Contents lists available at ScienceDirect

Turkish Journal of Emergency Medicine

Original article

Jolt accentuation and its value as a sign in diagnosis of meningitis in patients with fever and headache

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ABSTRACT

Objectives: Meningitis is an important disease among the patients being visited in Emergency Departments (EDs). There are many signs to diagnose it with different sensitivity and specificity reported in previously done studies. Current study tries to evaluate diagnostic accuracy of "Jolt accentuation" in the diagnosis (Dx.) of meningitis in patients with fever and headache.
Materials and methods: 48 adult patients, who were referred to two teaching EDs for fever and headache and were diagnosed as suspected meningitis, were included in this prospective observational study. Demographic characteristics of patients were recorded in data sheets, as well as the results of exams including nuchal rigidity, Kernig and Brudzinski signs, and Jolt accentuation. Then, lumbar puncture (LP) was done and cerebrospinal fluid (CSF) was analyzed for each patient; pleocytosis (more than five white blood cells in high power field) were considered as meningitis. Sensitivity, specificity, positive and negative predictive values (PPV and NPV), and positive and negative likelihood ratios (LR^+ and LR^-) of the above mentioned signs were compared to each other.
Results: Meningitis was proved in 33 patients (68.8% of them), according to CSF analysis. Jolt accentuation had sensitivity, specificity, PPV, NPV, LR^+, and LR^- of 69.6%, 33.3%, 69.6%, 33.3%, 1.02, and 0.91, respectively. Jolt accentuation had the highest sensitivity rate all of the signs mentioned above; although, it was not significant.
Conclusion: Jolt accentuation alone cannot rule in or out the Dx. of meningitis in patients with fever and headache; LP is still recommended for these patients.

1. Introduction

Every Emergency Department (ED) may encounter patients with some signs and symptoms suggesting diagnosis of meningitis [1], including headache, fever, nuchal rigidity, decreased level of consciousness, and photophobia [2,3]. Bacterial meningitis has a mortality rate of about 20—30% [4]. It has been shown that the most important factor to achieve a good outcome in these patients is to start intravenous (IV) antimicrobials, as soon as possible; so,

meningitis is a medical emergency needing rapid diagnosis and therapeutic intervention [5,6]. There are multiple signs detectable during the physical examination to make the diagnosis of meningitis, such as nuchal rigidity, Kernig's sign, Brudzinski's sign, and Jolt accentuation [7—9]. Jolt accentuation is a sign that different studies have shown heterogeneous results about its accuracy [10,11]. Previous studies could not find jolt accentuation as an accurate diagnostic test to confirm the diagnosis of acute bacterial meningitis [5,10].

The aim of this study was to test the diagnostic values of Jolt accentuation in terms of sensitivity, specificity, positive and negative predictive values and to compare them with the diagnostic values of other signs for meningitis in patients referred to EDs with fever and headache.

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Peer review under responsibility of The Emergency Medicine Association of Turkey.

Table 1
CSF analysis of patients suspected to have encephalitis or meningitis.

CSF value	Mean	± SD
Leukocytes/μL	11800	3400
Neutrophils (%)	54.3	29.1
Lymphocytes (%)	45.3	32.3
Glucose (mg/dL)	66.4	58.3
Number of samples having glucose value < 40 mg/dL	19	–
Protein (mg/dL)	128.3	193.1
Number of samples having protein value < 100 mg/dL	17	–

CSF: cerebrospinal fluid, μL: microliter, mg/dL: milligrams per deciliter.

2. Materials and methods

This prospective observational study was performed on consecutive patients who were admitted to two teaching EDs (Rasool-e-Akram and Firoozgar Hospitals) in Tehran the Capital of Iran from September 2014 to September 2015. They were presented with chief complaint of fever and headache and high index of suspicion for meningitis. Inclusion criteria included age over 18 year, onset of symptoms less than 24 h, and physical ability and cooperation to accomplish Jolt accentuation. Exclusion criteria included any contraindication to perform lumbar puncture (LP) and antibiotic use during the previous week. Two patients were excluded from study due to recent use of antibiotics.

Demographic characteristics of patients, including age and sex were recorded in data sheets, as well as the results of exams including fever, nuchal rigidity, Kernig and Brudzinski signs, Jolt accentuation and the positive findings of brain computed tomography (CT) scan (needed to perform LP). Then the patient was placed in the lateral recumbent position with the hips, knees and chin flexed toward the chest and LP was done in L3-L4 spinal level. Cerebrospinal fluid (CSF) was analyzed for each patient. Pleocytosis (more than five white blood cells in high power field) were considered as meningitis. The study was approved by the ethics committee of Iran University of Medical Sciences (IUMS). Informed consent was obtained from patients or their relatives.

Fever considered as orally measured body temperature higher than 37.8°C. To achieve Kernig's sign, the examiner flexed the patient's ipsilateral hip and knee joints in supine position, up to 90°; then, extends the knee. The sign is positive if this maneuver causes any pain in the back of the same thigh. Brudzinski's sign is considered as positive when the patient flexes his or her hip joint

because of pain following passive flexion of his or her neck. Jolt accentuation is regarded as positive if the patient's headache is worsened by turning his or her head actively, leftward and rightward, intermittently in a rate of 2–3 per second [2,6,7]. All of the exams were done by an academic attending physician of Emergency Medicine.

Data recorded in check lists, were analyzed using SPSS 18 software. Sensitivity, specificity, positive and negative predictive values (PPV and NPV), and positive and negative likelihood ratios (LR+ and LR−) of the above mentioned signs were obtained and compared to each other. Also we calculated the diagnostic values of the combination of signs. Pleocytosis of CSF was considered as the gold standard to diagnose meningitis and evaluate the signs.

3. Results

Forty-eight patients were admitted to ED suspected to have meningitis; CSF analysis proved meningitis in 33 patients (68.8% of them). Mean age of patients studied was 37.29 ± 12.8.27 (56.2%) of them were male while 21 (43.8%) of them were female. Mean body temperature measured orally was 38.04 ± 0.92 (in the range of 37.5–40) degrees Celsius. Table 1 shows CSF characteristics of patients.

Twenty-six patients (54.2%) had nuchal rigidity, while Kernig's sign and Brudzinski's sign were positive in 17 (35.4%) and 18 (37.5%) of them, respectively. 33 patients (68.8%) had positive Jolt accentuation. Jolt accentuation had the highest sensitivity (69.7%) but the lowest specificity (33.3%) compared to other signs. Sensitivity, specificity, PPV, NPV, LR+, and LR-of the studied signs have been mentioned in Table 2. Table 3 shows the diagnostic values of the exams in combination with each other. The combination of Jolt accentuation with Kernig's and Brudzinski's sign reached the highest specificity (100%).

Finally, diagnosis. of bacterial meningitis and viral encephalitis were established in 26 (54.8%) and 7 (14.6%) of patients, respectively while, 15 cases were discharged home as meningitis and encephalitis were ruled out. CSF culture results had been recorded in 23 patient files in which Neiseriameningitidis (meningococcus) was the most prevalent microorganism.

4. Discussion

This study evaluated and compared diagnostic value of specific

Table 2
Diagnostic values of physical exams (nuchal rigidity, Brudzinski's sign, Kernig's sign, and Jolt accentuation) in patients with positive lumbar puncture test.

Sign	Sensitivity (95% CI)	Specificity (95% CI)	PPV (95% CI)	NPV (95% CI)	LR+ (95% CI)	LR− (95% CI)	LR+/LR−
Nuchal rigidity	66.7 (48.2–82)	73.3 (44.9–92.1)	84.6 (65.1–95.6)	50 (28.2–71.8)	2.5 (1–6)	0.45 (0.26–0.8)	5.5
Brudzinski's	42.4 (25.5–60.8)	80 (51.9–95.7)	82.3 (56.6–96.2)	38.7 (21.8–57.8)	2.12 (0.7–6.3)	0.72 (0.5–1)	2.94
Kernig's	42.4 (25.5–60.8)	73.3 (44.9–92.2)	77.8 (52.3–93.6)	36.7 (19.9–56.1)	1.59 (0.6–4)	0.79 (0.5–1.2)	2.01
Jolt accentuation	69.7 (51.3–84.4)	33.3 (11.8–61.6)	69.7 (51.3–84.4)	33.3 (11.8–61.6)	1.05 (0.7–1.6)	0.91 (0.38–2.2)	1.15

PPV: positive predictive value, NPV: negative predictive value, LR+: positive likelihood ratio, LR−: negative likelihood ratio.

Table 3
diagnostic value of Jolt accentuation in combination with other physical signs.

Combination	Sensitivity (95%CI)	Specificity (95%CI)	PPV (95%CI)	NPV (95%CI)	LR+ (95%CI)	LR− (95%CI)
Jolt accentuation + Brudzinski's sign	27.3 (13.3–45.5)	93.3 (68–99.8)	90 (55.5–99.7)	36.8 (21.8–54)	4.13 (0.57–29.45)	0.78 (0.6–1)
Jolt accentuation + Kernig's sign	33.3 (17.9–51.8)	80 (51.9–95.7)	78.6 (49.2–95.3)	35.3 (19.7–53.5)	1.67 (0.54–5.1)	0.83 (0.6–1.18)
Jolt accentuation + nuchal rigidity	48.8 (30.8–66.4)	86.7 (59.5–98.3)	88.9 (65.3–98.6)	43.3 (25.4–62.6)	3.64 (0.95–13.8)	0.59 (0.4–0.87)
Jolt accentuation + Brudzinski's sign + Kernig's sign	18.2 (6.9–35.5)	100 (78.2–100)	100 (54.1–100)	35.7 (21.5–52)	Infinity	0.82 (0.7–0.96)
Jolt accentuation + Brudzinski's sign + nuchal rigidity	21.2 (9–38.9)	93.3 (68–99.8)	87.5 (47.3–99.7)	35 (20.6–51.7)	3.18 (0.43–23.6)	0.84 (0.68–1)
Jolt accentuation + Kernig's sign + nuchal rigidity	27.3 (13.3–45.5)	93.3 (68–99.8)	90 (55.5–99.7)	36.8 (21.8–54)	4.13 (0.57–29.45)	0.78 (0.6–1)x

PPV: positive predictive value, NPV: negative predictive value, LR+: positive likelihood ratio, LR−: negative likelihood ratio.

examinations including nuchal rigidity, Kernig's sign, Brudzinski's sign, and Jolt accentuation. Current study found a rate of 69.6%, 33.3%, 1.02, and 0.91 for sensitivity, specificity, LR^+, and LR^- of Jolt accentuation, respectively. As, the most appropriate test to screen a disease is the one which is able to detect the disease among the patients more than the others, the most important parameter is sensitivity [12]. Despite, the sensitivity of Jolt accentuation was showed not to be so high in our study, it was the highest among 4 physical signs.

Kernig's sign and Brudzinski's sign which have been introduced since more than 100 years ago [5], have shown a very low sensitivity in the Dx. of meningitis [5,7]. Jolt accentuation is a newer Ph. Ex. which has had a range of sensitivity (6–97%) reported in different studies [9–13]; this wide range could be due to the variation in sample size, common regional pathogens, and basic characteristics of patients [10].

Limited studies have been done in this domain. The first one was published in 1991 by Uchihara et al. It was done on the patients with headache and fever, as our study. They concluded that Jolt accentuation has a good sensitivity (97%) in detection of patients who had CSF pleocytosis and they propounded that LP must be done in patients with positive Jolt accentuation exam, even if there is no nuchal rigidity or Kernig's sign [11]; these results are not compatible with whatever we attained.

Nakao showed 21% sensitivity for Jolt accentuation to detect CSF pleocytosis in patients suspected to have meningitis. There was shown a low sensitivity rate for Kernig's sign, Brudzinski's sign, and nuchal rigidity, 2%, 2%, and 13%, respectively [5].

There was done another study in patients suspected to have meningitis in Japan. Sensitivity, specificity, LR^+, and LR^- of Jolt accentuation was achieved as 63.9%, 43.2%, 1.12, and 0.84, respectively and the authors concluded that existing physical examination. clues are not able to detect patients suspected to have meningitis [10].

Considering the disappointing results of previous studies and current study, we decided to evaluate the diagnostic power of Jolt accentuation in combination with 3 other exams. Combining them lowers the sensitivity too much but, combination of Jolt accentuation, Kernig's sign, and Brudzinski's sign has 100% specificity and PPV and a very high LR^+, so we can suppose a high possibility of meningitis for a patient with headache and fever and a positive result of all of 3 tests.

5. Limitations

Current study had some limitations including a relatively low sample size. To attain more accurate results, it is recommended to design a study with higher sample size. Meanwhile, it was done in a crowded ED which can affect the precision of the examiner.

6. Conclusion

As other physical signs, Jolt accentuation does not have a high sensitivity in detecting patients suspected to have meningitis and LP is still recommended to rule out meningitis in these patients.

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