

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

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ABSTRACT

Background: Muscular compartment syndrome that is a 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 a 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. We used an 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. 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 significantly higher than a normal region of them.

Keywords: Measuring Instrument of Tissue pressure, Intramuscular pressure, Closed Fracture.

Article Information

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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.[2] 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.[6, 14] Some

researchers reported that normal compartmental pressure in steady state was less than 10mmHg, and if a patient has 30~40mmHg achieved, they should incise the fascia to reduce the intramuscular pressure.[16] An investigator found that normal pressure in some muscular compartment was 10 mmHg to 12 mmHg [13,20], and other investigator reported 0mmHg to 8 mmHg.[3, 19]·

A researcher measured the intramuscular pressure was 5 mmHg in normal antebrachium[17], and some others measured normal compartmental pressure was 0 mmHg to 10 mmHg in legs of adults. [4, 5, 8, 9, 15, 18]

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.[1, 11, 12, 13] Acute muscular compartment syndrome is one of the urgent diseases that needs 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 30 mmHg, so they needed to reduce the pressure as quickly as possible.[7]

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.

OBJECT AND METHOD

In our study, We studied on 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. In 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, they are 7(35.0%) people (older than 20, less than 29) and 2(10.0%) people (older than 40, less than 49). And also they are 9 people who have closed fracture in limbs, and the most.

We divided brachium and forearm, femor and crus into several sections following fasciae 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

Measurement of intramuscular pressure of limbs in healthy subjects.

1) Intramuscular pressure in particular sections.

Table 1. Intramuscular pressure in brachium(M±SE).

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

As you can see at Table 1, the intramuscular pressure in humeral anterior section is 4.82±0.55mmHg and in posterior section is 4.90±0.57mmHg, finally difference between 2 sections did not reach statistical significance.

Table 2. Intramuscular pressure in forearm (M±SE).

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

As you can see at Table 2, the intramuscular pressure in antebrachial anterior section is 5.31±0.58mmHg and in posterior section is 5.33±0.61mmHg, finally difference between 2 sections did not reach statistical significance.

Table 3. Intramuscular pressure in femor (M±SE).

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

As you can see at Table 3, the intramuscular pressure in femoral anterior section is 5.83 ± 0.60 mmHg, in posterior section is 5.80 ± 0.60 mmHg and in lateral section is 6.01 ± 0.61 mmHg, finally differences between 3 sections did not reach statistical significance.

Table 4. Intramuscular pressure in crus (M±SE).

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

As you can see at Table 4, the intramuscular pressure in crus anterior section is 6.03 ± 0.64 mmHg, in lateral section is 6.15 ± 0.59 mmHg, in posterior deep section is 6.22 ± 0.77 mmHg and in posterior superficial section is 6.28 ± 0.58 mmHg, finally differences between 4 sections did not reach statistical significance.

2) Intramuscular pressure following sex, age and job.

Differences between intramuscular pressures of limbs in healthy subjects did not reach statistical significance following sex and age.

Table 5. Intramuscular pressure in arms following jobs (M±SE).

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	$5.26 \pm 0.53^*$	5.82 ± 0.47

As you can see at Table 5, the humeral intramuscular pressure in officers is 4.60 ± 0.43 mmHg, in workers is 4.67 ± 0.49 mmHg, in sportsmen is 5.26 ± 0.53 mmHg and humeral intramuscular pressure in officers is 5.01 ± 0.61 mmHg, in workers is 5.26 ± 0.44 mmHg, in sportsmen is 5.82 ± 0.47 mmHg, in result differences between sportsmen and officers or workers achieved statistical significance. ($p < 0.05$)

Table 6. Intramuscular pressure following job in legs (M±SE).

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	$6.44 \pm 0.54^*$	6.55 ± 0.48

As you can see at Table 6, 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.

Measurement of intramuscular pressure in patients with closed fracture of limbs.

1) Intramuscular pressure in patients with brachial fracture.

Table 7. Intramuscular pressure in the patients with brachial fracture (M±SE).

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

As you can see at Table 7, the intramuscular pressure in normal side in patients with brachial fracture is 4.54 ± 0.47 mmHg and in fracture side is 14.32 ± 0.69 mmHg, difference was statistically significant. ($P < 0.05$)

2) Intramuscular pressure in patients with antebrachial fracture.

Table 8. Intramuscular pressure in patients with antebrachial fracture (M±SE).

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

As you can see at Table 8, the intramuscular pressure in normal side in patients with antebrachial fracture is 5.08 ± 0.65 mmHg and in fracture side is 16.26 ± 0.75 mmHg, difference was statistically significant. ($P < 0.05$)

3) Intramuscular pressure in patients with femoral fracture.

Table 9. Intramuscular pressure in patients with femoral fracture(M±SE).

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

As you can see at Table 9, the intramuscular pressure in normal side in patients with femoral fracture is 18.25±0.59mmHg and in fracture side is 5.69±0.48mmHg, difference was statistically significant. ($P < 0.05$)

4) Intramuscular pressure in patients with crus fracture.

Table 10. Intramuscular pressure in patients with crus fracture(M±SE).

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

As you can see at Table 10, the intramuscular pressure in normal side in patients with femoral fracture is 21.57±0.66mmHg and in fracture side is 5.69±0.48mmHg, difference was statistically significant. ($P < 0.05$).

DISCUSSION

Intramuscular pressure of limbs in healthy people did not reach statistical significance according to divided sections. In other words, results of divided sections in limbs have not difference. But we think that region of measurement may be changed following measuring instrument.

In our results, intramuscular pressure of arm was 4~6mmHg and intramuscular pressure of leg was 5.5~7mmHg. These are similar to results of previous references.

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.

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 significantly than normal region of them.

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