

# Appraisal of Kernig's and Brudzinski's sign in meningitis

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## Introduction

Meningitis is a common life-threatening medical emergency caused by infectious and non-infectious agents. Rapid and accurate evaluation by history and clinical examination is helpful to guide further specific investigation and treatment. Kernig's sign, Brudzinski's sign, and nuchal rigidity are bedside diagnostic signs used to evaluate suspected cases of meningitis. The presence of meningeal irritation, however, is not pathognomonic for meningitis.

## Historical origin and clinical aspects

### Kernig's sign

Vladimir Mikhailovich Kernig (1840-1917), a Russian physician, described first meningeal sign, known as Kernig's sign. He was born in Lapaia, Latvia and received his medical education at the Russian University. He observed that many patients with meningitis had restriction in passive extension at the knee because of spasm of the hamstring muscles, and this was named as Kernig's sign and published in 1882 and 1884.<sup>[1,2]</sup> He used to elicit this sign by keeping the patient in sitting posture, but nowadays the maneuver is usually performed in supine position.

To elicit the Kernig's sign, patient is kept in supine position, hip and knee are flexed to a right angle, and then knee is slowly extended by the examiner. The appearance of resistance or pain during extension of the patient's knees beyond 135 degrees constitutes a positive Kernig's sign [Figure 1a].<sup>[3]</sup> Kernig in his original description did not consider pain as a required component of the maneuver; however, many clinicians include pain as an essential component of a positive sign. Chauvard hypothesized that muscular hypertonia of the lower limbs as well as physiological predominance of the extensor muscles of

the neck and back over the flexor muscles of the lower limbs is the basis for the genesis of Kernig's sign. Later on, it has been proposed that, it is a protective reaction to prevent the pain or spasm of the hamstring muscles induced by stretch of the inflamed and hypersensitive nerve roots. Asymmetry of Kernig's sign may be seen in patients with meningeal irritation, who have concomitant hemiparesis.

### Brudzinski's sign

Josef Brudzinski (1874-1917), a Polish born pediatrician in early nineties, described 4 maneuvers for the clinical diagnosis of meningitis: The obscure cheek sign, symphyseal sign, Brudzinski's reflex, and the most popular Brudzinski neck sign. A positive cheek sign is elicited by applying pressure on both cheeks inferior to the zygomatic arch that leads to spontaneous flexion of the forearm and arm.<sup>[3]</sup> A positive symphyseal sign occurs when pressure applied to the pubic symphysis elicits a reflex hip and knee flexion and abduction of the leg. Brudzinski's contralateral reflex sign consists of reflex flexion of a lower extremity after passive flexion of the opposite extremity [Figure 1b].<sup>[4]</sup> Sometimes, a lower limb first placed in flexion causes a reflex movement of extension after the passive flexion of the other limb, known as reciprocal contralateral reflex of Brudzinski.

The most popular maneuver Brudzinski's neck sign is performed with the patient in the supine position. To elicit this maneuver, the examiner keeps one hand behind the patient's head and the other on chest in order to prevent the patient from rising. Reflex flexion of the patient's hips and knees after passive flexion of the neck constitutes a positive Brudzinski sign [Figure 1c].<sup>[5]</sup> It has been proposed that in patients with meningitis, passive flexion of the neck stretches the nerve roots through the inflamed meninges, leading to pain and flexion movements of lower extremities. Forward head flexion exerts traction on the intradural spinal nerve roots, which attain maximal relaxation when both hip and knee are placed in intermediate degrees of flexion.

## Usefulness and limitations

Brudzinski, in his original article entitled "Über die kontralateralen Reflexe an den unteren Extremitäten bei Kindern" ("A New Sign of the Lower Extremities in Meningitis of Children"), reported the sensitivity of Brudzinski's neck and Kernig's signs was 97% and

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**Figure 1: (a) Kernig's sign-** Extension of the knee on a flexed hip at 90° causes restriction and pain Beyond 135°, **(b) Brudzinski contralateral leg sign-** Reflex flexion of a lower extremity on passive flexion of the opposite extremity, **(c) Brudzinski neck sign-** Reflex flexion of the patient's hips and knees on passive flexion of the neck

57%, respectively.<sup>[6]</sup> Since the mechanism of genesis of Kernig's and Brudzinski's signs are based on the meningeal and nerve roots inflammation, the severity of inflammation that occurs in bacterial meningitis would likely result in greater sensitivity of the signs. The majority of examined patients described in Kernig's and Brudzinski's original research papers were children affected by tubercular meningitis. Brudzinski's sign and nuchal rigidity are not accurate in diagnosing meningitis in infants younger than 6 months and in elderly populations. In 1991, a prospective study by Uchihara and Tsukagoshi reported a sensitivity of 9% and specificity of 100% for Kernig's sign.<sup>[7]</sup> The sensitivity and specificity was 15% and 100%, respectively, for nuchal rigidity in the same study. A recent study, by Thomas *et al.* analyzing 297 adults with suspected meningitis, reported a sensitivity of 5% and specificity of 95% for both Kernig's and Brudzinski's signs.<sup>[8]</sup> In a study by Gil Amariljo in children (2 months to 16 years age group) with meningitis found that Kernig signs had a sensitivity of 27%, specificity of 87% and had relatively high positive predictive values 77%. Surprisingly, sensitivity of both the signs described above for the diagnosis of meningitis has been reported quite low, ranging from 5% to 27%. In a study by Uchihara *et al.*, exclusion of those patients with meningitis who had mental status abnormalities or focal neurological deficits might be the reason for low diagnostic sensitivity.<sup>[7]</sup> Thomas *et al.* reported that the sensitivity of meningeal signs are not proportionate to the disease severity in patients with moderate or severe meningeal inflammation or with microbiological evidence of central nervous system infection.<sup>[8]</sup> Irrespective of disease severity, these meningeal signs may be absent in infants or elderly patients, in immunocompromised or comatose patients. All these factors may account for low sensitivity.

From the figures and studies mentioned above, it is apparent

that both, Kernig's and Brudzinski's signs, are not very sensitive for detecting meningitis and, therefore, when absent, should not be inferred as there is no evidence of meningitis. Although the sensitivity is quite low, the high specificity suggests that if Kernig's or Brudzinski's sign is present, there is a high likelihood for meningitis. The two signs, Kernig's and Brudzinski's, are often performed together in clinical practice.

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