Pressure Exerted In The Peroneal Nerve Depending On The Different Positions In The Intensive Care Unit Bed

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Citation

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Abstract

Peroneal paresis during the stay of patients in the Intensive Care Unit is a common phenomenon. It is due to their improper placement in bed which causes neuroapraxia of the common peroneal nerve. This can be anticipated by appropriate positioning of the patients in a way that their knees are overstepping the lower hinge of the bed. Of even greater value in order to tackle this complication is to stabilize the hips in the neutral position in the transverse plane.

INTRODUCTION

A great number of patients in the Intensive Care Unit (ICU) in Greece sustain peroneal paresis during their hospitalization. Approximately 10% of patients that stay in the ICU for a period longer than 4 weeks are expected to develop paresis of the peroneal nerve[1]. This is due to the pressure exerted on the nerve in the confined space between the bed matrix and the overlying body [2]. This pressure is augmented when the popliteal angle is larger [3]. Moreover the torsion of the lower limb seems to have an additional effect in this nerve injury[4]. We investigate the effect of different positions of the lower limb in the pathogenesis of this phenomenon [5]. To our knowledge there hasn't been conducted a similar trial until today.

The aim of this study is to demonstrate the importance of the correct patient positioning in bed for avoidance of neuroapraxia of the common peroneal nerve.

MATERIAL AND METHODS

STUDY DESIGN

The present study may be considered a clinical pilot study.

A pressure manometer and an air-chamber of 2 cm^3 (photo 1) were used in this study. The air-chamber was stabilized over the head of the fibula, and was filled with air up to a pressure of 30 mmH_2O (photo 2). The pressure was calculated according to the formula, $\Delta p = p - 30$ mmH_2O, where p equals the manometer reading, and Δp the actual pressure exerted on the fibula's head.

The sample of n= 35 patients (15 women-20 men), ICU patients of "Attikon" University Hospital in Athens, Greece. Their age was between 58- 78 years and age was not considered to be an inclusion criterion.

Neither their hospitalization in the ICU was considered to be an inclusion criterion, which ranged between 2 to 30 days.

Regarding patients' height, the patients included were between 1.60m to 1.80m. Shorter or taller patients were excluded due to anatomical difficulties in their accurate positioning regarding the different bed parts.

Finally, another important criterion for admittance to the study was the patient's level of consciousness. All included patients must be semiconscious so that they wouldn't react with their positioning.

The population that matched the inclusion criteria, was divided in three groups according to whether the knee joint was found above the lower hinge of the bed (group , n= 11), or if it overstepped the lower hinge of the bed (group B, n= 12), while their hips were in a relaxed position, i.e. in external rotation. In the third group (group C, n= 12), were the patients that had their hips stabilized in the neutral position in the transverse plane, regardless of the position of the knee in relation to the lower hinge.

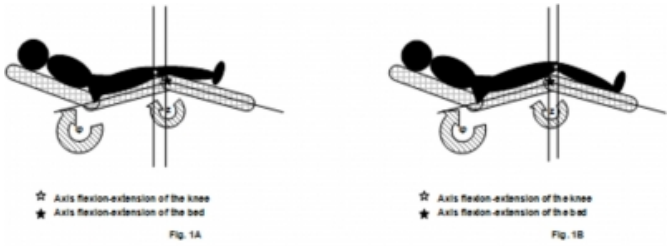
Their randomization was based upon their ICU bed number.

In every even number ICU bed, the patient was placed in A group. In every odd number, the patient was in B group.

All patients were placed in a recumbent position with the back of the bed stabilized at an inclination of 30° (angle), a commonly used position in the ICU, while the lower extremities changed position as the angle of the lower hinge, that was situated underneath the knee joint, changed from 0° to 35 ° (angle z), at a rate of 5 °. (Pictures 1A, B)

Figure 1

Figures 1A, B



Figures 1A, B

STATISTICAL ANALYSIS

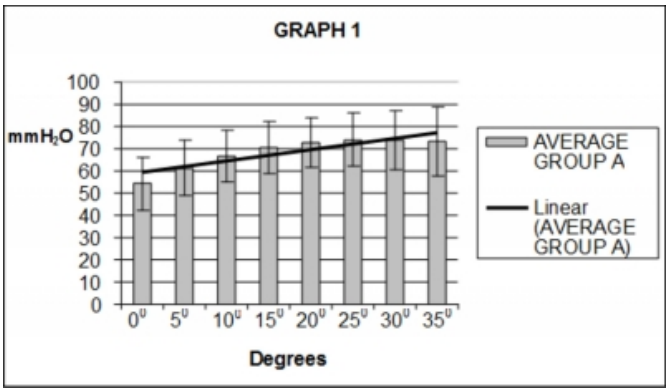
One-way analysis of variance (ANOVA) was used to determine whether the eight subgroups differed. Each subgroup consisted of the values of pressures in the specific angle. If there were any statistically significant differences or trends indicated by the ANOVA analysis, post hoc tests were carried out between individual subgroups with a Bonferroni correction to minimize Type I error due to multiple testing. Daniels XL toolbox version 2.72, for windows was used for the statistical analysis, and a probably value of less then 0.01 was considered statistically significant.

Moreover, in order to test the normality of distributions, we applied non parametric test, i.e. Kolmogorov-Smirnov test, with SPSS Statistics 17.0.1. We found that all subgroups were normal. The D-value in this test was less than 0, 01. according to the critical values table.

RESULTS

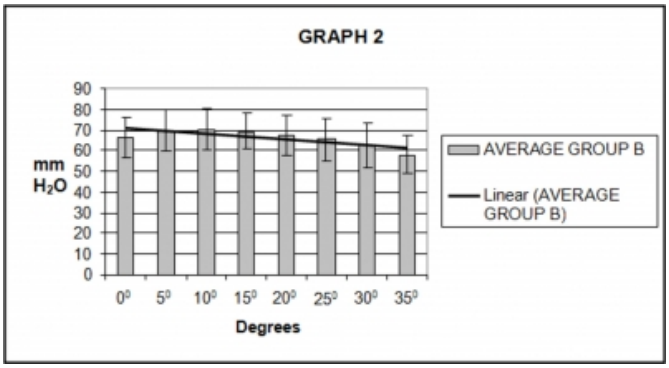
In all patients pressure readings changed during different angulations of the knee joint. In group A, while the angle of the knee increased, the pressure readings rose. The correlation between the raise of pressure exerted on the peroneal nerve and the increment of the angle of the lower bed hinge was analyzed. It showed that for $_1$= 11 (= group's population) and for 8 different positions, the p-value was significant (p= 0.0019). The standard deviation was calculated in the following diagram, and the trend was added (Graph 1).

Figure 2



On the other hand in group B, the increment of the angle of the lower bed hinge, resulted in a slight reduction of pressure exerted on the peroneal nerve, (Graph 2), without being statistically significant (p= 0.154), (ANOVA group B). This means that in this study group, no correlation can be made between the two variants that were examined. Nevertheless, the trend showed a slight fall of pressure as the angle increased.

Figure 3



By the analysis between the two groups, a new p value equal to 0.008 was found. This statistically proved that groups A and B were heterogenic.

Finally, when the hips were stabilized in the neutral position in the transverse plane the pressure readings in the pressure manometer was found to be 30 mm H_2O. By using the formula, p= (p- 30) mm H_2O, the result was zero. This meant that there was no pressure exerted on fibula's head.

DISCUSSION

The correct positioning of the patient in the bed is essential for the whole period of his/her hospitalization, especially for

the patients who are not in an alert state of consciousness. In a previous study conducted at our department, Improvement of the patient's ventilation by correcting the slid recumbent position in the ICU[6], the importance of having the patient properly aligned in bed for his optimal aeration was pointed out. A new study coming from the same center reveals the importance of the correct position of the lower extremities as well. A 1st announcement was preformed during the ongoing trial under the title, Pressure exerted in the peroneal nerve pending on the different positions in the ICU bed [7] , which was presented as a written presentation at the 17th Physical and Rehabilitation Medicine (PRM) European Congress. This stated the following conclusions, which were relevant to the completion of the present trial. Paresis of the peroneal nerve, a common phenomenon in the ICU, is caused by the external pressure application from the bed's matrix against the peroneal nerve at the confined area, where the nerve passes over the head of fibula causing neuroapraxia of the common peroneal nerve. Placing the patient in bed so that the knee joint will be below the lower hinge of the bed, lowers effectively the pressure. This may be the simplest yet most effective way to protect the nerve from this kind of injury.

As already mentioned in the material and method section, this is a pilot clinical study which demonstrates the significance of the correct positioning of the lower extremities in the ICU. Due to the small number of patients included in this trial (ie 35) the results need to be proven on a large-scale review which will determine the balance of benefits of repositioning and will draw a firm conclusion.

Finally, when patient's hips were stabilized in the neutral position in the transverse plane, there was no pressure increment in any angulation of the knee. This is the most important result of the study. To the best knowledge of the authors, the extremely important issue of hip rotation in the proper positioning of patients in the ICU, is discussed for the first time in the lterature.

CONCLUSIONS

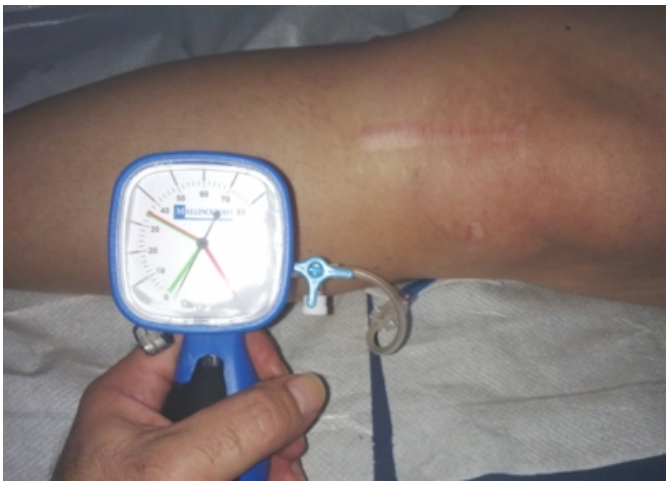
It is extremely crucial for the ICU patient that the positioning of the knees is slightly below the lower hinge of the bed to avoid injury of the peroneal nerve. Of even greater importance is the maintenance of the hips in the neutral position in the transverse plane.

Figure 4

Fig 4. The device used in the trial

Figure 5

Fig 5. Application of the device



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