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Original Article

Intramuscular Pressure following Compartment of Limbs by Electric Measuring Instrument of Tissue Pressure

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ABSTRACT

Background and Aim: Muscular compartment syndrome that is surgical disease at high risk of morbidity and disability causes intra-compartment bleeding as injury of muscle tissue with fracture and luxation in limbs. Increasing pressure of compartment makes small veins exhausted and migration of humor difficult in that compartment, finally it causes arterial ischemic block of blood circulation and muscular necrosis by increasing tissue pressure that is just opposite of systolic pressure. That is why it is really important to diagnose and treat this disease earlier than irreversible ischemic changes, so we can reduce permanent disability. **Methods:** We used electric measuring instrument of tissue pressure and obtained some basic results to diagnose those disease that causes increasing disability earlier by measuring intramuscular pressure following compartment in healthy people and patients with closed fracture in their limbs. **Results and Conclusion:** The difference between every muscles following compartment, sex, age in healthy people was not statistically significant and difference between sports men and officers or workers reached statistical significance. Intramuscular pressure in fracture region of patients with closed fracture in limbs was statistically significant than normal region of them.

Key words: Tissue pressure, Intramuscular pressure, Closed fracture, Limbs.

INTRODUCTION

It is very important to measure the intramuscular pressure in patients with limb diseases, so we can select the right treatment method. There are some different kinds of measuring instruments that includes Stryker's pressure monitoring system, ductus arteriosus tonometer, Whitesides and so on. Every instrument has a straight needle, another needle that has a hole on their side and slit catheter. Stryker instrument has high accuracy.[1] Fracture is a common factor that causes acute muscular compartment syndrome (almost 75%) and tibia fracture is the most frequent disease that is related to this syndrome.[2,3]

Some researchers reported that normal compartmental pressure in steady state was less than 10mmHg and if a patient have 30~40mmHg achieved, they should incise the fascia to reduce the intramuscular pressure.[4] An investigator found that normal pressure in some muscular compartment was 10mmHg to 12mmHg[5,6] and other investigator reported 0mmHg to 8mmHg.[7,8] A researcher measured the intramuscular pressure was 5mmHg in normal antebrachium[9] and some others measured normal compartmental pressure was 0 mmHg to 10 mmHg in legs of adults.[10-15]

Absolute limit of compartmental pressure is not still clearly found and it is only given that the extent is 30 mmHg to 50 mmHg in some references.[5,16-18] Acute muscular compartment syndrome is one of the urgent diseases that need surgical operation.[10] Most of researchers reported that the risk of muscular compartment syndrome was highest when the difference between diastolic pressure and compartmental pressure was lower than 30mmHg, so they needed to reduce the pressure as quickly as possible.[20] We studied to compare and analyze advantages and disadvantages of prior results and manufactured the more correct and useful electric measuring instrument of tissue pressure and clarified its clinical effects and signification.

MATERIALS AND METHODS

In our study, we studied 60 subjects in good health [male=35 (58.3%), female=25 (41.7%)] and 20 patients [male=12 (60.0%), female=8 (40.0%)] with closed fracture in limbs. Among healthy people, 16 (26.7%) people who is older than 19 years old is the most, 6 (10.0%) people who is older than 50 years old is the least. Following age in healthy people, they are 16 (26.7%) people (older than 19 years old) and 6 (10.0%) people (older than 50 years old). In patients with closed fracture in limbs, 7 (35.0%) were between 20 and 29 years old and 2 (10.0%) were between 40 and 49 years old. And also 9 people who have closed fracture in limbs and the most.

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We divided brachium and forearm, femor and crus into several sections following fasicae and their sections. They are anterior and posterior section in brachium and forearm, anterior, posterior and outside section in femor, anterior and lateral, posterior surface and posterior depth section in crus. We determined intramuscular pressure in all sections and compared intramuscular pressure with normal and abnormal side in same section of patients with closed fracture in limbs.

RESULTS AND DISCUSSION

Table 1 showed the intramuscular pressure in humeral anterior section was 4.82±0.55 mmHg and in posterior section was 4.90±0.57 mmHg; finally difference between 2 sections did not reach statistical significance. The intramuscular pressure in antebrachial anterior section was 5.31±0.58 mmHg and in posterior section was 5.33±0.61 mmHg; finally difference between 2 sections did not reach statistical significance (Table 2). Table 3 showed the intramuscular pressure in femoral anterior section was 5.83±0.60 mmHg, in posterior section was 5.80±0.60 mmHg and in lateral section was 6.01±0.61 mmHg; finally differences between 3 sections did not reach statistical significance.

The intramuscular pressure in crus anterior section was 6.03±0.64 mmHg, in lateral section was 6.15±0.59 mmHg, in posterior deep section was 6.22±0.77 mmHg and in posterior superficial section was 6.28±0.58 mmHg and were not statistically significant (Table 4). The humeral intramuscular pressure in officers was 4.60±0.43 mmHg, in workers was 4.67±0.49 mmHg, in sportsmen was 5.26±0.53 mmHg and humeral intramuscular pressure in officers was 5.01±0.61mmHg, in workers was 5.26±0.44 mmHg, in sportsmen was 5.82±0.47mmHg, which were statistically significant. (P<0.05) (Table 5). The difference between intramuscular pressure of femur and crus in officers and workers did not reach statistical significance, and difference between sportsmen and officers or workers reached statistical significance (Table 6).

The intramuscular pressure in normal side in patients with brachial fracture was 4.54±0.47 mmHg and in fracture side was 14.32±0.69 mmHg, and the difference was statistically significant (P<0.05) (Table 7). Table 8 showed the intramuscular pressure in normal side in patients with antebrachial fracture was 5.08±0.65 mmHg and in fracture side was 16.26± 0.75mmHg, and the difference was statistically significant (P<0.05). Table 9 showed the intramuscular pressure in normal side in patients with femoral fracture was 18.25±0.59 mmHg and in fracture side was 5.69±0.48mmHg, and the difference was statistically significant (P<0.05). Table 10 showed the intramuscular pressure in normal side in patients with femoral fracture was 21.57±0.66mmHg and in fracture side was 5.69±0.48mmHg, and the difference was statistically significant (P<0.05).

Intramuscular pressure of limbs in healthy people did not reach statistical significance according to divided sections. But we think that region of measurement may be changed following measuring instrument. In our study, intramuscular pressure of arm was 4-6 mmHg and intramuscular pressure of leg was 5.5-7mmHg. These results were in concordance with results of previous studies. Intramuscular pressure in fracture region of patients with closed fracture in limbs was statistically significant than normal region of them. Limits of intramuscular pressure that can develop compartment syndrome have need of study.

Table 1: Intramuscular pressure in brachium.

Section	Cases (n)	Pressure (mmHg)
Anterior section	10	4.82±0.55
Posterior section	10	4.90±0.57

Values are expressed as mean±SE.

Table 2: Intramuscular pressure in forearm.

Section	Cases (n)	Pressure (mmHg)
Anterior section	10	5.31±0.58
Posterior section	10	5.33±0.61

Values are expressed as mean±SE.

Table 3: Intramuscular pressure in femor.

Section	Cases (n)	Pressure (mmHg)
Anterior section	10	5.83±0.60
Posterior section	10	5.80±0.57
Lateral section	10	6.01±0.61

Values are expressed as mean±SE.

Table 4: Intramuscular pressure in crus.

Section	Cases (n)	Pressure (mmHg)
Anterior section	10	6.03±0.64
lateral section	10	6.15±0.59
Posterior depth section	10	6.22±0.77
Posterior surface section	10	6.28±0.58

Values are expressed as mean±SE.

Table 5: Intramuscular pressure in arms following jobs.

Section	Cases (n)	Brachium	Forearm
Officer	23	4.60±0.43	5.01±0.61
worker	19	4.67±0.49	5.26±0.44
Sports	18	5.26±0.53*	5.82±0.47

Values are expressed as mean±SE. P<0.05 considered as statistically significant.
* indicates P<0.05

Table 6: Intramuscular pressure following job in legs.

Section	Cases (n)	Femur	Crus
Officer	23	5.54±0.38	6.00±0.56
Worker	19	5.60±0.43	6.02±0.55
Sports	18	6.44±0.54*	6.55±0.48

Values are expressed as mean±SE. P<0.05 considered as statistically significant.
* indicates P<0.05

Table 7: Intramuscular pressure in the patients with brachial fracture.

Section	Cases (n)	Intramuscular pressure (mmHg)
Normal side	3	4.54±0.47
Fracture side	3	14.32±0.69

Values are expressed as mean±SE.

Table 8: Intramuscular pressure in patients with antebrachial fracture.

Section	Cases (n)	Intramuscular pressure (mmHg)
Normal side	5	5.08±0.65
Fracture side	5	16.26±0.75

Values are expressed as mean±SE.

Table 9: Intramuscular pressure in patients with femoral fracture.

Section	Cases (n)	Intramuscular pressure (mmHg)
Normal side	3	5.69±0.48
Fracture side	3	18.25±0.59

Values are expressed as mean±SE.

Table 10: Intramuscular pressure in patients with crus fracture.

Section	Cases (n)	Intramuscular pressure (mmHg)
Normal side	9	6.38±0.69
Fracture side	9	21.57±0.66

Values are expressed as mean±SE.

CONCLUSION

We manufactured the electric measuring instrument of tissue pressure and confirmed intramuscular pressure in healthy people following compartment and its change in patients with closed fracture in limbs by using it. The difference between every muscles following compartment, sex, age in healthy people was not statistically significant and difference between sports men and officers or workers reached statistical significance. Intramuscular pressure in fracture region of patients with closed fracture in limbs was statistically significant than normal region of them.

CONFLICT OF INTEREST

The authors declare that they have no conflict of interest.

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