5. Lumbar puncture:
   All patients underwent lumbar puncture under complete aseptic condition with the patient in the lateral decubitus position with legs extended during pressure measurement, then the opening pressure is measured.
   CSF samples were taken for analysis to ensure normal sugar, protein, chloride and cell count.

6. Laboratory investigations:
   Routine laboratory investigations included, complete blood count, erythrocyte sedimentation rate, fasting and post-prandial blood glucose levels, liver and kidney function tests, lipid profile, serum uric acid and serum electrolytes.

7. Single photon emission computerized tomography (SPECT):

SPECT scans of the brain were performed for all patients at the Department of Nuclear Medicine, Cairo University.

Tc99m Hexamethyl Propylenamine (HMPAO) brain SPECT was prepared by addition of freshly eluted Tc99m pertechnate to a freeze-dried kit of HMPAO at room temperature. Twenty millicuries (470 mBq) were then withdrawn and injected intravenously within 5 minutes of the kit preparation.

SPECT images were acquired 60 minutes post-injection of the radiopharmaceutical by a dual head gamma camera equipped with high resolution collimators interfaced to a dedicated computer.

Quantitative analysis of SPECT images were performed as follows:
1. Average counts/pixel expressions regional blood flow were calculated for each region of interest and measured as a ratio to main total cerebellar counts per pixel.
2. Thus, the value obtained by computer analysis of the cerebellum was considered as 100%, values below cerebellar perfusion were considered as hypoperfusion of the analyzed region, whereas values above the cerebellar perfusion were considered to be hyperperfusion of the analyzed region.
3. As there is a normal variability of the uptake of the radioactive tracer, in different parts of the brain, a cut-off point value was determined for each region of the brain, below which pathological hypo or hyperperfusion was considered. This value was determined by calculating the main radiotracer uptake in the specific region plus one
standard deviation (Mean±SD), shown in the following table.

Normal quantitative, SPECT value in different regions of the brain described as a percentage from the cerebellar uptake:

<table>
<thead>
<tr>
<th>Site</th>
<th>Normal quantitation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Frontal lobe</td>
<td>87-105%</td>
</tr>
<tr>
<td>Parietal lobe</td>
<td>78-90%</td>
</tr>
<tr>
<td>Occipital lobe</td>
<td>70-90%</td>
</tr>
<tr>
<td>Caudate</td>
<td>85-100%</td>
</tr>
<tr>
<td>Thalamus</td>
<td>85-105%</td>
</tr>
<tr>
<td>Putamen</td>
<td>80-105%</td>
</tr>
<tr>
<td>Lateral temporal</td>
<td>70-90%</td>
</tr>
<tr>
<td>Medial temporal</td>
<td>60-80%</td>
</tr>
</tbody>
</table>

In general any activity compared to the cerebellum that is below 60% is considered abnormal14.

**RESULTS**

This study included 25 patients presenting with symptoms and signs consistent with modified Dandy criteria for the diagnosis of PTC. 22 patients were females (88%) and 3 patients were males (12%). The age of patients ranged from 13 to 44 with a mean of 30.32±7.39 years. Among the female patients (22 patients), 1 female (4.54%) did not reach menarche yet, 11 patients (50%) had regular menstruation, 5 females (22.72%) had menstrual irregularities and the remaining 5 females (22.72%) had hormonal treatment including contraceptive pills and injections.

**Clinical Results:**

All patients complained of headache (100%) affecting different sites (frontal, bitemporal, fronto-temporal, and whole cranium) of variable frequency and character. 80% of patients had blurring of vision, 56% had transient visual obscurations (TVO) and only 8% had diplopia of vision. Nausea was reported in 6 patients (24%), while nausea and vomiting was in 11 patients (44%) (Fig. 1).

* General examination of the patients was within normal apart from systemic arterial hypertension in 5 patients (20%). Regarding the body mass index, it ranged from 20.7 to 56.2 with a mean of 34.79±8.97. 18 patients were considered to be obese.

* Neurological examination revealed left 6th cranial nerve palsy in 2 patients (8%):
  - All patients had papilledema of different grades (100%). According to Frisen grading of papilledema, 9 patients (36%) had grade 1 papilledema, 2 patients (8%) had grade 2 papilledema, 4 patients (16%) had grade 3 papilledema, 6 patients (24%) had grade 4 papilledema, and 4 patients (16%) had grade 5 papilledema.
  - The perimetric findings were graded from 0 to grade 4 according to degree of field affection. 3 patients (12%) had normal field, 4 patients (16%) had mild field changes (grade 1), 14 patients (56%) had moderate changes (grade 2), 2 patients (8%) had severe field changes (grade 3) and 2 patients (8%) had advanced field changes (grade 4).
  - Visual acuity was normal in 20% of patients, diminution of vision of variable degrees in 76% of patients and counting fingers in 4% of patient. Ophthalmological assessment is shown in Table (1).
- Lumbar puncture opening pressure in our patients ranged from 250 to 570 mmH\(_2\)O with a mean of 306.80±81.89. CSF constituents were within normal levels in all patients.
- Also the values of routine laboratory investigations done were within normal limits.
- CT and MRI of the brain of all patients were within normal except for 2 patients (10.5%) had partial empty sella and 1 patient (5.3%) had superior sagittal sinus thrombosis.

**Results of SPECT:**
Out of the 25 patients included in this study, 4 patients (16%) had normal SPECT study of the brain and 21 patients (84%) had areas of hypoperfusion, 4 of them (16%) had hypoperfusion in one site while the other 17 patients (68%) had more than one site of hypoperfusion. No sites of hyperperfusion were detected in our 25 PTC patients. The distribution of hypoperfusion sites is shown in table (2) and figures (2a,b).

**Comparisons and Correlation:**
* Comparison between global hemispheric CBF in PTC patients with normal and mild visual field changes to those with moderate to severe visual field changes. A highly significant reduction in the global hemispheric CBF in both sides was found in patients with moderate to severe visual field changes compared to those with normal to mild visual field changes (Table 3 and Fig. 3).
* Comparison between global hemispheric CBF in PTC patients with papilledema grade 1 and 2 to those with grade 3, 4 and 5 revealed that, there was a highly significant reduction in the global hemispheric CBF in patients with high papilledema grades 3, 4 and 5 compared to those with mild papilledema grades 1 and 2 shown in Table (4) and Fig. (4).
* Comparison between global hemispheric CBF in PTC patients regarding CSF pressure: Although the global hemispheric CBF was lower in PTC patients with CSF pressure more than 300 mmH\(_2\)O compared to those with CSF pressure less than 300 mmH\(_2\)O, there was no significant statistical difference between the two results (Table 5).
* Comparison between global hemispheric CBF in patients regarding PTC symptoms: There was no significant statistical difference between global hemispheric CBF in PTC patients with or without the following symptoms: TVO, nausea and/or vomiting and the presence or absence of intra-cranial noises.
* Comparison between global hemispheric CBF in PTC patients with and without hypertension: There was a significant reduction in the global hemispheric CBF in PTC patients with systemic hypertension compared to those without systemic hypertension (Fig. 5).
* Comparison between global hemispheric CBF in patients regarding the body mass index (BMI), and hormonal troubles: We divided the patients according to BMI into:
  - Patients with BMI below 30, included 7 patients (28%).
  - Patients with BMI equal to or more than 30, included 18 patients (72%).

**N.B.:** BMI = 30 is the value above which the patient is considered to be obese. Although the global hemispheric CBF was lower in PTC patients with BMI equal to or more than 30, there was no significant statistical difference between the two results.
Also, there was no significant statistical difference of CBF between patients having hormonal troubles (10 females) and those without hormonal troubles (12 females).

* Correlation between grades of papilledema, field changes, CSF pressure, BMI and CBF:
  - A highly significant negative correlation between the grades of papilledema and global hemispheric CBF was present in PTC patients (P-value <0.01).
  - Also correlation between field changes and global hemispheric CBF showed, a highly significant negative correlation between grades of field changes and left hemispheric CBF (P value <0.01) and only significant negative correlation between field changes and right hemispheric global CBF (P value <0.05).
  - Whereas, no significant correlation was observed between the CSF pressure, body mass index, and global hemispheric CBF (P value >0.05) (Table 6).

Fig. (1): Symptoms among 25 PTC patients.
Table 1. Ophthalmological assessment among 25 patients with PTC.

<table>
<thead>
<tr>
<th>A- Visual acuity</th>
<th>Number</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Normal</td>
<td>5</td>
<td>20</td>
</tr>
<tr>
<td>Diminution of variable degree</td>
<td>19</td>
<td>76</td>
</tr>
<tr>
<td>Counting fingers</td>
<td>1</td>
<td>4</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>B- Grade of papilledema</th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Grade 1</td>
<td>9</td>
<td>36</td>
</tr>
<tr>
<td>Grade 2</td>
<td>2</td>
<td>8</td>
</tr>
<tr>
<td>Grade 3</td>
<td>4</td>
<td>16</td>
</tr>
<tr>
<td>Grade 4</td>
<td>6</td>
<td>24</td>
</tr>
<tr>
<td>Grade 5</td>
<td>4</td>
<td>16</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>C- Grades of perimetric affection</th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Grade 0</td>
<td>3</td>
<td>12</td>
</tr>
<tr>
<td>Grade 1</td>
<td>4</td>
<td>16</td>
</tr>
<tr>
<td>Grade 2</td>
<td>14</td>
<td>56</td>
</tr>
<tr>
<td>Grade 3</td>
<td>2</td>
<td>8</td>
</tr>
<tr>
<td>Grade 4</td>
<td>2</td>
<td>8</td>
</tr>
</tbody>
</table>

Table 2. Distribution of sites of hypoperfusion among 25 patients with PTC.

<table>
<thead>
<tr>
<th>Site</th>
<th>Number</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Frontal lobe:</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Right</td>
<td>8</td>
<td>32</td>
</tr>
<tr>
<td>Left</td>
<td>11</td>
<td>44</td>
</tr>
<tr>
<td>Parietal lobe:</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Right</td>
<td>3</td>
<td>12</td>
</tr>
<tr>
<td>Left</td>
<td>4</td>
<td>16</td>
</tr>
<tr>
<td>Temporal lobe:</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Right</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Left</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Occipital lobe:</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Right</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Left</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Basal ganglia:</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Right</td>
<td>17</td>
<td>68</td>
</tr>
<tr>
<td>Left</td>
<td>16</td>
<td>64</td>
</tr>
</tbody>
</table>
Fig. (2a,b): SPECT in two PTC patients showing hypoperfusion.
Table 3. Global hemispheric CBF in relation to field changes.

<table>
<thead>
<tr>
<th>Visual field changes</th>
<th>t-test</th>
<th>P-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>NL. &amp; Mild Mod. &amp; Severe</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Rt. Hemispheric CBF</td>
<td>3.96</td>
<td>&lt;0.01</td>
</tr>
<tr>
<td>Lt. Hemispheric CBF</td>
<td>4.18</td>
<td>&lt;0.01</td>
</tr>
</tbody>
</table>

P-value <0.01 (highly significant)

Fig. (3): Global hemispheric CBF in relation to visual field changes.

Table 4. Global hemispheric CBF in relation to grades of papilledema

<table>
<thead>
<tr>
<th>Grade of papilledema</th>
<th>t-test</th>
<th>P-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Grade 1-2</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Rt. Hemispheric CBF</td>
<td>3.32</td>
<td>&lt;0.01</td>
</tr>
<tr>
<td>Lt. Hemispheric CBF</td>
<td>3.75</td>
<td>&lt;0.01</td>
</tr>
</tbody>
</table>

P-value <0.01 (highly significant)
Fig. (4): Global hemispheric CBF in relation to grades of papilledema.

Table 5. Global hemispheric CBF in relation to CSF pressure

<table>
<thead>
<tr>
<th>CSF pressure</th>
<th>t-test</th>
<th>P-value</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>&lt;300 mmH2O</td>
<td>&gt;300 mmH2O</td>
</tr>
<tr>
<td></td>
<td>M ±SD</td>
<td>M ±SD</td>
</tr>
<tr>
<td>Rt. Hemispheric CBF</td>
<td>88.65±3.98</td>
<td>87.15±7.19</td>
</tr>
<tr>
<td>Lt. Hemispheric CBF</td>
<td>84.59±4.70</td>
<td>82.89±5.20</td>
</tr>
</tbody>
</table>

P-value >0.05 (Non significant)

Fig. (5): Global hemispheric CBF in relation to systemic hypertension
Table 6. Correlation between grades of papilledema, field changes, CSF pressure, BMI and global hemispheric CBF.

<table>
<thead>
<tr>
<th></th>
<th>Rt. Hemisph. CBF</th>
<th>Lt. Hemisph. CBF</th>
</tr>
</thead>
<tbody>
<tr>
<td>Grades of papilledema</td>
<td>R= -0.655</td>
<td></td>
</tr>
<tr>
<td></td>
<td>P= 0.000**</td>
<td>R= -0.621</td>
</tr>
<tr>
<td></td>
<td></td>
<td>P= 0.001**</td>
</tr>
<tr>
<td>Field changes</td>
<td>R= -0.503</td>
<td>R= -0.520</td>
</tr>
<tr>
<td></td>
<td>P= 0.010*</td>
<td>P= 0.008**</td>
</tr>
<tr>
<td>CSF pressure</td>
<td>R= -0.329</td>
<td>R= -0.093</td>
</tr>
<tr>
<td></td>
<td>P= 0.108</td>
<td>P= 0.660</td>
</tr>
<tr>
<td>BMI</td>
<td>R= -0.108</td>
<td>R= -0.214</td>
</tr>
<tr>
<td></td>
<td>P= 0.609</td>
<td>P=0.305</td>
</tr>
</tbody>
</table>

* Statistically significant    ** Highly significant

**DISCUSSION**

Cerebral circulation is a dynamic state, thus the cerebral vasculature is endowed with complex regulatory systems that allow the brain to finely regulate its blood supply. Intracranial pressure is closely related to brain perfusion. The cerebral blood flow is dependent on the intra-cranial pressure, in a simplified statement cerebral perfusion pressure is the difference between the main arterial blood pressure and the intra-cranial pressure\(^{15}\). Other major factors that regulate CBF are; neuronal activity, autoregulation, arterial PCO\(_2\), arterial PO\(_2\) and neurogenic regulation\(^{16}\).

The present study aimed to evaluate the cerebral blood flow in patients with pseudotumor cerebri using single photon computed tomography (SPECT) and to detect any relation between the disease severity and degree of cerebral blood flow changes.

Brain perfusion abnormalities in the form of hypoperfusion were detected in 84% of our patients. 16% of them had hypoperfusion in one site, while the other 68% had more than one site of hypoperfusion. No sites of hyperperfusion were detected in our 25 PTC patients.

This was similar to other studies\(^{5,9}\), who demonstrated areas of hypoperfusion in 54.5% and 5.3% of their patients respectively using SPECT study. Also there was no areas of hyperperfusion detected.

Other workers previously demonstrated a significantly reduced CBF in their group of PTC patients, these workers studied CBF, cerebral metabolic rate for oxygen, and cerebral blood volume (CBV) by direct carotid injection of H215O, 15O-hemoglobin, and C 15O respectively\(^7\).

The distribution of hypoperfusion sites in our study was, 68% in right basal ganglia, 64% in left basal ganglia, 44% in the left frontal lobe, 32% in the right frontal lobe, 16% in the left parietal lobe, and 12% in the right parietal lobe. Whereas, the distribution of hypoperfusion sites in Loberboym et al.\(^5\) study was 36.3% in left parietal lobe, 9% in left temporal lobe, 9% in right basal ganglia and 9% in the right occipital lobe.

Several mechanisms were proposed to explain the observed changes in the cerebral blood flow in PTC patients, an increase of the cerebrovascular resistance, an impairment of
the CBF autoregulation and reduction in the tissue vascular density as a result of brain edema\(^9,17\).

In contrast, two studies demonstrated elevated CBF in their PTC patients using invasive radionuclide techniques, the first used nitrous oxide method and found raised levels of CBF in there patients and the second examined nine PTC patients using Xe-133 inhalation technique and found elevated CBF in all of them.

On the other hand, Brooks et al.\(^8\) found no changes in the cerebral blood flow or cerebral blood volume in their PTC examined group which included 5 patients. They postulated that as intracranial pressure becomes elevated, an initial compensatory vasodilatation results to maintain CBF. This cerebral blood volume increase was shown to be fully reversible.

Papilledema is the single most important physical sign in patients with PTC, since without papilledema it is simply a headache management problem. Papilledema is usually bilateral but may be unilateral in some cases\(^19,20\).

In the present study, we chosed papilledema, visual field changes and CSF pressure as indicators for disease severity to demonstrate the relation between the degree of disease severity and cerebral blood flow.

We found a highly significant reduction in the global hemispheric CBF (P-value <0.0) in patients with papilledema grades 3, 4 and 5 compared to those with papilledema grades 1 and 2. In addition, there was a highly significant negative correlation (P-value <0.01) between the grade of papilledema and global hemispheric cerebral blood flow.

Also, there was a highly significant reduction in the global hemispheric CBF (P-value <0.01) in the patient group with moderate to severe field changes compared to those with normal to mild field changes.

In addition, there was significant negative correlation between grades of visual field changes and hemispheric global cerebral blood flow.

So our results regarding the grades of papilledema and visual field changes support the association between PTC severity and abnormal SPECT findings of CBF.

These results are inagreement with other studies\(^5,7,17,21\), who reported that patients classified as having severe PTC were 20 times more likely to have abnormal SPECT findings as patients classified as having only mild PTC.

On the other hand, inspite that the global hemispheric CBF was lower in PTC patients with high CSF pressure compared to those with lower CSF pressure, there was no significant statistical difference between the two results, and the correlation between the CBF and the CSF pressure did not reach significant statistical value.

This was inagreement with Mathew et al.\(^22\), who examined CBF in patients with PTC before and after reduction of CSF pressure by lumbar puncture and found non-significant change.

Others\(^8,15\) in their studies about the regional cerebral oxygen utilization, blood flow, and blood volume in PTC patients using positron emission tomography with simultaneous recording to lumbar CSF pressure concluded that, the raised CSF pressure of PTC is not associated with any significant deterioration in cerebral oxygen metabolism or hemodynamics. Also the regional CBF values were evaluated during both the plateau waves of the CSF and the intervals, and they found that inspite of severely reduced cerebral perfusion pressure, regional CBF during the plateau waves was not reduced.

Five of our PTC patients (20%) were found to have systemic arterial hypertension.
Arterial blood pressure is an important factor which can influence the CBF. Although it was once believed that CBF follows arterial blood pressure passively, it is now well established that CBF is relatively independent of changes in arterial pressure within a certain range. This property of the cerebral circulation, is termed autoregulation. The increase in the cerebrovascular resistance counteracts the increase in cerebral perfusion pressure so that flow tends to remain constant.

In our study, there was a significant reduction (P-value <0.05) in the global hemispheric CBF in PTC patients with systemic hypertension compared to those without systemic hypertension. Thus systemic hypertension may be a significant risk factor for complications in PTC patients.

Similarly, Corbett et al., found that 22.8% of their PTC patients had systemic hypertension. And blindness occurred in 8 out of the 13 hypertensive patients (61.5%). So they suggested that systemic hypertension was a significant risk factor for visual loss in PTC patients.

The urge to treat systemic hypertension vigorously in a patient with PTC should be tempered by the knowledge that much of the permanent visual loss that occur with papilledema is due to superimposed focal optic disc ischemia i.e. infarction of the swollen optic disc.

The relation between PTC and obesity has long been recognized. According to Body Mass Index (BMI), 18 of our patients (72%) were found to be obese.

This was inagreement with other reports, who reported obesity in 75% and 77.5% of their patients respectively.

Obesity is associated with increased activity of the sympathetic nervous system. This effect is mediated by the noval protein hormone “Leptin” which is produced almost exclusively by adipose tissue and influence the autonomic nervous system through a specific receptor and multiple neuropeptide pathways. The cerebral circulatory system has a strong sympathetic innervation that passes upward from the superior cervical sympathetic ganglia along with the cerebral arteries. This innervation supplies both the large superficial arteries and the small arteries that penetrate into the substance of the brain. Neither transection of these sympathetic nerves nor mild to moderate stimulation of them usually causes significant changes in the cerebral blood flow because the blood flow autoregulation mechanism can override the nervous effect.

In this study, we compared the global hemispheric CBF between obese and non-obese patients. Although, the CBF was lower in obese patients, there was no significant statistical difference between the two results.

Others previously suggested another way by which obesity may affect CBF in PTC patients, they reported that extra-ovarian production of estron as a result of conversion of androstenedione by adipocyte has been a causative factor in PTC.

The cerebral vasculature is an important target tissue for estrogen, as evidenced by significant effects of estrogen on vascular reactivity and protein levels of endothelial nitric oxide synthase and prostacycline synthase. However, the presence, location and regulation of estrogen receptors in the cerebral vasculature have not been fully investigated.

Among the 22 female patients included in this study 10 females had menstrual irregularities and hormonal treatment including contraceptive pills and these females were compared to the rest of females as regards the global hemispheric CBF. But there was no significant difference between the two groups.
In contrast, Penotti et al.\(^3\) found that in women given transdermal estradiol, the pulsatility index of both internal carotid and middle cerebral arteries was significantly reduced compared with that in the control and they reported that the action of transdermal estradiol on pulsatility index of cerebral arteries is the expression of generalized action of estrogens on arterial vessels.

**REFERENCES**


الملخص العربي

الأشعة المقطعية باستخدام النظائر المشعة أحادية الفوتون
في حالات ارتفاع ضغط المخ الحميد

أجريت هذه الدراسة على 25 مريضا مصريا يعانون من ارتفاع ضغط المخ الحميد، وقد تم عمل الفحوصات التالية لكل مريض:
1- فحص إكلينيكي عام وفحص إكلينيكي للجهاز العصبي.
2- فحص حدة الأصابات وقاع العين ومجال الأصابات.
3- قياس ضغط السائل النفخى وفحصه معمليا.
4- أشعة مقطعية بالكمبيوتر.
5- زئن مغناطيسي على المخ (تشمل 19 مريضا).
6- فحص المخ بالنظائر المشعة أحادية الفوتون.

وقد استهدف البحث تقييم الإعداد الدموي للمخ في حالات ارتفاع ضغط المخ الحميد ومعرفة ما إذا كانت هناك علاقة بين شدة المرض والتغييرات التي تحدث في الإعداد الدموي للمخ.

وأظهرت نتائج البحث أن فحص المخ بالنظائر المشعة كان طبيعيا في 16% من الحالات وكان هناك نقص في الإعداد الدموي للمخ في 84% من الحالات بينما لم يكن هناك زيادة في الإعداد الدموي في أي من الحالات.

لواضح وجود نقص ذو دلالة إحصائية في الإعداد الدموي للمخ في المرضى ذوي درجات الارتشاح العالية في العصب البصري مقارنة بالمرضى ذوي درجات الارتشاح البسيطة.

كما لواضح وجود نقص ذو دلالة إحصائية في الإعداد الدموي للمخ في المرضى ذوي التغييرات العالية في مجال الأصابات مقارنة بالمرضى ذوي التغييرات البسيطة.

بالإضافة لذلك لواضح وجود علاقة سلبية ذات دلالة إحصائية بين درجة ارتشاح العصب البصري، درجة التغير في مجال الأصابات ودرجة التغير في الإعداد الدموي للمخ.

كما أظهر البحث وجود علاقة ذو دلالة إحصائية بين نقص الإعداد الدموي للمخ في حالات مرضى ارتفاع ضغط المخ الحميد وضغط السائل النفخى.

أخيرا أظهر البحث أن هناك نقص ذو دلالة إحصائية في الإعداد الدموي للمخ في مرضى ارتفاع ضغط المخ الحميد الذين يعانون من ارتفاع ضغط الدم مقارنة بغيرهم من المرضى.