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## Research Article

# Risk factors relating the surgical outcomes of lower leg traumatic compartment syndrome in Vietnam

## Summary

**Objective:** Risk factors relating the surgical outcomes of lower leg traumatic compartment syndrome in Vietnam.

**Patients and method:** We retrospectively studied 26 patients diagnosed with leg compartment syndrome who were operated at Saint Paul University Hospital from 2009 to 2013. Our study assessed relevant factors: the duration from injury time to operative time, symptoms of sensory loss, motion loss, vascular Doppler signal loss and increased CPK level. Other less relevant factors: pain, stiffness and swelling of leg, GOT/GPT, Urea/ Creatinine, white blood cell count.

**Results:** The more prolonged duration from injury time to operative time the more severe prognosis. Sensory loss, motion loss and vascular Doppler signal loss are major prognosed factors. The higher CPK level the severe prognosis, in particular with CPK level > 12000 U/L. Symptoms such as pain, stiffness and swelling of leg don't have prognostic significance. GOT/GPT, Urea/ Creatinine, white blood cell count are less significant in prognosis.

**Conclusion:** The factors have tight relationship with the surgical results of lower leg compartment syndrome is: clinical sign, Doppler signal and CPK level.

## Background

The acute compartment syndrome is caused by bleeding or edema in a closed muscle compartment surrounded by fascia and bone. It is characterized by increased intracompartmental pressure and decreased tissue perfusion. Well-known causative incidents are acute trauma and reperfusion after treatment for acute arterial obstruction. Most commonly the lower leg is involved. Inadequate therapy of the syndrome usually leads to muscle ischemia, rhabdomyolysis, and renal insufficiency. Perioperative morbidity and mortality are high [1]. Tissue injury is based on ischemia caused by hypoperfusion or deoxygenation. The acute compartment syndrome is one of the most dangerous complications of leg bone fracture. If the syndrome is not timely diagnosed and treated, it may not only result in muscle or nerve dysfunctions but also develop into more severe conditions like kidney failure, septicemia, amputation and even death [2]. There are many factors involved in the outcomes of lower limb compartment syndrome surgery including: time duration since trauma occurs till surgery is performed, severity of clinical and paraclinical symptoms and mixed lesions when opening galea, etc...

With the aim to facilitate the diagnosis and treatment of compartment syndrome, we conducted a study on this topic: Risk factors relating the surgical outcomes of lower leg traumatic compartment syndrome in Vietnam.

## Patients and Methods

The study is conducted on 26 patients who were diagnosed with acute lower limb compartment syndrome and treated at Saint Paul University Hospital from 2009 to 2013. Analysis was conducted on the relation between the severity of clinical and paraclinical symptoms with potential muscle necrosis during surgery to evaluate the connection between symptoms and outcomes of surgery. Accordingly, muscle lesions during surgery are categorized into two comparative groups: one is necrotic muscles which are grey, not bleeding nor responding to stimulation and the other one is non-necrotic muscles which are pinkish, still bleeding and responding to stimulation.

The data was processed by SPSS statistical software 20.0.

## Results

The difference is statistical with  $P < 0.05$ . Time duration since

trauma occurs until surgery is performed for necrotic muscles is longer than that for non-necrotic muscles (Table 1).

The difference between necrotic and non-necrotic muscles is not statistic for the above three symptoms ( $P > 0.05$ ) (Table 2).

In the group of necrotic muscles, 80% of patients lost sensation; meanwhile only 4.8% of patients in the group of non-necrotic muscles had the same symptom. Almost patients with sensation loss had lesions of necrotic muscles (Table 3).

The difference between two groups is statistic with  $P < 0.05$ . All patients who lost movement had lessions of necrotic muscles (Table 4).

60% of patients lost signal of pulse on Doppler in the group of necrotic muscles that was almost 6 times higher than that in the group of non-necrotic muscles with 10.5% (Table 5).

Average result of CPK in necrotic muscle group is 12581U/L, much higher than that in non-necrotic muscle group with 1707U/L (Table 6).

Mean GOT of necrotic muscle group is 187U/L, much higher than that of non-necrotic muscle group with 72 U/L. Average GPT of necrotic group is 54 U/L, higher than that of non-necrotic group with 39U/L. The difference is statistic with  $P < 0.05$  (Table 7).

Average values of Urea and Creatinine of the two groups are similar. The difference is not statistic with  $P > 0.05$  (Table 8).

100 % of patients of necrotic group and 95.2% of patients of non-necrotic group had strong increase of their leucocytes. The difference is not statistic with  $P > 0.05$  (Table 9).

## Discussion

It can be said that the average time duration since trauma occurs until surgery is performed of the necrotic muscle group

**Table 1:** Time duration since trauma occurs until surgery is performed.

Symptoms	Necrotic muscles	Non-necrotic muscles
Time duration since trauma occurs until surgery is performed	22.6 ± 8.0	10.2 ± 4.3

**Table 2:** Symptoms of pain and contracture of lower limb.

Symptoms	Necrotic muscles		Non-necrotic muscles	
	n	%	n	%
Severe pain in lower limb	5/5	100%	20/20	100%
Pain increases with passive movement	5/5	100%	15/15	100%
Contracture and oedema of lower limb	21/21	100%	5/5	100%

**Table 3:** Symptoms of Sensation.

Symptoms of sensation	Necrotic muscles		Non-necrotic muscles	
	n	%	n	%
Sensation disorder	1/5	20%	20/21	95.20%
Loss of sensation	4/5	80%	1/21	4.80%

**Table 4:** Symptom of movement

Symptom of movement	Necrotic muscles		Non-necrotic muscles	
	n	%	n	%
Normal or decreased	2	40%	21/21	100%
Loss of movement	3	60%	0/21	0%

**Table 5:** Result of pulse Doppler

Result of pulse Doppler	Necrotic muscles		Non-necrotic muscles	
	n	%	n	%
Normal or decreasing	2/5	40%	17/19	89.50%
Loss of signal	3/5	60%	2/19	10.50%

**Table 6:** CPK result.

Symptom	Necrotic muscles	Non-necrotic muscles
CPK (U/L)	12581 ± 6236	1707 ± 1347

**Table 7:** GOT/GPT result.

Symptom	Necrotic muscles	Non-necrotic muscles
GOT (U/L)	187 ± 138	72 ± 67
GPT (U/L)	54 ± 31	39 ± 26

**Table 8:** Urea/ Creatinine results.

Symptom	Necrotic muscles	Non-necrotic muscles
Urea (mmol/L)	5.5 ± 1.3	5.7 ± 1.5
Creatinine (umol/L)	85.0 ± 8.8	80.7 ± 18.5

**Table 9:** Leucocytes results.

Leucocytes results	Necrotic muscles		Non-necrotic muscles	
	n	%	n	%
Normal	5	0%	21	4.80%
Strongly increased	5	100%	20/21	95.20%
Mean value	12.4 ± 4.7		15.22 ± 3.3	

is well longer than that of non-necrotic muscle group. This indicates that the more delayed the surgery is, the more severe necrotic lesions are, that results in the higher possibility of amputation. According to the research by Tran Hung Cuong [3], the average time duration since trauma occurs until surgery is performed of the amputated group is 74.3 ± 35.2 (Table 1). This conclusion also coincides with the study done by Muara S.J and Owen C.A [4].

The research findings show that there's no evident difference in symptoms of severe pain in lower limb, increase of pain in passive movement and contracture and oedema of lower limb between necrotic muscle group and non-necrotic muscle group (Table 2).

Almost patients who lost sensation have necrotic muscle lesions (Table 3). This shows that sensation loss is quite a severe symptom; other researchers also agree that opening of galea should be recommended if sensation disorder occurs in combination with reduction of movement and pulse lesion image on Doppler. It's important not to wait until loss of

sensation appears as, by then, the lesions are too bad and it's more likely for amputation to be performed.

All patients who lost movement have necrotic muscle lesions (Table 4). It can be said that loss of movement is a severe symptom. This symptom if occurs means muscles have had anemia for a long time and are becoming necrotic, so the prognosis is negative. Therefore, patients of compartment syndrome with reduction of movement must be recommended for opening galea immediately.

The number of patients losing signal on pulse Doppler in necrotic muscle group is 6 times higher than that of non-necrotic muscle group (Table 5). This symptom if appears means the compartment syndrome goes with pulse lesions or the compartment syndrome is at later phase with worse prognosis.

CPK is a valuable test to assess the severity of muscle lesion. Our research findings show that average CPK value in necrotic muscle group is 12581 U/L which is much higher than that in non-necrotic muscle group with 1707 U/L (Table 6).

From our research findings, average GOT/ GPT values in necrotic group are higher than those in non-necrotic group (Table 7). This can be explained as GOT/GPT is an enzyme released when the muscle cells are necrotic. The more severe the muscle organization is, the higher these values are.

The study also shows that average Urea and Creatinine values in necrotic group and non-necrotic group are similar (Table 8). This is not so useful for the evaluation of the level of muscle lesions as well as prognosis of surgery.

From our study, 100% of patients in necrotic group and 95.2% of patients in non-necrotic group had strong increase of their leucocyte (Table 9). This may be an increase to respond to the injury of the body. Therefore, the increase of leucocyte does not mean much for the prognosis of surgery.

## Conclusions

- The time duration since trauma occurs until surgery is longer, the prognosis is worse.
- Have symptom of loss of sensation and loss of movement means the prognosis is worse.
- Loss of signal on pulse Doppler means worse prognosis.
- The CPK value is higher, the prognosis is worse, particularly when this value is higher than 12,000 U/L.
- The symptoms pain, swelling, edema of lower limb as well as values of GOT/ GPT, Urea/ Creatinine and leucocyte do not count in prognosis.

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