Assessment of Different Technique of Eliciting the Planter Reflex in Term Neonates

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Authors' contributions

This work was carried out in collaboration among all authors. Author AT designed the study, performed the statistical analysis, wrote the protocol, and wrote the first draft of the manuscript. Authors RR, SY and PZ managed the analyses of the study. Author RM managed the literature searches. All authors read and approved the final manuscript.

Study Protocol

ABSTRACT

Background: Planter reflex is still an essential part of the neurological examination. The usual plantar reflex involved bending of the big toe or no response. There is a positive Babinski signal with corticospinal dysfunction, which involves big toe dorsal flexion and the accompanying fanning of the other toes. It's one of the infant reflexes that disappers as the infant nervous system grows. The plantar reaction is primarily extensive in stable, term neonates. Many have researched this reflex's accuracy but very few studies have analyzed the various techniques of the planting reflex.
Objective: To assess the five different technique of eliciting the plantar reflex in newborn babies.
Materials and Methods: In this cross-sectional study, the eligible healthy newborn will be given the different methods for the elicitation of the plantar reflex i.e. Oppenheim sign, Gordon sign, Gonda's sign, Chaddock sign, and Schaefer sign. During this procedure, we will record the baseline RR, HR, and SpO2 before, and after the procedure. Three pediatric residents of the different years will be selected for examining the newborn reflexes throughout the study period.

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Results: After completion of the study, we will come to know the negative likelihood ratio, negative predictive value, positive predictive, specificity, positive likelihood ratio, and sensitivity of the Oppenheim sign, Gordon sign, Gonda's sign, Chaddock sign, and Schaefer sign.
Conclusion: The study will probably give us information about the sensitivity and specificity of the Oppenheim sign, Gordon sign, Gonda's sign, Chaddock sign, and Schaefer sign for the elicitation of the plantar reflex in the neonates.

1. INTRODUCTION

The plantar reflex is a polysynaptic superficial reflex, intended to withdraw the stimulated part, i.e., the foot from a potentially risky stimulus. It was first explained by the neurologist Joseph Babinski in 1899 in his paper reflexes cutane plantaire. He mentioned in his paper that stimulation of plantar inpatient with hemiplegia and lower limb monoplegia on the healthy side shows flexion of the toe at the metatarsal bone and the same stimulus when applied to the affected side (no voluntary response) it shows the extension of toes at the metatarsal-phalangeal joint. That's why it is incorporated into regular CNS examination [1-3]. The Babinski reflex is easy to produce and needs no advanced equipment. This also involves no active involvement by patients so that patients who cannot participate in the neurological examination, even in them we can do these reflexes [2-5]. The superficial reflexes are mainly controlled by centers in the spinal segment L4 to S2 cord segments. This research will determine the sensitivity of the various techniques used to generate the reflex of the plantar in a newborn born.

1.1 Research Question

Do other methods (Gordan's / Gonda's) are as effective as a standard method for eliciting Babinski's response in Neonates?

2. AIM AND OBJECTIVES

Aim: To assess the five different technique of eliciting the plantar reflex in newborn babies

Objective: To know the related factors affecting the plantar reflex.

3. MATERIALS AND METHODS

a. Study Setting

This research will take place in Jawaharlal Medical College & AVBR Hospital, Sawangi, Wardha, the Department of Neonatology.

b. Sources of Data

All healthy neonates.

c. Study population

After delivery, clinically stable newborn babies.

Inclusion Criteria: Full-term neonate with appropriate for gestational age (AGA).

Exclusion Criteria:

- Neonates, who will be present with cold extremities immediately before the measurement
- Babies having neonatal meningitis or cranial hemorrhae, obvious chromosomal abnormalities, neurological, cephalhaematoma. caput succedaneum.

d. Study Design

Cross-sectional study.

e. Time Frame / Duration

12 month.

f. Assessments and Examination

A detailed information sheet will be given to the newborn parents in which the methodology of plantar reflex will explain in their local language. Demographic information will be collected for all neonates (study cases), which include their age, gender, and weight. All cases of study will enquire about perinatal history (maternal diseases, delivery method, APGAR score, history of cyanoses or seizures) and clinical examinations (including vital signs, anthropometric measures, and CNS examination).

- 3 pediatric residents of the different years will be selected for examining the newborn cases throughout the study period and

intensive training for elicitation of the plantar reflexes cases will be given by pediatric neurologist. Cases will be selected according to the inclusion criteria.

- The three observers will document their clinical examination findings separately.
- Which includes all the five methods of elicitation of the plantar reflex.
- The residents will evaluate each child independently, will be blinded and the interval between the observer's examinations ranged between 2-4hrs.

g. Intervention

- In this study we take the normal term neonates who are eligible according to the inclusion criteria, This is achieved by registering all births consecutively. Elicitation of the plantar reflex will be done 24 hours after birth. Birth weights and modes of delivery will be obtained.
- The GAs will be estimated using the method of Ballard. A newborn is considered an AGA if the weight of his birth is somewhere between 10th and 90th percentiles.

3.1 Standard Method of Elicitation of Planter Reflex

- In well-lit rooms with monitored, ambient temperature for all babies will be checked. the radiant warmers will keep the temperature at 36,6 °C.
- The patient is made to lie down in a supine position.
- Keep knee in flexed position and thigh in an externally rotated manner.
- Fix the ankle joint.
- Stroke the lateral aspect of the sole from the heel towards the great toe.
- Stroke slowly, it takes 5 or 6 seconds to complete the motion.

3.2 Stimulation

- Stimulates primarily the lateral surface of the sole and the transverse arch up to the middle metatarsophalangeal joint with a single movement.

3.3 An Instrument Used for the Elicitation of Reflex

- Use thumbnail in newborn.

3.4 Normal Plantar Reflex

- Adduction of the toes and plantar flexion of the foot and toes.
- Sometimes there will be flexion of the hip and knee joint on the stimulated side.

3.5 Babinski's Reflex-

- Usually, in neonate there will be an extension of the great toe along with other toes on stimulation, it is also associated with dorsiflexion of ankle along with flexion of hip and knee joint this is known as Babinski'response.

3.6 Other 5 Methods of Elicitation of Plantar Reflex

1. Gordon sign (calf-toe sign): Pressure is applied on the calf muscles or tendons-Achilles by squeezing/pinching to produce extensor plantar response.
2. Gonda's sign / Allen sign (toe-pull reflex): in these distal phalanges of the 2nd or 4th toe is forceful pulled downwards.
3. Oppenheim (shin-toe reflex): slight pressure has been applied to the thumb and index finger on the shin of the tibia from above downwards. The response occurs towards the end of the stimulus.
4. Chaddock sign: Skin around lateral malleolus is stroked circularly.
5. Schaefer sign (Achilles- toe reflex): Deep pressure or squeezing over the tendon-Achilles tendon produces extensor response.

f. Statistical Test

Data analysis is done with program STATA 12. Numerical information is summarized using standard deviations and means. The input and review of data are carried out using the program STATA. The proportions are evaluated using the chi-square test and the means are compared by student's t-test. For the determination of the correlation coefficients between parameters, the Pearson correlation test is used. The Sensitivity, Specificity, Positive Predictive Value, Positive Likelihood Ratio, Negative Likelihood Ratio will also be determined. The P-value below 0.05 is regarded as significant. We will use Kappa statistics for obtaining the agreement between the physical findings of the three observers.

3.7 Sample Size Calculation

The sample size is determined by keeping an indicator of the newborn population 10000, margin of error of 5%, indicator percentage of 0.50, and confidence interval of 95%, the calculated sample size: 375.

4. EXPECTED RESULTS

After completion of the study, we will come to know the negative likelihood ratio, negative predictive value, positive predictive, specificity, positive likelihood ratio, and sensitivity of the Oppenheim sign, Gordon sign, Gonda's sign, Chaddock sign, and Schaefer sign. We will compare the assessment of Babinski's signs by different methods. The interobserver agreement will be done among the three pediatric residents by using kappa statistics.

5. DISCUSSION

The Plantar reflex is a polysynaptic superficial reflex, intended to withdraw the stimulated part, i.e., the foot from a potentially risky stimulus. For doing Babinski reflex there is no special equipment needed and it is easy to perform. It requires patients' active participation, as it is difficult to perform in uncooperative patients [6-9]. The superficial reflexes are mainly controlled by centers in the spinal segment L4 to S2 cord segments. Extensor plantar response (EPR) has been found in approximately 5%–11% of a neurologically normal population. The study was done by Loo SF et al. [10] stated that it was easily eligible, with 91.5% having 2 positive Chaddock responses and 89.4% of them had least two positive Babinski responses (P < 0.001). Moreover, they also found that the pathological EPR was quicker to detect on stimulation, in which 89.1% were able to draw out when the stimulation reached mid-lateral sole (P < 0.001). Around 94% of pathological cases had persistent great toe extension throughout the process (controls, P < 0.001). The recorded plantar responses with spinal lesions with Babinski's is extensor response (94.7% vs. 71.4%, P< 0.05), Chaddock's (89.5% vs. 64.3%, P<0.05), and Schaef's (26.3% vs.3.6%, P<0.05) and less likely with dorsiflexion. The researchers concluded that the plantar reflex pathological extensor is more replicable, easy to detect, and extended compared to the physiology of the extensor reaction.

The study conducted by Kumhar GD et al [11] on 1281 term babies without any neurological

disease exemplifies the plantar response at various stages of an infant's life. The plantar response can be classified by the thumbnail drag method as a flexor, extender, and equivocal. in between right and left foot percentage of extensor, flexor, and equivocal responses was recorded and compared with the age categories.

Their study observed that the plantar is extensor mostly in less than 6 months of age.

They also observed that the bilateral extensor reaction was 79.4%, 67.8%, 32.5%, and 31.1% for the four age groups; the bilateral flexor reaction of 0.3%, 5.1%, 26.6%, and 39.3% respectively for the respective age categories. Asymmetrical response in ceratin age group 20.7 percent, 25.3 percent, 40.3 percent, and 28.7 percent. Lastly, the author noted that normal plantar reactions are predominantly extensive during early childhood and the transition to bending begins at 6 months of age.

The important sign to detect corticospinal tract function/lesion is by Babinski sign. However, it has been correlated with low interobserver agreement rates due to differences in testing and interpretation. Appasamy PT et al. [12] also referred to the diagnostic importance of finger and foot tappings for CST lesions. Appasamy PT et al. Three participant classes have been recruited. Group 1 was diagnosed in people with CST lesions from both clinical and neuroimaging exams; group 2 was a non-CST neurological disease, and group 3 was natural. It revealed a total Babinski sensitivity of 49.6%, and specificities of 85.8%, while a total finger and foot sensitivity of 79.5 % and specificities were 85.8 % reported.

Also, the interobserver agreement between medical students and neurologists was greater as compared to the Babinski sign (Kappa = 0.45) for finger and foot-tapping (Kappa = 0.83). Finally, they concluded that a successful and effective clinical trial of corticospinal lesions is finger and foot tapping. Furthermore, the reliability and validity of the sign of Babinski are less than the finger and foot tap test for diagnosing the manifestations of corticospinal lesions.

The study done by Rui Araújo et al. [13] on the utility of the plantar reflex. The various methods of plantar reflex were analyzed about intraobserver agreement; sensitivity; positive predictive value (PPV); and observational bias

were studied. They reported that for all paired reflexes the intraobserver and interobserver agreements were poor. The observer's bias was not shown. For the Babinski, sensitivity rose to 59.7%, for the Chaddock to 55.3%, and the Oppenheim to 30%. For the Babinski, PPV was 70.3%, for the Chaddock 66.5%, and the Oppenheim 61.3%. They found that the observation agreement on the plantar reflection was consistently poor.

A number of studies on neonatal health and their neurodevelopmental aspects were reported [14-17]. Few of the related studies were reviewed [18-20].

5.1 Implications

- Plantar reflex is a reliable, sensitive approach for assessing the functionality of the nervous systems and lower extremity motor pathways.
- Interpretation of the plantar response is the most crucial step in predicting whether the response is pathological or not.
- Assessment of the Planter Reflex is important in the routine examination of newborn infants when considering, neonatal developmental or neurological problems.

6. CONCLUSION

The study will probably give us information about the sensitivity and specificity of the Oppenheim sign, Gordon sign, Gonda's sign, Chaddock sign, and Schaefer sign for the elicitation of the plantar reflex in the neonates.

CONSENT AND ETHICAL APPROVAL

Due permission of the ethics committee of the institute will be taken before starting the study. As per international standard or university standard, patients' written consent will be taken by the author(s).

COMPETING INTERESTS

Authors have declared that no competing interests exist.

REFERENCES

1. Chew KS, Onn LL, Lee RA, Lim KS, Tan CT. Withdrawal response in healthy adults. Neurol Asia. 2010;15(2):159-65.
2. Khwaja AG. Plantar reflex. JIACM. 2005;6(3):193-7.
3. Dohrmann GJ, Nowack WJ. The upgoing great toe: Optimal method of elicitation. Lancet. 1973;1:339–41.
4. Van Gijn J. The babinski reflex. Postgrad Med J. 1995;71:645-648.
5. Chaddock C. The external malleolar sign. Interstate Med J. 1911;18:1026–1038.
6. Oppenheim H. Zur pathologie der hautreflexe an den unteren extremitäten. Mschr Psychiatr Neurol. 1902;12:518–530.
7. Hogan GR, Milligan JE. The plantar reflex of the newborn. N Engl J Med. 1971;285:502-3.
8. Campbell WW. Pathologic reflexes. In: Campbell WW. DeJong's The Neurologic Examination, 7th ed. Philadelphia, PA: Wolters Kluwer Health/Lippincott, Williams and Wilkins. 2013:583–597.
9. Singerman J, Lee L. Consistency of the Babinski reflex and its variants. Eur J Neurol. 2008;15:960–964.
10. Loo SF, Justin NK, Lee RA, Hew YC, Lim KS, Tan CT. Differentiating extensor plantar response in pathological and normal population.Ann Indian Acad Neurol. 2018;21:144-149.
11. Kumhar GD, Dua T, Gupta P. Plantar response in infancy. Eur J Paediatr Neurol. 2002;6(6):321-5.
12. Appasamy PT, Dan TA, Bandyopadhyay V, Mathew V, Jeyaseelan V, Babu S, Aaron S, Alexander M. Accuracy and reliability of Babinski sign versus finger and foot tapping in the diagnosis of corticospinal tract lesions. Neurol India. 2018;66:1377-1380.
13. Araújo R, Firmino-Machado J, Correia P, et al. The plantar reflex: A study of observer agreement, sensitivity, and observer bias. Neurology. Clinical Practice. 2015;5(4):309-316.
14. Patel, Archana B, Kunal Kurhe, Amber Prakash, Savita Bhargav, Suchita Parepalli, et al. Early identification of preterm neonates at birth with a tablet app for the simplified gestational age score (T-SGAS) when ultrasound gestational age dating is unavailable: a validation study. PLOS ONE. 2020;15(8). Available:https://doi.org/10.1371/journal.po ne.0238315
15. Mudey DA, Khapre DM, Mudey DG, Goyal DR. An innovative approach of mobile e-health intervention in tracking antenatal mothers & neonates in selected rural areas

of a district in central India: An ice breaking footstep for revolution. International Journal of Epidemiology. 2015;44(1):95–96.

16. Chaturvedi Anuj, Amrutha Garikapati, Charan Singh Bagga, Abhishek Chande, Sunil Kumar. Temporal lobe epilepsy: A rare post chicken pox neurological sequel. Medical Science. 2020;24(103):1596–99.

17. Agarwal Amit, Anand Kakani, Sanjot Ninave. Acute hypodense hemorrhage in an organized chronic subdural hematoma causing sudden neurological deterioration in a severely anemic patient. Indian Journal of Neurotrauma. 201;7(2):173–75. Available:https://doi.org/10.1016/S0973-0508(10)80036-X

18. Taksande Amar, Rewat Meshram. New guidance is needed on diagnosing microcephaly in severely malnourished children. Acta Paediatrica. 2015;104(11):E477. Available:https://doi.org/10.1111/apa.13140

19. Patil Manoj, Shital Telrandhe, Mahlaqua Nazli Khatib, Shilpa Gaidhane, Deepak Saxena, Somen Saha, Pankaj, et al. Improvements in developmental outcomes of an 18-month-old child from rural wardha - A case study. Medical Science. 2020;24(103): 1302–6.

20. Khanam N, Zahiruddin Quazi Syed RC, Goyal A. Athavale V, Gaidhane AM, Agarwal SS, Gaiki V. Prospective study on quality of newborn care. Indian Journal of Community Health. 2013;25(4):432–37.