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MEASUREMENT OF TISSUE PRESSURE, AN AID TO PREDICT COMPARTMENT SYNDROME: OUR STUDY

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ABSTRACT: BACKGROUND: Compartment syndrome (CS) is one of the dreaded complications of fractures. The incidence of CS is more with fractures of tibia and both bones of leg. If not diagnosed early, and treated promptly it may result in much morbidity and loss of the limb in extreme cases. So the measurement of tissue pressure in the affected compartment periodically will alert us to the possibility of development of CS. **MATERIALS & METHODS:** This study was conducted in the Emergency ward, Department of Orthopedics and Traumatology, Gandhi General Hospital, Secunderabad, during the period June 2007 to June 2009. A total of 46 patients were included in the study. The tissue pressures were measured by using an ingenious method, the instrument can be made from commonly available material in the hospital, there by obviating the need for costly equipment. **CONCLUSIONS:** Measurement of tissue pressure in the affected and normal compartments of the leg in cases of fractures of the leg give us an idea about the impending Compartment Syndrome. The early initiation of appropriate treatment will prevent serious consequences. The measurement of tissue pressure can be done by using a simple instrument.
KEYWORDS: Compartment Syndrome, Tissue pressure measurement, Fasciotomy, Manometer.

MATERIALS AND METHODS: Anterior compartment pressure measurement was carried out in 46 patients who attended the emergency ward of Gandhi Hospital between June 2007 to June 2009. Patients with closed fractures of both bones leg or closed fractures of tibia alone were selected at random for this study. Compound fractures were eliminated from this study. Whitesides[1] saline infusion technique was used for pressure measurements as described later.

This study consists of two parts:

a) Anterior compartment pressures were measured in the uninjured legs of the patients with fractures of other leg. This gives an idea of the normal pressure in the anterior compartment of leg in our population.
b) Anterior compartment pressure was measured in the injured legs with closed fractures of tibia or both bones leg.

Further, since the pressures were measured in the injured and uninjured legs of the same patient, the percentage increase of pressure could be calculated.

The following data were collected from the patients and entered in a proforma given later. On admission patient's name, age, sex, and blood pressure of the patients were noted. Antero-posterior and lateral radiographs of the leg were taken to know the site (Level) and types of fractures. The time interval between the injury and reporting at the emergency wards was noted. The pressure measurements were carried out in the anterior compartment of leg in each patient at the time of admission after noting the time interval between injury and pressure measurement.

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Pressures were also measured in the unaffected legs. Blood pressure of the patients was recorded at the time of pressure study. Fractures were reduced using intravenous sedation and then the legs were immobilized in above knee POP slabs. The legs were elevated on pillows.

Pressure measurements were repeated 48 hours after the initial injury to know the difference in pressure. This was not possible in one case as the patient reported to the causality 72 hours the injury and in another case as fasciotomy was performed after the initial measurement. Among the others only 28 patients could be subjected to a repeat pressure measurement.

In 3 cases both the pressures were equal and in all the rest, the pressures at 48 hours were less than the initial pressures.

The difference in pressure was CA and pressure and multiplying by 100. If the initial pressure was A and pressure at 48 hours was B, the coefficients was calculated using the formula (A-B)/Ax 100.

The coefficients were studied in relation to single bone (Tibia) both bones fractures. The averages of pressure measurements were studied in relation to age, level of fracture, type of fracture, duration of the fracture, displacement of fracture. They were analysed in relation to single bone fracture both bone fractures whenever necessary.

Equipment: (Fig. 1 & 2).

The equipment:

1. Two plastic extension tubes (Taken from an I.V. set), each 30 cm in length.
2. Two 18 guage needles.
3. One 20 CC syringe.
4. One 3 ay stop cock.
5. One bottle of sterile normal saline and.
6. One mercury manometer (Sphygmomanometer) without the cuff attachment.

Technique: White sides saline infusion technique was used for measurement of pressure in anterior compartment of leg. A 20ml syringe is attached to 3-way stop cock with 2 plastic extension tubes, one connected to a mercury manometer and the other to a sterile 18 guage needle. The needle was introduced into a bottle of sterile normal saline and the saline was aspirated up to half the length of the tube without air bubbles. The 3 way stop cock was turned to close it off so that no saline was lost in transfer of the needle.

The needle was withdrawn from saline bottle and inserted into the middle of the anterior compartment of the leg after sterlising the skin with betadine and alcohol. The stop cock was then turned so that the syringe communicates with both extension tubes. The system is now a closed one where pressure in the syringe is same as that in the anterior compartment of and the manometer and is measured by the manometer.

The pressure within the system was gradually increased by slowly depressing the plunger of the syringe while watching the column of the saline. This caused a rise in the mercury column when the pressure in the system surpasses the tissue pressure in the anterior compartment a small quantity of the saline gets injected into the compartment and the meniscus of the saline column in the extension tube moves toward the anterior compartment.

The pressure in the closed system, when the saline starts moving towards the leg, represents the anterior compartment pressure and is recorded directly from the mercury manometer.

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The pressure was measured again at a distance of one inch away from the previous site of measurement, the lower of the two readings were in the range of ±3mm Hg, the lower of the two there was a difference of more than ±3mm Hg the measurements was repeated till two readings fell within the range of ±3mmHg.

Common errors with this technique are injecting too much saline into the compartment which gives an inaccurate reading and placing a needle into a tendon rather than muscle belly.

OBSERVATIONS: There were 46 patients in this study of which 31 cases were of closed fractures of the both bones leg and 15 were fractures of the tibia alone. Pressure measurements were carried out in the uninjured compartments of the leg in 45 patients. The patients were from 10-75 yrs. of age. 38 of these patients were males and 6 were females. 26 fractures were in the right leg and 20 were in the left leg. Blood pressure was recorded in all the patients at the time pressure measurement and was found to be normal for the respective age groups.

PRESSURES IN NORMAL (UNINJURED) LEGS: This pressure could not be measured in one patient and the calculations are only for 45 cases. The anterior compartment pressures in the normal (uninjured) legs varied from 6 to 20 mm Hg. The average pressure for 45 patients was 7.9mm Hg (Table I)

The anterior compartment pressure was more in 3rd & 4th decades. However, the pressure rose again after 50 years of age.

PRESSURES IN THE INJURED LEGS: In one 55 years old man the pressure was very high 140 mm Hg on admission (pressure in the uninjured leg was 8 mmHg only). A fasciotomy of the anterior compartment was performed in this case.

The anterior compartment pressure in the injured legs ranges from 12 to 40mmHg. The average in 45 cases was 27.1 mmHg and when only the tibia was fractured the pressure was 27.8 mmHg (Range 12-40) and when both the bones were fractured the value was 26.7mmHg (Range 12-40).

The pressure measurements in the injured legs were analyzed in relation to age groups, duration, type of fracture, level of fracture and displacement of fracture the difference in pressure between the initial measurement and at 48 hours were also analysed. The pressures were analysed as a whole for all patients and later separately for single bone (Tibia) fractures and both bone fractures where ever necessary and compared. The percentage increase of pressure in the injured leg as compared to the normal leg was also calculated.

AGE: The average pressure for all the 45 cases in the injured leg was 27.1mm Hg. The average pressure in the anterior compartment seems to the increasing with age. However, after 50 years of age, there is a mild decline. (Table II)

DURATION: The pressure measurements were divided into groups according to the duration in hours between time of injury and time of recording (Table III)

Analysing the absolute values the pressures in the anterior compartment were maximum at 7-12 hours period, there was fall between 13-18 hours and again increase for 19-30 hours. Subsequently there was again a fall at 36 hours. Thus there was an irregular fluctuation in pressure.

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Percentage Increase of Pressure: The pressure in the anterior compartment of the injured leg which may measured on admission some hours after injury were found to be higher than the normal pressure, as obtained by measurements in the other (Normal) leg of the same patient, at the same time. This increase in pressure was calculated for each patient and expressed as a percentage of the normal pressure. These percentages of increase of pressure were divided into groups according to the duration in hours between time of the injury and time of recording of pressure and an average was obtained for each group. The averages were calculated separately for fractures of tibia and fractures of both bones leg (Table IV)

When all the fractures are considered together, the percentage increase of pressure was maximum between 7-12 hours after the injury and there was a gradual decline subsequently till 36 hours. Even when tribal fractures and both bone fractures were considered separately, the percentage of increase in pressure were maximum at 7-12 hours period and further gradually declined. However, the average percentage increase in pressure was more in fractures of both bones at 0-6 hour's periods and the average was more in fractures at tibia 7-12 hours and 19-24 hours period.

TYPE OF FRACTURE: Type of fracture were classified into comminuted, transverse and oblique. Highest average pressure of 28.4mm Hg was found in comminuted fractures ad least in oblique fractures 24.5 mm Hg (Table V).

LEVEL OF FRACTURE: The level of the Fracture were divided into proximal, middle and lower third. The data were divided and analysed separately for single bone (Tibia) fractures and fractures of both bones leg. When both bones were fractured, the fractures of the tibia was taken into account to decide the level off fracture. Later, all the cases were analysed together. The pressure were maximum in upper third fracture and minimum in lower third fractures. However, the difference was considerable when the tibia alone was fractured and the difference was marginal when both bones were fractured (Table VI).

DISPLACEMENT OF THE FRACTURE: Displacement of the fractures were categorised into 3 grades.
Grade I: Undisplaced fracture and displacement upto 50% 0f the diameter.
Grade II: More than 50% displacement but the fragments still in contact.
Grade III: Total loss of contact between the fragments (Table VII).

Analyzing the data there seems to be no appreciable difference in the pressures in different magnitudes of displacements. Fractures with Grade I displacement showed an average pressure of 25.6mmHg. Grade II revealed 30.2mmHg and grade III 30.5mmHg.

COEFFICIENT OF FALL IN PRESSURE WITH TIME: Although pressures were measured at the time of admission in all the 46 cases, pressure measurements after 48 hours (After injury) could be made only in 28 cases. In 4 cases the pressure remained the same at the second measurement (22, 32, 30 & 30mm Hg respectively). But in 2 cases there was a fall in the pressure at the second measurement (48 hours after the injury to varying degrees). In none of the cases there was increase in pressure (The master chart attaché at the end gives the details of fall in pressure). In pressure was noted and expressed as coefficient by dividing it by initial pressure and multiplying it by 100.

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Formula: Coefficient of fall in pressure = (A-B)/ A x 100.
A = Pressure on admission.
B = Pressure 48 hours after injury.

Injury fractures of the tibia (8 cases) the average coefficient of fall in pressure was 18.9 (9-26.6) compared to the fractures of both bones leg (16 cases) where the average coefficient of fall in pressure was 18.5 (6.6-33.3) (Table VIII).

There is no appreciable difference in the coefficient of fall in pressure in the two groups of single bone (tibia) and both bones fractures.

DISCUSSION: Ischemic changes in limbs following trauma are known since Volkman's.[2] times. Roberts Jones.[3] (1918) had stressed the importance of pressure in the limbs from within or without or both. Though Jepson (1948) has drawn attention to the importance of decompression in limbs to prevent contractures, the concept of four osseo-fascial compartments in leg was clearly enunciated only in 1966 by Seddon.[4] Since these compartments are closed spaces, hemorrhage and edema due to trauma can increase pressure in one or more of these compartments with the attendant sequelae of muscle necrosis and contractures when the pressures go beyond a critical level. This has promoted several workers to measure intra compartmental pressures following trauma and to enunciate the possible critical level so that a timely fasciotomy can save the limb from the grave sequelae.

In this study an attempt is made to establish a normal pressure of the anterior compartment and also to study the pressure variations in that compartment due to trauma as we seen in a general hospital. The anterior compartment of leg is chosen because of its easy accessibility.

Several workers have established different technique of measurement of compartmental pressures, each one claiming some advantages over the other.

White sides saline infusion technique (1975) appears to be reasonably accurate and simple enough to be practiced as a routine in an emergency room. The wick catheter technique of Mubarak.[5] and Slit Catheter technique of Rorabeck,[6] though appear to be more accurate than white sides have the disadvantages of being more complicated in construction of the apparatus. For the above reasons, it was decided to use white sides technique in this study.

Only two authors Harpern et al.[7] and Bhalla.[8] et al are found in the available literature, who have studied the pressure in the anterior compartment of leg using whitesides technique. So our observations are mostly compared with those. Mathur et al.[9] have studied the pressures in the leg compartments using whitesides technique, they have not restricted to the anterior compartment of leg and mixed up findings of all the compartments of leg, and forearm.

46 patients have been included in this study of anterior compartmental pressure measurements.

Normal Pressure: The average pressure in the uninjured anterior compartment in our study was 7.9 mmHg, the range being 6 to 20mmHg (Table-I). Bhalla et al (1988), using the same white sides technique established that the average pressure in the normal anterior compartment was 6.1 mmHg. Using the same technique, Mathur et al (1988) found that in the majority the pressures were between 6 and 10mmHg, but they mixed up values of all the compartment of leg ad not restricted to anterior compartment. Though the average values of both these studies are comparable to ours, their range started from 0mmHg.Whereas our minimum pressure was 6mmHg.

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Nevertheless, the upper limit of 22 and 22mmHg was same as ours (20mmHg). Normal pressures within the anterior compartment was quoted by whitesides (1975) as approximately 0 mm Hg.

Using wick catheter technique Mubarak (1976) found the resting pressure to be 4±4mmHg and Gershuni.[10] used the slit catheter technique and the normal anterior compartment pressure was 5±1 mmHg. In Mubaraks study, the pressure went up to 22mmHg, when the person was standing on both rest and 40mmHg while standing on one foot.

PRESSURE IN THE INJURED LEGS: We found that the average in the anterior compartment of leg, when either the tibia was broken alone or both the bones were broken, was 27.1mmHg. In Bhalla et al series only fractures of both the bones were included and the figure was 17.5mmHg. Halpren et al (1980) studied fractures of tibia only and the pressure in the anterior compartment was 37.3mmHg. It appears that the pressures were more when the tibia was fractured aloe, rather than when both the bones were fractured. In our series, the figures for tibia alone and both bones were 27.8 mmHg respectively the difference not been as much as in the above studies.

In order to convert the absolute values to a common denominator, we converted the figures not percentage increase of pressure in the anterior compartment as compared to the normal pressure in the uninjured leg of the same patient at the same time (Table-IV). The percentage increase of pressure when the tibia alone fractured was 297.3% as compared to 281.4% when both the bones were fractured. So it same to be confirmatory that the pressure was more, though not marked, when tibia was fractured alone. Similar studies were not available in the literature for comparison.

AGE: The pressure in the anterior compartment sees to increase with age, both in the injured and uninjured legs (Table-II). The fail in the fifth decade in normal legs and fail after 50 years in the injured leg could not be explained. Similar studies could not be located in the literature to enable us to compared the figures.

DURATION: In our study, the maximum average pressure recording (30.5mmHg) was between 7-12 hours after injury. Subsequently there was a fail at 13-16 hours (24mmHg) and maintained at the level with mild fluctuations (Table – III). The rise in pressures to 30 mmHg at 36hours was statistically insignificant as we had only one case at that duration.

The maximum average pressure recorded by Bhalla et al was only 21.5mmHg (As compared to 30.5 of ours) and this was between 12-24 hours. However, Halpren (1980), who recorded pressures every 6 hours in the same patient, noted that maximum pressures occurred between 24 and 48 hours and the (average maximum pressure was 37.3mmHg). In our study there was always a fail of pressure after 13 hours. In 28 cases, the pressure was recorded after 48 hours. These pressures were never more never than the initial pressures.

As noted earlier, to make the comparison more meaningful, the absolute values in ours study were converted in to a common denomination by expressing the increase in pressure in the injured leg as percentage as compared to the normal pressure in the uninjured leg of the same patient at the same time (Table-IV), formula (B-A)/A x 100 (where A – pressure in uninjured leg. B- initial pressure in injured leg).

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Here also the maximum percentage increase of pressure was at 7-12 hours and subsequently there was a gradual decline. When the absolute values were considered (Table- III) the fail in pressure from 13 hours onwards was not gradual and there were fluctuations. But when the figures were converted into percentages the decline was gradual without ups and downs. Thus there is a positive advantage of converting the absolute values into percentage. Similar conversion was not found in the literature.

In the present study pressures were recorded after 48 hours (After injury) in 28 cases. In 4 cases (Case 20, 32, 37, 44) the pressure recordings were same at the two sittings. In all the rest there was a fall in pressure at 48 hours to varying degrees. In order to be able to compare the different values, the coefficient of fail in pressure was calculated by using the formula (A-B)/A x 100, where CA is the initial pressure and CB is pressure after 48 hours.

A comparison of the fall in pressures is not well appreciated by scrutinizing the absolute values. But when the coefficients are perused, the magnitude of fall in pressure, is markedly different in different cases as evidenced by the wide variation in the range of the coefficient (6.6 in case No.3) to 33.3 in cases No. 21& 24.

However, average of the coefficient for the tibial fractures and both bone fractures showed little difference meaning thereby the fall in pressure did not differ whether it was a case of tibial fracture or both bone fracture.

TYPE OF FRACTURE: Three types of fractures were noted in our study comminuted, transverse and oblique. The average pressures were more in comminuted fractures and least in oblique fractures (Table-V). However, the difference is only moderate (28.4 & 24.5).

Such an analysis was found only in the study of Bhalla et al. Though the average pressure were more in comminuted fractures (18.1mmHg). In their study, least pressures were found in transverse fractures (14.8mmHg) contrary to our findings. They also came across spiral fractures whose average pressure (18.5mmHg) were more than comminuted fractures.

In the present study we had not only analysed the pressure in relation to type of fracture but categorized them for fractures of tibia alone and fractures both bones. In fractures of both bones leg, the average pressures were again highest in comminuted fractures but least in transverse fractures.

However, the difference were marginal only (28.3mmHg & 26mmHg). Whereas in fractures of tibia alone, transverse fractures showed highest pressures (29.3mmHg) and least was in oblique fractures (12mm Hg) and the difference was marked. Here the comminuted fractures showed average pressure of 28.4mmHg.

LEVEL OF FRACTURE: Proximal third fractures of leg revealed maximum pressure followed by middle and lower third fractures. When all the fractures were considered together as well as when tibial fractures and both bones fractures were considered separately (Table-VI)

Halpren's findings were also similar to ours. However, he has considered the fractures in distal two thirds together (Proximal third 42mmHg & distal two third 34.1 mmHg). But Bhalla et al did not find any significant difference in pressures between proximal, middle and lower thirds of legs. (16mmHg, 16.3mmHg & 15.7mmHg).

In our study the difference in maximum and minimum values was marked in fractures of tibia alone (33.8mmH, 26.2 mmHg and 17 mmHg) as compared to fractures of both bones leg (29.4mmHg, 26.3mmHg and 25.4mmHg).

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May be Halpren could find the difference since he took into account only fractures of tibia and tibia and Bhalla et al did not find any significant difference since they studied fractures of both bones leg.

DISPLACEMENT OF FRACTURE: Both Bhalla et al and Halpren et al have found that the pressures in the anterior compartment have increased with the magnitude of displacement, which is logical. Our study has also confirmed the same. Fractures with grade I (Undisplaced and displacement up to 50% of the diameter) displacement showed an average pressure of 25.6mmHg. Grade II (More than 50% displacement but the fragments still in contract) revealed 30.2 mmHg and Grade III (Total loss of contact) 30.5mmHg. The difference is pressure between Grade II and III is negligible. May be Halpren is right in dividing the displacements only into two categories less than 50% and more than 50% where the pressures were 33.3mm Hg and 49.25mm Hg respectively.

CRITICAL LEVEL OF PRESSURE FOR FASCIOTOMY: Bhalla et al have expressed that a pressure in the anterior compartment 30 mmHg less than the diastolic blood pressure of the patient should be taken as a critical level requiring fasciotomy, as advised by whitesides et al. this was supported by the clinical symptomatology in two cases. Mathur et al have shown 50mmHg as critical pressure requiring immediate fasciotomy. Those patients whose pressures were between 30 & 50mmHg were closely observed and repeat pressure measurements were done and one of them needed fasciotomy. Helpren et al did not perform fasciotomy for any one in their series as the tissue pressures did not exceed 50mmHg.

In our study only one patient demonstrated clinical signs of acute compartment syndrome and fasciotomy was performed with good result. In this case, the pressure in the anterior compartment of leg was very high (140mmHg). None of the other cases in our series had the compartment syndrome clinically and did not require fasciotomy. The maximum pressure recorded was 40mmHg. Hence the critical level of pressure for fasciotomy could not be established.

CONCLUSIONS:

1. White sides technique is simple and the equipment needed is easily available in any general hospital where fractures of legs is very common.
2. The maximum pressures were recorded at 7-12 hours after injury in this study. The percentage increase of pressure was more in tibial fractures than in fractures of both bones. At 48 hours after injury, the pressures were lower than the initial pressures.
3. Anterior compartment pressures was more in comminuted fractures and least in oblique fractures, Proximal tibia fractures revealed maximum pressure followed by middle and distal thirds, Pressures in the anterior compartment increased with the magnitude of displacement.

Measurement of compartmental pressures routinely increases the chance of diagnosing the compartment syndrome much earlier than relying only on clinical examination. In this way this helps in the early diagnosis and effective treatment of this serious complication of fracture.

BIBLIOGRAPHY:

1. Thomas E. Whitesides. Thomas C Haney, Kazuo Marimottos Hiraoshi harda: Tissue pressure measurements as a determinent for the need of faciotomy, clinical orthopaedics and related research No. 1113, Nov – Dec 975.

DOI: 10.14260/jemds/2015/2015

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2. Volkmann RV. Die ischaemischen muskellahmungen und kontrackuren. Zentralb F Chir 1881; 8:80–1.Andrew F Brooker: Clinical use of Tissue pressure measurements. A case report. The Journal of Trauma. Vol 17 No. 3.1977.
3. Jones R. Volkmann's ischaemic contracture with special reference to treatment. Br Med Journal 1928; 2:639–42.R Bhalla, A Dayal an J Thomas: comparison pressure measurement study in the leg, I.J.O. Vol-22, No.2, July 1988.
4. Seddon HJ. Volkmann's ischaemia in the lower limb. J Bone Joint Surg [Br] 1966;48-B:627–36
5. S. J. Mubarak, A.H. Hargerns C.A. Owen, L.P. Garetto W.H. Akeson, San Diego: The wick catheter technique for measurement of intramuscular pressure, JBJS 58A, 1976.
6. Cecil H Rorabeck, CS castle R, hardle: Compartment pressure measurements: An experimental investigation using the slit catheter.the Jonral of Trauma Vol 21, No.6, 1981.
7. Alan A, Halpren and Dand A. Nagal: Anerior compartment pressures in patients with tibial fractures. The Journal of Trauma Vol. No; 9, 1980.
8. R Bhalla, A Dayal an J Thomas: comparison pressure measurement study in the leg, I.J.O. Vol-22, No.2, July 1988.
9. Aswini K, Mathur, N.L. Jhamaria, Mahesh udawat, Madhu Mathur, Raghuveer S. bhatt: Intra compartmental pressure studies in Acute compartment syndrome. IJO Vol22, no2, July 1988.
10. D. A. Gershuni, N.C. Yaru, A. R. Hargens, R. L. Lieber, R.C.O. Hara, W. H. Akesonsan Diego: Ankle and the Knee position as a factor modifying intracompartment pressure in the human leg. JBJS Vol.66 A, No.9, Dec 1984.

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