Review (Derleme)

A Brief Review on Normal Pressure Hydrocephalus Diagnosis in Primary Neuropsychiatric Care Settings

Birinci Basamak Nöropsikiyatrik Bakım Hizmetlerinde Normal Basınçlı Hidrosefali Tanısına İlişkin Kısa Bir Derleme

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Özet

Normal basınçlı hidrosefali klinik olarak zihinsel bozulma, yürüme bozukluğu ve idrar kaçırma üçlüsü ile karakterizedir. Kognitif gerilemenin potansiyel olarak tedavi edilebilir olması nedeniyle diğer daha yaygın, ancak geri dönüşsüz, demans türlerinden ayırt edilmesi gerekmektedir. Normal basınçlı hidrosefali, öte yandan, modern sağlık sistemlerine sahip ülkelerde bile beklenenden az tanı konulan bir nöropsikiyatrik antite olmaya devam etmektedir. Özellikle klasik semptom üçlüsünün gözlenmediği veya psikiyatrik semptomlar gibi atipik semptomlarla prezente olan hastalarda tanısal süreç daha da karmaşık hale gelmektedir. Bu yazıda normal basınçlı hidrosefalinin atipik klinik belirtileri ve temel radyolojik bulguları kısaca gözden geçirilmekte, ve birinci basamakta tanı ve tedavi zincirinin başlatılması için bazı öneriler özetlenmektedir.

Anahtar kelimeler: Demans, Evans indeksi, kallozal açı, normal basınçlı hidrosefali

Abstract

Normal pressure hydrocephalus (NPH) is clinically characterized by the triad of mental deterioration, gait disturbance, and urinary incontinence. Correct diagnosis and referral of patients is important because NPH is a potentially treatable cause of cognitive decline and should be distinguished from more common forms of irreversible dementia. Unfortunately, it remains to be an underdiagnosed and controversial neuropsychiatric entity even in countries with modern healthcare systems. The diagnostic process is complicated by diverse clinical presentations, especially when the classical triad is incomplete or atypical such as with psychiatric symptoms. This manuscript aims to briefly review atypical clinical presentations of NPH as well as basic radiologic findings associated with NPH and to outline recommendations for primary care physicians regarding diagnosis and referral.

Keywords: Callosal angle, dementia, Evans index, normal pressure hydrocephalus

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INTRODUCTION

Normal pressure hydrocephalus (NPH) is clinically characterized by the triad of mental deterioration, gait disturbance, and urinary incontinence (1). The incidence of NPH is increasing in aging populations. Correct diagnosis and referral of patients is important because NPH is a potentially treatable cause of cognitive decline and should be distinguished from more common forms of irreversible dementia (2-4). This brief review aims to go over some atypical clinical presentations of NPH and basic radiologic findings associated with it, and function as a reminder to the primary care providers, i.e., family medicine, geriatrics, psychiatry, and even radiology who encounter these patients before other specialties.

DEFINITION AND RELEVANT TERMINOLOGY

As the name implies, NPH patients have enlarged cerebral ventricles and normal opening pressures of cerebrospinal fluid (CSF). It is a type of communicating hydrocephalus without elevated opening CSF pressures where secondary causes such as trauma, prior subarachnoid hemorrhage, and meningitis are excluded; therefore, it is also referred to as "idiopathic normal pressure hydrocephalus" in the literature. Another term for NPH is "intermittent pressure hydrocephalus" because there may be intermittent bouts of increased CSF pressures, more than 20 cmH2O, detected during repeated spinal taps (5-7).

EPIDEMIOLOGY

NPH is encountered in elderly populations, basically the older the patient the higher the risk. Prevalence of probable NPH in prospective, population-based studies is around 3.7% among individuals 65 years and older; and it is significantly more frequent among those aged 80 years and older (8.9%) than among those younger than 80 years (2.1%) (8). Retrospective studies from Nordic and Japanese registries show lesser prevalence varying between 0.2 to 5.9% with an estimated mean of 1.5%. On the other hand, exact prevalence is difficult to establish because a significant percentage of NPH patients remain undiagnosed. It is assumed that NPH remains an underdiagnosed and controversial neuropsychiatric entity even in countries with modern healthcare systems (3,5,9-11).

DIAGNOSTIC DIFFICULTIES AND PSYCHIATRIC SYMPTOMS

The diagnostic process is complicated by diverse clinical presentations, especially when the classical triad of symptoms is incomplete or atypical. In addition, as NPH often occurs in elderly individuals prone to various comorbidities, there is always the risk of misdiagnosis as other neurodegenerative diseases, especially Alzheimer's disease. To complicate the picture further, there are other conditions to cause a complete triad of symptoms; for example, vascular dementia, parkinsonism, Lewy body dementia, progressive supranuclear palsy, multiple system atrophy, corticobasal degeneration, neurosyphilis, and medication side effects.4,7 That may be why symptoms of NPH are often overlooked by primary care providers at nursing homes where 20% of all patients, or residents, have gait disturbance, 15% have urinary incontinence and 10% have dementia (12).

Psychiatric symptoms in the setting of NPH cause further confusion among the uninitiated primary physicians as the cognitive effects of NPH may cause a wide spectrum of psychiatric symptomatology ranging from mild dementia to severe late-onset psychosis. Indeed, in patients with a classic triad, there is an increased likelihood of psychiatric symptoms with various degrees of psychotic features (13). Diagnostic delays occur particularly when patients present with psychiatric symptoms ahead of the more expected gait and urinary disturbances (14). Non-cognitive psychiatric findings in NPH are yet to be systematically investigated; however, case series suggest a close association between classical psychotic symptoms and NPH (15-17). Instances where patients initially diagnosed and treated with late-onset psychotic disorder or dementia experienced prompt regression of psychotic symptoms following ventriculoperitoneal shunt surgery. In the initial clinical description of NPH, that is about 60 years ago, severe depression and apathy were cited as expected psychiatric symptoms. Accumulating evidence over time suggests an even broader spectrum of psychiatric symptoms such as hallucinations, ideas of reference, personality changes, mania, aggression, agitated behavior, poor self-care, blunted affect, somatic delusions, delusions of persecution or infidelity, and even akinetic mutism (18-22).

PATHOPHYSIOLOGY BEHIND COGNITIVE DISTURBANCE AND PSYCHIATRIC SYMPTOMS

The underlying pathophysiologic mechanism of NPH remains controversial as various theories are trying to explain the progression of symptoms. What we

may assume so far is that NPH is an obstructive type of communicating hydrocephalus due to reduced absorption of cerebrospinal fluid (CSF). Enlargement of ventricles leads to increased intracranial pressure which impairs perfusion and causes weakening of ventricle walls. This in turn causes ischemia in periventricular white matter which slows down CSF flow rate through extracellular spaces resulting in a back-pressure effect thereby contributing to further ventricular enlargement. This vicious cycle ends in diffuse hypoperfusion in the prefrontal cortex, basal ganglia, and thalamus. Whatever the exact etiology may be, the resulting tangential shearing forces exerted on corticospinal tracts and other periventricular white matter are responsible for gait disturbance and urinary problems as both symptoms in NPH occur in the absence of primary sensorimotor or cerebellar deficits (23-25). The cognitive decline observed in NPH usually resembles subcortical dementia types, presenting prominently with executive function deficits and memory problems which are more associated with prefrontal structures. Therefore, symptoms such as severe memory deficits, naming impairments, agnosia, and psychiatric symptoms such as hallucinations, delusions, poor judgment, changes in mood, personality, and behavior, and an inability to perceive danger should prompt consideration of NPH in the differential diagnosis (26-27).

RECOMMENDATIONS FOR DETECTION OF NPH IN PRIMARY CARE SETTINGS

At present, there are two accepted guidelines regarding the diagnosis of NPH, namely the American-European and the Japanese guidelines. Unfortunately, there are considerable discrepancies between the two guidelines when diagnosing NPH and their clinical applicability may sometimes be questionable (28-29). On the other hand, recognizing NPH at the primary care level is extremely important because it is a potentially treatable condition with CSF diversion such as ventriculoperitoneal, ventriculoatrial, or lumboperitoneal shunt surgeries. Meta-analyses show that dementia and psychiatric symptoms will be reversed in more than 75% of patients undergoing surgery. In addition, surgical complication rates are low even in rural hospitals. Of particular importance is that a shorter duration of presurgical symptoms, i.e., less than 6 months, is one of the major favorable prognostic factors (4,5,30-32). Therefore, the following recommendations and reminders should be emphasized:

1. Do not miss the obvious cases: Any patient with mild cognitive deterioration who also has gait disturbance, with or without urinary incontinence, should be considered as possibly having NPH in the background (33).

2. Systematic work-up is essential: Diagnostic work-up requires a thorough medical anamnesis, and neurological examination including baseline evaluation of cognition, assessment of gait --balance, and urinary function. Because symptoms often have insidious onset and progress slowly, it is important to involve family members during clinical assessment. Considering patients' cognitive impairment, medical jargon should be avoided during history taking. An easy-to-understand screening questionnaire for assessing typical symptoms of NPH is presented in Table 1. The possible total score is between 0 and 10 points. A score between 0 and 2 implies that NPH is unlikely. A score of 3 or higher may indicate that the patient's symptoms may be due to NPH (8,34).

Table 1. An easy-to-understand screening questionnaire for assessment of typical symptoms of NPH which comprises two questions on cognition, three questions on gait and postural stability, and two questions on urinary continence. The number of points allocated for each positive response is given in parentheses.

Questions
Do you have difficulty maintaining attention for longer periods? (1 point)
Do you have difficulty remembering things? (1 point)
Do you feel like your feet are glued to the ground when you walk? (2 points)
Do you have difficulty keeping my balance when walking or turning around? (2 points)
Have you fallen more than once without losing consciousness? (2 points)
Have you experienced sudden urges to urinate and need to quickly find a toilet? (1 point)
Have you peed on yourself? (1 point)

3. Strongly consider contacting radiology: Threshold for ordering imaging tests should be kept lower for suspected NPH patients. Magnetic resonance imaging (MRI) can visualize brain anatomy with detail and does not expose the patient to ionizing radiation. Computed tomography (CT), which utilizes ionizing radiation, can also visualize the anatomic changes that support NPH diagnosis. Though CT is inferior to MRI regarding image detail, it has practical advantages such as being more readily accessible and quicker to perform compared to MRI which requires patient collaboration and can sometimes be tedious for those with cognitive decline. Therefore, CT is usually the initial imaging test for NPH especially in case of the elderly individuals with limited compliance or patience (5).

Two radiologic measurements are helpful for supporting or ruling out NPH. The most used is the Evans Index (EI) which is the ratio of maximum width of frontal horns of lateral ventricles and maximal internal diameter of skull at the same level in axial CT or MRI images (Figure 1). EI is accepted as marker of ventricular volume with an EI greater than 0.30 indicating pathologic ventricular enlargement. Unfortunately, EI is a very rough marker of ventriculomegaly and varies depending on the location and angle of the image slice. In addition, EI increases with age and differs between men and women. Therefore, new EI thresholds for elderly are proposed as 0.34/0.32 for age 65-69, 0.36/0.33 for 70-74 years, 0.37/0.34 for 75-79 years and for those aged 80-84 years 0.37/0.36, for men and women, respectively (35,36).

The other measurement proposed as a marker of NPH is the callosal angle (CA) which is helpful in distinguishing NPH from ex-vacuo ventriculomegaly, i.e., ventricular enlargement in response to brain atrophy. CA is the angle between medial superior borders of the left and right ventricles and is measured on a coronal image perpendicular to the anterior commissure - posterior commissure (AC-PC) plane at the level of the posterior commissure (Figure 2). A normal CA is typically obtuse, about 100 to 120 degrees, whereas CA in NPH is acute, usually between 50 and 80 degrees. Rate of response to CSF diversion surgery is higher in patients with smaller CA (mean=59°, 95% CI 56°–63°) compared to those with greater (mean=68°, 95% CI 61°–75°) with a cutoff value of 63° (5,7,35,37,38).

In summary, NPH is radiologically characterized by enlargement of lateral and third ventricles that look out of proportion to cortical sulcal enlargement and is also associated with widening of Sylvian fissure and crowding of the vertex. This pattern, termed "disproportionately enlarged subarachnoid hydrocephalus" (DESH), helps to distinguish NPH from other causes of hydrocephalus (Figure 3) (4,5,7,35,39).

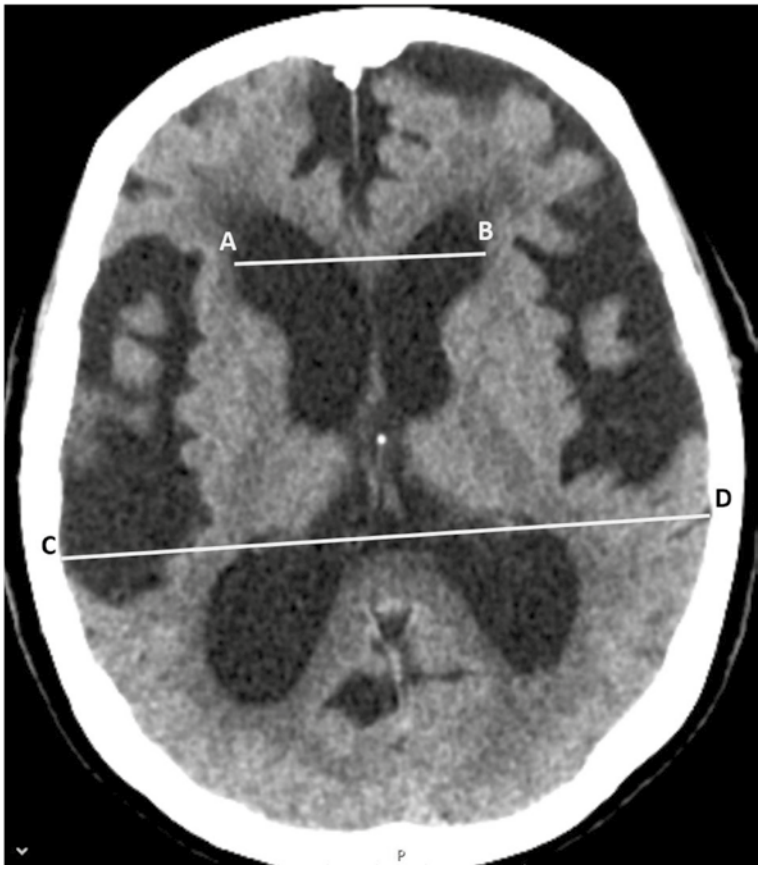

Figure 1. Axial CT slice in a patient with NPH. The Evans index is measured by dividing the maximal width of the frontal horns [A-B] with the maximal internal width of the skull at the same level [C-D]. In this case Evans index is 0.40.

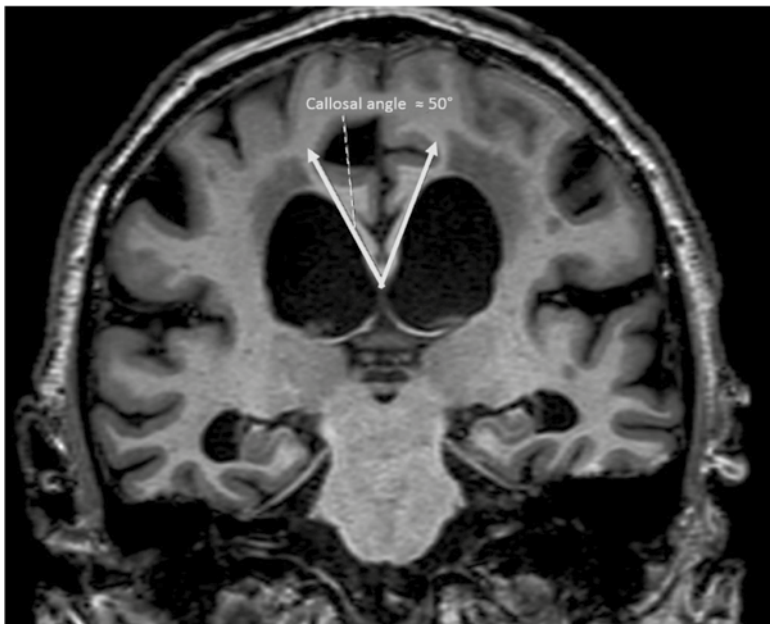

Figure 2. Coronal MRI at the level of posterior commissure. The callosal angle is acute, about 50 degrees, suggesting NPH as the cause of ventriculomegaly.

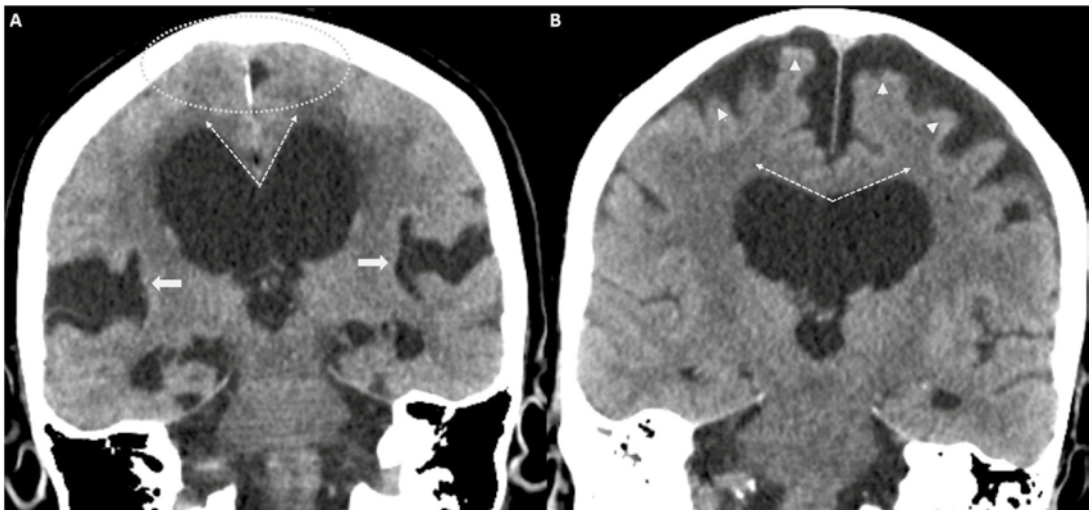

Figure 3. Disproportionately enlarged subarachnoid hydrocephalus (DESH) pattern in a patient with NPH (A) versus ex vacuo ventriculomegaly as seen in other types of neurodegenerative processes (B). Both have enlarged lateral and third ventricles. However, in NPH this is out of proportion to the cortical sulcal enlargement, and the vertex is crowded (dotted ellipse on A). There is also a widening of Sylvian fissures (thick arrows on A). In typical brain atrophy, in contrast to NPH, CSF spaces over the convexity near the vertex and medial cisterns are wide (arrowheads on B). Callosal angle (dashed arrows on A and B) is acute in NPH whereas it is obtuse in ex vacuo ventricle dilation.

It is particularly important to inform the reporting radiologist that imaging is being ordered to identify or rule out radiologic criteria of NPH. Otherwise, subtle changes in the brain may be overlooked or reported as simple brain atrophy because the above-described measurements are uncommonly used in day-to-day reporting. Therefore, in addition to the Evans Index, the referring physician should specifically request the radiologist to measure the callosal angle (4,5,7)

4. Do not hesitate to refer the patient: NPH requires a multidisciplinary approach and involves collaboration between neurology, neurosurgery, physical therapy, occupational therapy, and, in an increasing number of centers, psychiatry. The neurologist has a significant role in differentiating NPH from other neurodegenerative diseases mentioned previously. Then the neurosurgeon assesses the patient's operability. The physiotherapist analyzes the patient's movement pattern, walking, and balance skills. Occupational therapy and neuropsychological assessment aim to map physical and cognitive impairments and activity limitations that are typical of NPH. The physical and occupational

therapist as well as the neuropsychologist have assessment instruments available to quantify the clinical findings. Therefore, referral to neurology is recommended if a patient examined in primary care shows symptoms and radiologic findings that give rise to suspicion of NPH (40).

CONCLUSION

Normal pressure hydrocephalus remains underdiagnosed, especially in cases with incomplete triad of symptoms or with atypical cognitive changes such as psychiatric disturbances. Its coexistence with other more common types of dementia further complicates the diagnostic process. On the other hand, patients significantly benefit from CSF diversion surgery, which also has low complication rates. Thus, NPH is a diagnosis that should always be kept in mind in the primary care of the elderly. The threshold for radiologic imaging and referral to specialist clinics should be low for its prompt diagnosis and treatment.

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