Comparison of Amplitude and Area Decrement in Repetitive Nerve Stimulation

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Objective: *To access the percentage of the patients whose repetitive nerve stimulation (RNS) studies were negative for 10% amplitude decrement but positive for 10% area decrement and to compare these disagreed results with specialist physician's diagnosis.*
Study Design: *Retrospective descriptive study.*
Setting: *Electrodiagnosis laboratory, Department of Rehabilitation Medicine, King Chulalongkorn Memorial Hospital.*
Material and Method: *All of the electromyography (EMG) reports of RNS studies were reviewed. Both 10% amplitude and area decrement were used as criteria for diagnosis in each patient. The disagreed results would be compared to final diagnosis of the specialist physicians that were recorded in out-patient medical records.*
Results: *Eighty-three reports were included in the present study. Nineteen records (22.9%) were negative for 10% amplitude decrement but positive for 10% area decrement. Three records (3.6%) were positive for 10% amplitude decrement but negative for 10% area decrement. Twenty-two patients had disagreed results. Sixteen disagreed out-patient medical records (72.7%) were available for review the final specialist doctors' diagnosis. About 69% of patients, whose test was negative for 10% amplitude decrement but positive for 10% area decrement, were diagnosed as myasthenia gravis (MG) or suspected MG. All of the patients, whose test was negative for 10% area decrement but positive for 10% amplitude decrement, were diagnosed as MG. The use of both 10% amplitude and area decrement instead of 10% amplitude decrement alone will provide additional diagnostic yields in about 13% of the cases.*
Conclusion: *Twenty-three percent of patients had disagreed RNS results that were negative for 10% amplitude decrement but positive for 10% area decrement. When these disagreed results were compared to the final diagnosis of specialist doctors, 69% of these patients were diagnosed or suspected and treated as MG. Using both 10% amplitude and area decrement may improve sensitivity of MG diagnosis in about 13% of the cases.*

Keywords: *Repetitive nerve stimulation, Amplitude decrement, Area decrement*

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Repetitive nerve stimulation (RNS) is a simple, rapid, and widely utilized test for the evaluation of neuromuscular junction disorder [1]. RNS studies are positive in about 75% of patients with generalized myasthenia gravis (MG) and approximately 50% of patients with ocular MG [2,3]. Most RNS studies compare amplitude decrements between the first and fourth or fifth compound muscle action potential (CMAP) as a measure of abnormality. Lo, et al[4] reported that decrement of response area provided additional diagnostic yields of 5.3 to 30%, and recommended as a diagnostic adjunct, to measurement of amplitude decrement during RNS. Asahi, et al[5] analyzed the change of CMAP amplitude and CMAP area of RNS at different stimulated frequencies and reported that the measurement of CMAP area produces less ambiguous results than amplitude measurement in RNS studies. In the past, CMAP area could not be accurately analyzed. Technological developments now allow automatic and precise measurement of CMAP area. The electromyography (EMG) laboratory at Department of

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Rehabilitation Medicine, King Chulalongkorn Memorial Hospital had electrodiagnosis studies in service for more than two decades. The author[6] reported the 72% of RNS's results in generalized MG and 24% of RNS's results in ocular MG, agreed with the final clinician's diagnosis. All of these were diagnosed by using 10% amplitude decrement to be a criterion. Even though a modern EMG monitoring system that automatically measures area decrement was used in many labs, an analysis of area decrement in RNS studies has not been well documented. The objectives of the present study were to access the percentage of the patients whose RNS studies were negative for 10% amplitude decrement but positive for 10% area decrement and to compare these disagreed results with specialist physician's diagnosis.

Material and Method

All of the electrodiagnosis reports at EMG laboratory, Department of Rehabilitation Medicine, King Chulalongkorn Memorial Hospital were reviewed. The reports of patients who were investigated with RNS studies by using the modern EMG monitoring systems: Medelec™ Synergy T2, were included in the present study. The included reports were carefully reviewed the data of amplitude decrement and area decrement by using 10% decrement (compare 1 to 4 response) to be a cut-point. The records the results of which did not agree in diagnosis of abnormality, its out-patient medical records would be reviewed to explore the final diagnosis of specialist physicians.

The guidelines of performing RNS studies at EMG laboratory, Department of Rehabilitation Medicine, King Chulalongkorn Memorial Hospital are as follows:

1. The patients who were receiving anticholinesterase medication (edrophonium or prostigmine), the medication was withdrawn for 12 hours before the examination.

2. Choose the proper tested muscle and nerve. A surface-active electrode was placed to the muscle's motor point while a reference electrode was located over the distal tendinous region.

3. Establish supramaximal CMAPs.

4. Warm the tested muscle for about 5 minutes.

5. Stimulate nerve at 3 Hz for 10 responses. The percentage decrement is calculated by comparing the forth response with the first response.

6. Exercise protocol, the patient was asked to maximally exercise the muscle for 30 seconds. A train of stimuli is performed immediately after exercise.

7. Repeat stimulation at 2 and 4 minutes after exercise to detect post-exercise exhaustion.

The SPSS statistic program version 13.0 was used to analyze the data. The qualitative and quantitative data were presented in mean and SD, number and percent.

Results

Eighty-three records from January 2005 to October 2007 were included into the present study. All of the records were operated by a team of doctors who were training in the residency program of rehabilitation medicine and supervised by their doctor staff. The demographic data: age, sex, and type of MG are shown in Table 1. Nasalis, orbicularis occuli and abductor digiti minimi were the most selected muscles for doing the RNS studies, respectively. No significant difference between a number of left and right side muscles that were investigated (Table 1).

Sixty-one records (73.4%) were agreed and twenty-two records (26.6%) were disagreed in the results (Table 2). Nineteen records (22.9%) were negative for amplitude decrement but positive for area decrement. Three records (3.6%) were positive for amplitude decrement but negative for area decrement. In twenty-two records with disagreed results, fifteen (68.2%) were suspected of ocular MG and seven (31.8%) were suspected of generalized MG..

Table 1. Demographic, clinical and laboratory testing data of the included records

Characteristics	
Number of patients	83
Mean age (yr) (range)	55.2 ± 15.04 (12-77)
Sex: Male/Female (n)	32 / 51
Type: Ocular MG (n) (%)	50 (60.2)
Generalized MG (n) (%)	33 (39.8)
Tested muscles:	
Rt. Nasalis/Lt. Nasalis (n) (%)	58 (69.9)/ 57 (68.7)
Rt. Orb. Occuli/Lt. Orb. Occuli (n) (%)	11 (13.3)/ 12 (14.5)
Rt. ADM/Lt. ADM (n) (%)	3 (3.6)/ 4 (4.8)
Rt. Trapezius/Lt. Trapezius (n) (%)	4 (4.8)/ 2 (2.4)
Rt. Anconeus/Lt. Anconeus (n) (%)	3 (3.6)/ 0

Table 2. Comparison of RNS's results between using 10% decrement of amplitude and area to be criteria (n = 83)

	10% area decrement		
10% amplitude decrement	Positive (n) (%)	Negative (n) (%)	Total (n) (%)
Positive (n) (%)	28 (33.7)	3 (3.6)	31 (37.3)
Negative (n) (%)	19 (22.9)	33 (39.7)	52 (62.6)
Total (n) (%)	47 (56.6)	36 (43.3)	83 (100)

Table 3. The final diagnosis of specialist doctors in disagreed RNS's results (n = 16)

Diagnosis	Amp - / Area +	Amp + / Area -	Total
MG (n) (%)	7 (43.75%)	2 (12.5%)	9 (56.3%)
Suspected MG (n) (%)	4 (25.00%)	0	4 (25.0%)
Not MG (n) (%)	3 (18.75%)	0	3 (18.7%)
Total (n) (%)	14 (87.50%)	2 (12.5%)	16 (100%)

All of the twenty-two patients who had disagreed results were followed by the out-patient medical records. Sixteen out-patient medical records (72.7%) were available for the final specialist doctors' diagnosis. Nine patients (56.3%) had obvious clinical symptoms and responded with medication for myasthenia gravis disorder. Four patients (25%) were diagnosis as suspected MG and given the medication for therapeutic diagnosis. Three patients (18.7%) had no definite diagnosis or treatment (Table3). About 69% of patients, who had a negative result of 10% amplitude decrement but a positive result of 10% area decrement, were diagnosed as MG or suspected MG. All of the patients (100%), who had a negative result of 10% area decrement but a positive result of 10% amplitude decrement, were diagnosed as MG.

Discussion

In comparison with single-fiber EMG (SFEMG), the yield of abnormality with RNS was low, especially in the patient group with mild neuromuscular transmission defects [7-10]. SFEMG has the limitation about its technical difficulties and is not available in Thailand. RNS is a well-tolerated and noninvasive technique that is a widely utilized technique for the evaluation of neuromuscular transmission defect[11]. The use of the amplitude as a measure of decrement is a standard technique for RNS test in every EMG laboratory. Low sensitivity is the accepted limitation for RNS, especially in ocular MG[8]. The author's laboratory reported the sensitivity for diagnosis ocular MG about 24%[6] that was similar to several laboratories[12-13].

Nasalis and orbicularis oculi were the most performed muscles that could be explained by the more likely to exhibit abnormality of facial muscles[7,12]. About 23% of the reports were negative for amplitude decrement but positive for area decrement. When the out-patient medical records of these patients were reviewed, 69% of them were diagnosed as MG or suspected MG by the specialist doctors. Only 3% of the reports were negative for area decrement but positive for amplitude decrement. It looked like the area of decrement is more sensitive than amplitude decrement for the diagnosis of MG. Decrement of response provided additional diagnostic yields of about 13% in the present study.

The present results are similar to the report by Lo and et al[4] in 2002 that concluded that the use criteria of both area and amplitude decrement could add up diagnostic yields 5.3 to 30%. It also correlates with Ratnagopal's suggestion[14] that area decrement may be a helpful indicator of a neuromuscular junction defect at an earlier level.

In Thailand, SFEMG has not been used in any electrodiagnosis laboratory. If the diagnostic criteria of MG included both amplitude and area decrement, the sensitivity of RNS should be improved. A prospective study is recommended for the further study to prove this assumption.

Limitation of the present study was a lack of SFEMG for confirmation the results of RNS. Instead, the author used the final conclusion and management of the specialist physicians who mainly were ophthalmologists and neurologists. Furthermore, it was a retrospective study so some of the data could not be completely reviewed.

In conclusion, twenty-three percent of the patients had a negative result of 10% amplitude decrement and a positive result of 10% area decrement. Sixty-nine percent of these patients were diagnosed or suspected and treated as MG. Using both 10% area and amplitude decrement to be criteria of RNS studies may improve sensitivity for diagnosis MG about 13% of the cases.

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เปรียบเทียบผลของการลดลงระหว่าง amplitude และ area ของการตรวจด้วย repetitive nerve stimulation

จริยา บุญหงษ์

***วัตถุประสงค์**: เพื่อให้ได้มาซึ่งสัดส่วนเป็นร้อยละของผู้ป่วยซึ่งผลตรวจด้วย repetitive nerve stimulation (RNS) ให้ผลเป็นลบเมื่อใช้ค่าที่ลดลงเกิน 10 เปอร์เซ็นต์ของ amplitude แต่ให้ผลเป็นบวกเมื่อใช้ค่าที่ลดลงเกิน 10 เปอร์เซ็นต์ ของ amplitude และเปรียบเทียบผลที่ไม่ตรงกันนี้กับผลการวินิจฉัยสุดท้ายของแพทย์ผู้เชี่ยวชาญเฉพาะทาง*

***การออกแบบการศึกษา**: การศึกษาชนิดพรรณนา*

***สถานที่**: ห้องปฏิบัติการตรวจวินิจฉัยคลื่นไฟฟ้ากล้ามเนื้อ ฝ่ายวิชาเวชศาสตร์ฟื้นฟู โรงพยาบาลจุฬาลงกรณ์*

***วัสดุและวิธีการ**: ทบทวนกราฟคลื่นไฟฟ้าของกล้ามเนื้อและเส้นประสาทที่ได้รับการตรวจด้วย RNS ทุกบันทึก ใช้เกณฑ์การลดลงเกิน 10 เปอร์เซ็นต์ ของทั้ง amplitude และ area ในการวินิจฉัยผลของผู้ป่วยแต่ละราย บันทึกที่ให้ผลการวินิจฉัยไม่ตรงกันจะนำไปเปรียบเทียบกับการวินิจฉัยสุดท้ายของแพทย์ผู้เชี่ยวชาญเฉพาะทาง ซึ่งบันทึกไว้ในเวชระเบียนผู้ป่วยนอก*

***ผลการศึกษา**: บันทึกผลการตรวจคลื่นไฟฟ้าของกล้ามเนื้อและเส้นประสาทด้วย RNS จำนวน 83 บันทึกถูกนำมาศึกษา จำนวน 19 บันทึก (22.9%) ให้ผลลบต่อการใช้ค่าลดลงของ amplitude แต่ให้ผลบวกกับการใช้ค่าลดลงของ area มีเพียง 3 ราย (3.6%) ให้ผลบวกต่อการใช้ค่าลดลงของ amplitude แต่ให้ผลลบกับการใช้ค่าลดลงของ area ในจำนวนนี้สามารถสืบค้นเวชระเบียนผู้ป่วยนอกเพื่อสืบผลการวินิจฉัยสุดท้ายของแพทย์ผู้เชี่ยวชาญเฉพาะทางได้ 16 ราย (72.7%) พบว่าประมาณ 69 เปอร์เซ็นต์ ของผู้ป่วยที่ให้ผลลบต่อ amplitude แต่ให้ผลบวกต่อ area ได้รับการวินิจฉัยว่าเป็นหรือน่าจะเป็นโรค myasthenia gravis ส่วนผู้ป่วยทั้งหมดที่ให้ผลบวกต่อ amplitude แต่ให้ผลลบต่อ area ได้รับการวินิจฉัยว่าเป็นโรค myasthenia gravis พบว่าการใช้ค่าที่ลดลงเกิน10 เปอร์เซ็นต์ ของทั้ง amplitude และ area ในการวินิจฉัยจะเพิ่มความไวของการตรวจประมาณ 13 เปอร์เซ็นต์ เมื่อเปรียบเทียบกับการใช้ค่าที่ลดลงของ amplitude เพียงค่าเดียว*

***สรุป**: พบว่า 23 เปอร์เซ็นต์ของผู้ป่วยให้ผลลบต่อการลดลงเกิน 10 เปอร์เซ็นต์ของ amplitude แต่ให้ผลบวกต่อการลดลงเกิน10 เปอร์เซ็นต์ของ area เมื่อนำผลที่แตกต่างนี้เปรียบเทียบกับการวินิจฉัยสุดท้ายของแพทย์ผู้เชี่ยวชาญ จะพบว่าถ้าใช้ค่าที่ลดลงเกิน 10 เปอร์เซ็นต์ ของทั้ง amplitude และ area ในการวินิจฉัยจะเพิ่มความไวของการตรวจได้เพิ่มขึ้นประมาณ 13 เปอร์เซ็นต์*