

# Sri Lanka Journal of Forensic Medicine, Science & Law

ISSN 2012-7081

Vol. 5 No. 2 - December 2014

Biannually



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Official Publication of the Department of Forensic Medicine  
Faculty of Medicine, University of Peradeniya  
Sri Lanka



**A peer reviewed journal**

**Published by Faculty of Medicine, University of Peradeniya, Sri Lanka.**

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# EDITORIAL

## Teaching Law for Forensic Medical and Forensic Science Students

*Induwara Gooneratne*

The term “forensic” is related to law or court functions. In forensic medicine or in forensic sciences, a practitioner would assist court in conducting relevant investigations and providing facts and evidence based opinions to solve legal issues. The contributions by experts in forensic medicine and science to solve legal issues in court room have been immense and of paramount importance.

As forensic medical and science practitioners in their everyday activities deal with law enforcement officers or court officers and engage in legal procedures, a question arises as to whether or not these forensic practitioners should know the law and legal concepts relevant to their practice and if so, should forensic medical and forensic curricula cover the law and legal concepts adequately by a trained legal expert. Then the extent to which these concepts should be covered and what concepts to be covered need to be discussed.

There are two main positions on this situation. On the one hand some believe that the practitioners of forensic medicine and sciences should be aware of the law and legal concepts that are relevant to them so that they would be in a better position to provide a relevant opinion or a report to court to suit the needs for the court. However on the other hand, some believe that the law and legal concepts are for the lawyers and judges and that the

responsibility of the forensic medical and science practitioner is to provide a truthful, unbiased report to court and answer any question that may be raised in the process. This fraction further believes that the imparting of these law and legal concepts to forensic practitioners can skew the opinions they provide and tend to ‘lawyer’ their opinion which may adversely affect the fairness and administration of justice.

My research in to this issue especially the focus group discussions I had with medical students, law students and informal discussions with practitioners revealed that it is important to formally impart essential and relevant legal concepts to practice forensic medicine and science so that the forensic practitioners will be able to provide their report and their evidence more meaningfully. Out of the legal concepts that were thought to be useful and relevant were mostly concepts from criminal law and law of evidence. The concepts included but not limited to ‘ what is a crime, elements of crimes, legal and factual causation, law of murder and homicide, law of hurt, sexual offenses, child abuse, negligence, legal process of crime investigations, expert evidence, law related to death and death investigation’. Further I strongly believe that elements of proof and approaches to proof of evidence too are highly relevant to forensic practitioners. However it will not be possible to impart all these in an under

graduate curriculum but it is possible to provide the required knowledge of law to post graduate forensic students as part of their core curriculum or optional curriculum. It must be noted that it has been observed by the author that non-lawyers or medical practitioners tend to teach and sometimes write articles on content legal issues which may not be the right approach where it is always possible to hire a trained legal academic or legal practitioner for this purpose.

On the other hand it is also important to consider the opposing argument which posits that 'the object and purpose of a forensic practitioner or an expert witness to court is not to have another lawyer in court but to have an expert who will provide a comprehensive report and answer raised questions in an unbiased manner in examination in chief and in cross examination so that the legal experts will isolate and use the pieces of evidence they want to establish their pan ultimate

and ultimate probanda to suit the needs of the court.

It has also been observed by the author that some expert witnesses tend to provide evidence as if they were 'eye witnesses' to the event in question which is detrimental to the fairness, scientific scrutiny, due process and administration of justice which can be overcome by educating the forensic practitioners on the law of evidence.

In conclusion, the position of the author is that it is relevant and essential that the forensic practitioners are imparted with relevant and important legal concepts at least superficially by a trained legal academic/lawyer but striking a balance between the possibility of their presentation of facts and opinions could be skewed on the one hand o VS the forensic practitioner provides an unbiased opinion to court meaningfully having an idea as to what they should provide why and how.

# A CASE OF MUNCHAUSEN SYNDROME BY PROXY: IS IT A MISDIAGNOSIS?

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## **ABSTRACT**

### **Introduction**

Child abuse is an area in Forensic Medicine where the diagnosis and management could be difficult. A deep history and close inward observation is a must where there is the slightest doubt of child abuse, in order to identify compounding factors and address accordingly. Here we report a case of repeated episodes of hematuria which was extensively investigated in three tertiary care hospitals revealing no cause, ultimately the mother being discovered as the culprit.

### **Case report**

A three year old boy who was extensively investigated for repeated episodes of gross hematuria since the age of seven months was admitted to Teaching Hospital, Peradeniya with another episode of gross hematuria. The child was clinically normal and investigations including blood, imaging studies and renal biopsy were unremarkable. Urine checked for bar bodies was positive. A case conference was held and it was decided to keep the child under parental custody under supervision of medico-legal authorities, while the mother is followed up at the psychiatry clinic for depression.

## **Discussion**

Munchausen syndrome (MS) by proxy is a psychiatric disorder which consists of fabricating or inducing illness in a child, usually by his mother, leading to unnecessary and potentially harmful medical investigations and/or treatment which are seen in this case as well. Thus this emphasizes the importance of thinking of MS, before going into potentially harmful investigations when the basic investigations are normal and identifying the importance of having an interlinked e database system in medical facilities in countries like Sri Lanka.

## **INTRODUCTION**

Munchausen syndrome by proxy (MSBP) which is also known as pediatric condition falsification<sup>1</sup> or fabricated or induced illness<sup>2</sup>, is an unusual form of child abuse, subjecting the child repeatedly to multiple medical procedures, both diagnostic and therapeutic which might lead to significant morbidity and pose threats to the life of the child. Compared with other forms of child abuse, MSBP has proven to be a child maltreatment associated with rather different diagnostic and legal problems.

Seeking treatment from different doctors at different places in order to conceal the truth, imposes difficulties in diagnosis. If an interlinked data system for each patient between hospitals were to exist, the issue of misdiagnosis and unnecessary repeated investigations would easily be overcome.

## CASE REPORT

A three year old boy who has had repeated episodes of gross hematuria since the age of seven months, was admitted to a tertiary care hospital in the central province, with an episode of gross hematuria. He had been extensively investigated in three tertiary care hospitals previously due to changes in residence.

The child was a product of a non-consanguineous marriage and was the second-born of a family of three children. The antenatal history was unremarkable while the birth weight was 1.9 kg. The child was given PBU (Premature Baby Unit) care for the first two days for hypoglycemia.

The child was first brought to a tertiary care hospital at the age of seven months with a two months' history of on-and-off gross hematuria with straining during micturition. The child did not have features of an infection and was clinically normal with normal blood pressure and no abdominal masses detected on examination. All the blood investigations were normal while the urine full report (UFR) showed red blood cells (field full) without any evidence of infection. Ultra Sound Scan reports and X-rays were normal.

The child was presented with the same clinical picture at the age of 2 years and one month to the same hospital. During this admission, too, all the investigations except the UFR were normal. The child had to undergo a renal biopsy which revealed no abnormality.

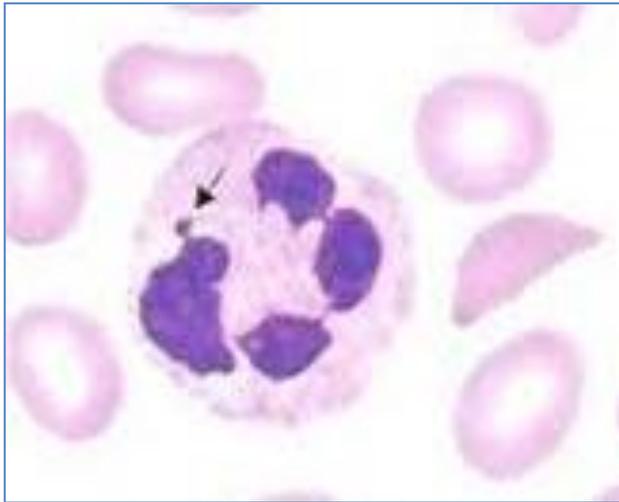
The child presented with a similar history, 3 months later and again all the blood investigations and X-rays were normal. This time he had to undergo a cystoscopy under

general anesthesia, which was found to be normal.

During the most recent admission (at the age of three years) the child presented with a similar history. The mother had complained of a similar hematuric episode in her other child who was one year younger, which was investigated, but the medical records were not available for our perusal. The child had to undergo several blood, urinary and radiological investigations during this hospital stay as well, all being unremarkable except for the hematuria in UFR. Urine which was collected under supervision showed no gross hematuria, while the urine which was collected by the mother was red in color. On suspicion of Munchausen Syndrome by Proxy, the urine which was collected by the mother was checked for bar bodies and it was positive in this male child.

Clinical forensic evaluation excluded any form of physical or sexual child abuse. On further inquiry it was revealed that the mother, who is a nursing officer in Jaffna, has undergone severe mental stress in the past. She has undergone a left-sided mastectomy for carcinoma breast few years back, she has lost a child during the time of war and her husband has been in custody for 2 years recently. Her past medical history was unremarkable. She appeared irritable and showed lack of warmth and attachment towards the child. She was diagnosed as having depression on referral to the Psychiatrist.

A case conference was held and this was diagnosed as a case of MSBP. It was decided to keep the child under parental custody under supervision of medico-legal authorities, while the mother is being followed up at the psychiatry clinic.



**Figure 1: Barr body is indicated by the arrow**

## DISCUSSION

Child abuse is an area in Forensic Medicine where the diagnosis and management could be difficult. MSBP is a psychiatric disorder where there is fabrication or induction of illness in a child, usually by his mother<sup>3,4</sup>, very rarely by the father<sup>5</sup>. This poses even more diagnostic problems as the caretakers' actions to fabricate the illness usually evade early detection, as the symptoms and signs they report seem plausible. Furthermore they appear concerned about the child and they might even have had a training in nursing or medical/paramedical training<sup>3</sup>. This leads to unnecessary and potentially harmful medical investigations and/or treatment and may pose severe morbidity and mortality to the child's life, as seen in this case. Thus, medical professionals continue to struggle with this form of child abuse.

Boys and girls are victimized almost equally<sup>6</sup>. Although several children within a family may be victimized sequentially, it is unusual for more than one child to be victimized within any given period of time<sup>7</sup>. In this case too, the younger sibling had similar symptoms which may have been the result of MSBP, but the medical records were not available for confirmation. Most of the victims are infants and toddlers,

presumably due to the fact that younger children lack the verbal skills necessary to disclose their abuse and are relatively helpless physically<sup>3,6,8,9,10</sup>. Although victimization of the children commonly begins early in life, there is usually a delay in making the correct diagnosis. In two series, average time from onset of symptoms and signs to diagnosis was 15-22 months<sup>4,6</sup>, it might be as long as 20 years<sup>6</sup> or never<sup>11</sup>.

The commonest presentation of MSBP reported in literature includes any form of bleeding, seizures, central nervous system depression, apnea, diarrhea, vomiting, fever and rash<sup>12,13</sup>. According to Feldman et al., 25% of the children with MSBP had renal or urologic issues. The falsifications done by the caregivers included false or exaggerated history, specimen contamination, and induced illness. In our case the mother had contaminated the child's urine sample with her blood without being noticed by medical professionals. Caretakers also intentionally withhold appropriately prescribed treatment<sup>14,15</sup>. They usually welcome painful and invasive tests in the child and grow anxious if the child improves<sup>16</sup>.

Usually there is a history of family dysfunction, with the father being uninvolved and emotionally distant and the mother having few social outlets<sup>17</sup>. The motive for the perpetrators' behavior is receiving satisfaction and attention from the investigations and treatment that the child receives from the medical environment as part of a unique mental disturbance. In this case the severe mental stress the mother was subjected to in the past, may have attributed to her current psychiatric condition.

Some evidence suggests that these victimized children may go on to develop Munchausen syndrome themselves<sup>18</sup> or some type of personality disorder later in life if they survive.<sup>19,20</sup> According to Fissure et al., features of MSBP may be seen in one-

third of patients, and the rest may have depression or personality disorder<sup>21</sup>.

Because MSBP is a relatively uncommon form of maltreatment, pediatricians need to have a high index of suspicion when faced with a persistent or recurrent illness or an unusual symptom or sign that cannot be explained and that results in multiple medical procedures, or when there are discrepancies between the history, physical examination, and health of a child<sup>22,23</sup>. Insistence by a parent that more investigations should be carried out, including invasive ones, would be a warning sign that MSBP might be present. The primary care provider may be in a position to raise the question of MSBP because he/she may be able to recognize larger dynamics at play between child and family that are less apparent to subspecialists because he/she has an existing overtime relationship with the family<sup>24</sup>. It also stresses the importance of having an interlinked e-database system in medical facilities in countries like Sri Lanka, in order to manage the same case if presented to different hospitals, as a collective effort with inputs from the medical officers who handled the case previously.

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# REGRESSION ANALYSIS FOR STATURE DETERMINATION FROM HAND ANTHROPOMETRY OF MALAYSIAN MALAYS FOR FORENSIC INVESTIGATION

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## ABSTRACT

During the investigation of mass disasters cases, the primary aim of any forensic investigator is to identify the individuals by analyzing the disintegrated human body organs. Stature determination has been shown as possible using the measurements of different body parts. Hand anthropometry is found to yield important predictive information about an individual's stature and may further help in narrowing down the possible matching identities. Literature review shows that a limited number of studies have been conducted on stature estimation from hand measurements. The present investigation is aimed to derive population specific regression equations to estimate stature from hand anthropometry of Malaysian Malays, since it is improper to utilize a single equation derived from a particular population for various populations.

## KEYWORDS:

Forensic science, Forensic anthropology, Stature, Hand anthropometry, Malaysian Malays.

## INTRODUCTION

Stature estimation has been shown as possible using the measurements of different body parts<sup>1-3</sup>.

“Stature provides insight into various features of a population including nutrition, health and genetics; geographical location, environment and climatic condition”<sup>4</sup>. Assessment of height from different body parts is an area of interest to anatomists, anthropologists and to forensic experts<sup>5</sup>. It is generally accepted that the most accurate biological profile is formulated using contemporary population specific standards<sup>6</sup>. Several studies were conducted to estimate stature from dimensions of hands, handprints<sup>6</sup>, feet and footprints<sup>7</sup> in the past, and derived regression equations to estimate stature from these variables for person identification. There are no population specific formulae for stature determination from hands in a Malaysian Malay population. Hence, the aim of the present investigation is to derive population specific regression equations to determine stature from hand anthropometry in Malaysian Malays.

## MATERIALS AND METHODS

### Materials

Participants that included 100 male and 100 female Malaysian Malays were of age ranging from 18 to 60 years. Malays are an ethnic group who predominantly inhabit the Malay Peninsula, the east coast of Sumatra and the coast of Borneo and who speak a Malayo-Polynesian language, which is a member of the Austronesian family<sup>8</sup>. The participants were confirmed to be descent from three generations of Malays to ensure no genetic variation within races that can disrupt the results as characteristics of hand measurements can be affected by not only environment but also genetic makeup<sup>9</sup>. Information such as name of subject and place of origin was recorded. Informed consent was obtained from all participants, and followed the procedures in accordance with the ethical standards of University Research Ethics Committee (Human). A total of 400 bilateral hand measurements were obtained from Malaysian Malay participants. All the participants included in the study were healthy and free from any apparent symptomatic deformity of the hand.

### Methods

“Stature was measured without head and footwear using a portable body meter measuring device (SECA model 208). The body meter was suspended upright against the wall and measurements were taken to the nearest 0.5 cm. The subject was advised to stand under the body meter with his heels together and weight evenly distributed between both feet. Stature was measured in cm as the vertical distance between the vertex and the sole of the foot when the individual was standing barefoot with head held in the Frankfurt horizontal plane with eyes looking forward. Following the previous research, the

measurements were repeated until concordant values achieved”<sup>10</sup>. Considering the diurnal variation, all the measurements were taken at a fixed time in the afternoon. “The diurnal change in height of a person was indicated as early as 1726 and the shortening in stature during daytime was reported and confirmed by the researchers”<sup>11-12</sup>. Seven anthropometric measurements were taken on each individual using a 250 mm digital sliding caliper (Mitutoyo CD67-S20PS). “The hand of the subject was placed on the flat hard horizontal surface with the thumb in abducted position and other fingers in extended position”<sup>13</sup>. “The hand length is the linear distance between the point inter-stylian and the most anterior projection of the middle finger”<sup>13</sup>. “The hand breadth is the linear distance between the radial side of the second metacarpophalangeal joint and the ulnar side of the fifth metacarpophalangeal joint”<sup>13</sup>. “The finger length (thumb, Index, middle, ring and little fingers) is the distance between the proximal flexion crease of the finger to the tip of the respective finger”<sup>6,14-15</sup> (Fig 1). The measurements on the subjects were made by the same researcher<sup>13</sup>. The data obtained were computed and analyzed with SPSS (Statistical Package for Social Sciences, Version 20.0) computer software.

## RESULTS

Descriptive statistics of stature measurements in males, females are shown in Table 1. In males, the stature ranges from 157.0 to 184.0 cm (mean 168.7 cm) and in females it ranges from 142.0 to 168.0 cm (mean 156.3 cm). The result showed that the mean stature is found to be significantly higher in males than females.

Tables 2 and 3 show the statistical data of the hand dimensions in the female and male of Malaysian Malay population. The mean values of the male hand dimensions were

higher than those of the female hand dimensions, and the differences in the hand dimensions between the males and the females were statistically significant ( $p < 0.05$ ) in the population (Fig 2). Sex differences were significant for all measurements. It is readily apparent that there appears to be very little bilateral variation in the hand dimensions in both sexes. The mean left hand length of male is found to be slightly longer than the right. But the finding is opposite in female hand length measurements.

Table 4 presents the correlation coefficient (R) between stature and various hand and finger length measurements and are found statistically significant ( $< 0.001$ ). Correlation coefficient values are found to be more in females (0.630–0.673) than males (0.041–0.610) hand length measurements. The correlation coefficient between stature and hand lengths is found to be higher than hand breadth and finger length measurements.

Table 5 and 6 present the linear regression equations derived from the stature and bilateral hand dimensions in both sexes. Standard error of estimate (SEE) shown in the tables indicated that SEE of hand length is comparatively lower than hand breadth and finger lengths in both genders.

## DISCUSSIONS

The mean value of male stature is comparatively higher than that of female stature in this population, and this finding is in accordance with other population results showing that males are taller than females<sup>4-7,10,13-16</sup>. “Small differences exist in the mean value of stature of both sexes between the present study and other studies”<sup>4-7,10, 13-16</sup> because of population variation. The differences in the bilateral hand dimensions are not statistically significant in this

population. “The hand length showed a higher correlation coefficient for stature than the hand breadth in both sexes, and the similar findings were observed in the previous studies”<sup>3,13,15-16</sup>. The findings of the present and previous studies indicated that a more accurate stature could be estimated based on hand length than hand breadth. The left hand length shows higher correlation coefficient while right hand breadth shows higher correlation in both genders of this population but some studies have reported different results<sup>3,13-16</sup>. The regression equations derived from hand dimensions of Malaysian Malay population are different from other populations<sup>3,4-6,13-16</sup>, and so do the correlation coefficients showing population variation. In assessing the accuracy of simple linear regression models in Malaysian Malays, the standard error of the estimate (SEE) was comparatively lower using the measurement of hand length (SEE 4.465–4.757 cm). Expectedly, other population studies have indicated that this is the most accurate measurement for estimating stature, albeit their regression models have a higher stated accuracy: eg. North Indian population<sup>5</sup> (3.78–5.22 cm); Western Australian population<sup>6</sup> (SEE 4.74–5.17 cm); Hans population of Southern China<sup>13</sup> (5.05 – 5.64 cm); Egyptian population<sup>14</sup> (4.54–5.48cm); Indian medical students<sup>15</sup> (4.23–4.96 cm); north and south Indian population<sup>16</sup> (3.65–5.04 cm). Thus the variations in hand dimensions may be attributed to the population and ethnic differences.

## CONCLUSION

It is concluded that hand dimensions can provide good reliability in stature determination. The present study developed regression equations for stature determination from various hand measurements in a Malaysian Malay population. Similar stature-

hand research may be continued to investigate and derive relevant regression equations to determine stature from hand anthropometry for other populations living in different parts of the world.

## ACKNOWLEDGMENT

The authors are thankful to the participants who took part in the study. The authors did not receive any specific funding for the aforementioned research.

## CONFLICT OF INTEREST

The authors have no conflict of interest to declare.

**Table 1: Descriptive statistics of stature in males and females of adult Malaysian Malays.**

| Sex    | N   | Min (cm) | Max(cm) | Mean(cm) | SD  |
|--------|-----|----------|---------|----------|-----|
| Male   | 100 | 157.0    | 184.0   | 168.7    | 0.6 |
| Female | 100 | 142.0    | 168.0   | 156.3    | 0.6 |

N: Number of participant; Min: Minimum; Max: Maximum; SD: Standard deviation

**Table 2: Descriptive statistics of right and left hand measurements of Malaysian Malay females (in cm)**

| Measurement   | N   | Right side |      |      |     | Left side |      |      |     |
|---------------|-----|------------|------|------|-----|-----------|------|------|-----|
|               |     | Min        | Max  | Mean | SD  | Min       | Max  | Mean | SD  |
| Hand length   | 100 | 15.0       | 19.8 | 17.0 | 0.9 | 15.1      | 19.7 | 16.9 | 0.8 |
| Hand breadth  | 100 | 5.8        | 8.2  | 7.0  | 0.5 | 5.9       | 7.8  | 6.9  | 0.4 |
| Thumbs finger | 100 | 4.9        | 7.2  | 5.8  | 0.5 | 4.2       | 7.0  | 5.8  | 0.4 |
| Index finger  | 100 | 5.4        | 7.7  | 6.6  | 0.4 | 5.2       | 7.8  | 6.6  | 0.4 |
| Middle finger | 100 | 6.3        | 8.5  | 7.2  | 0.4 | 6.3       | 8.5  | 7.2  | 0.4 |
| Ring finger   | 100 | 5.7        | 8.0  | 6.7  | 0.4 | 5.9       | 7.9  | 6.7  | 0.4 |
| Little finger | 100 | 4.7        | 6.4  | 5.4  | 0.4 | 4.3       | 6.4  | 5.4  | 0.4 |

N: Number of participants; Min: Minimum; Max: Maximum; SD: Standard deviation;

**Table 3: Descriptive statistics of right and left hand measurements of Malaysian Malay males (in cm)**

| Measurement   | N   | Right side |      |      |     | Left side |      |      |     |
|---------------|-----|------------|------|------|-----|-----------|------|------|-----|
|               |     | Min        | Max  | Mean | SD  | Min       | Max  | Mean | SD  |
| Hand length   | 100 | 17.1       | 20.9 | 18.6 | 0.9 | 17.2      | 21.6 | 18.7 | 0.9 |
| Hand breadth  | 100 | 7.0        | 9.1  | 7.9  | 0.4 | 6.8       | 9.1  | 7.8  | 0.4 |
| Thumbs finger | 100 | 5.4        | 7.7  | 6.4  | 0.5 | 5.4       | 7.7  | 6.5  | 0.5 |
| Index finger  | 100 | 5.9        | 8.3  | 7.2  | 0.5 | 6.1       | 8.5  | 7.2  | 0.5 |
| Middle finger | 100 | 6.8        | 9.3  | 7.8  | 0.5 | 7.0       | 9.5  | 7.9  | 0.5 |
| Ring finger   | 100 | 6.3        | 8.7  | 7.3  | 0.5 | 6.4       | 8.7  | 7.3  | 0.5 |
| Little finger | 100 | 5.0        | 7.0  | 5.9  | 0.4 | 5.0       | 7.4  | 5.9  | 0.4 |

**Table 4: Pearson correlation coefficient (R) between stature and right and left hand measurements of male and female Malaysian Malays**

| Hand measurements    | R (male)   |           | R (female) |           |
|----------------------|------------|-----------|------------|-----------|
|                      | Right side | Left side | Right side | Left side |
| Hand length          | 0.604      | 0.610     | 0.630      | 0.673     |
| Hand breadth         | 0.424      | 0.390     | 0.230      | 0.173     |
| Thumb length         | 0.444      | 0.363     | 0.460      | 0.396     |
| Index finger length  | 0.448      | 0.458     | 0.537      | 0.567     |
| Middle finger length | 0.494      | 0.492     | 0.528      | 0.533     |
| Ring finger length   | 0.436      | 0.465     | 0.469      | 0.541     |
| Little finger length | 0.464      | 0.396     | 0.413      | 0.472     |

**Table 5: Linear regression equations for stature determination from male hand measurements of Malaysian Malays (in cm)**

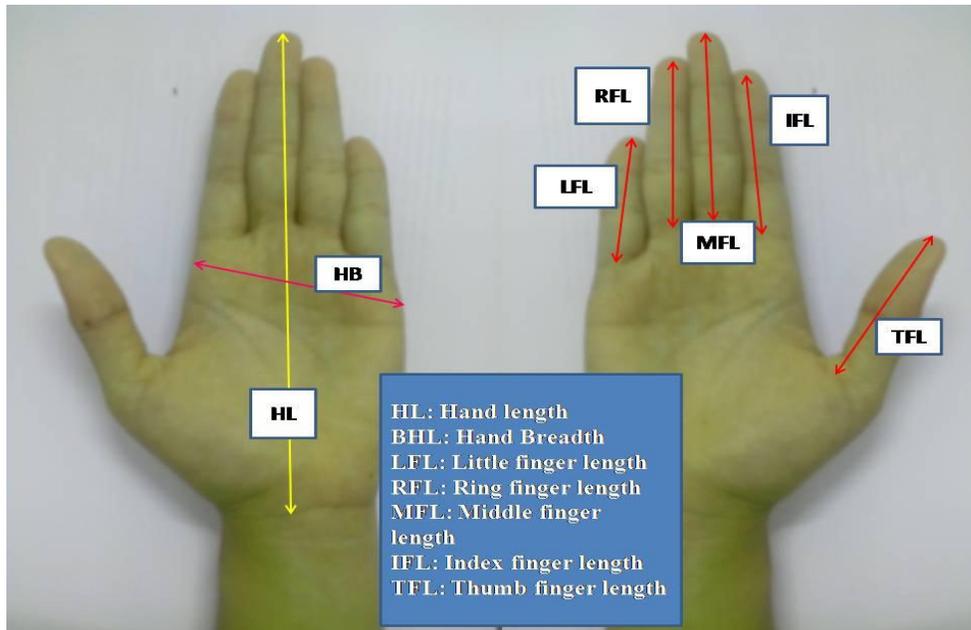
| Hand Measurement     | Male right side        |       | Male left side         |       |
|----------------------|------------------------|-------|------------------------|-------|
|                      | Equations              | SEE   | Equation               | SEE   |
| Hand length          | $S=94.399 + 4.005HL$   | 4.757 | $S=92.156 + 4.092HL$   | 4.729 |
| Hand breadth         | $S= 123.729 + 5.696HB$ | 5.406 | $S=127.053 + 5.322HB$  | 5.496 |
| Thumb length         | $S=132.659 + 5.615TFL$ | 5.348 | $S=139.283 + 4.543TFL$ | 5.561 |
| Index finger length  | $S=128.658 + 5.597IFL$ | 5.336 | $S=126.352 + 5.904IFL$ | 4.976 |
| Middle finger length | $S=123.211 + 5.805MFL$ | 5.191 | $S=121.077 + 6.067MFL$ | 5.198 |
| Ring finger length   | $S=129.702 + 5.353RFL$ | 5.372 | $S=126.469 + 5.801RFL$ | 5.284 |
| Little finger length | $S=132.100 + 6.172LFL$ | 5.286 | $S=134.744 + 5.803LFL$ | 5.480 |

S: Stature; SEE: Standard error of estimate; HL: Hand length; Hand breadth; TFL: Thumb length; IFL: index finger length; MFL: Middle finger length; RFL: Ring finger length; LFL: Little finger length.

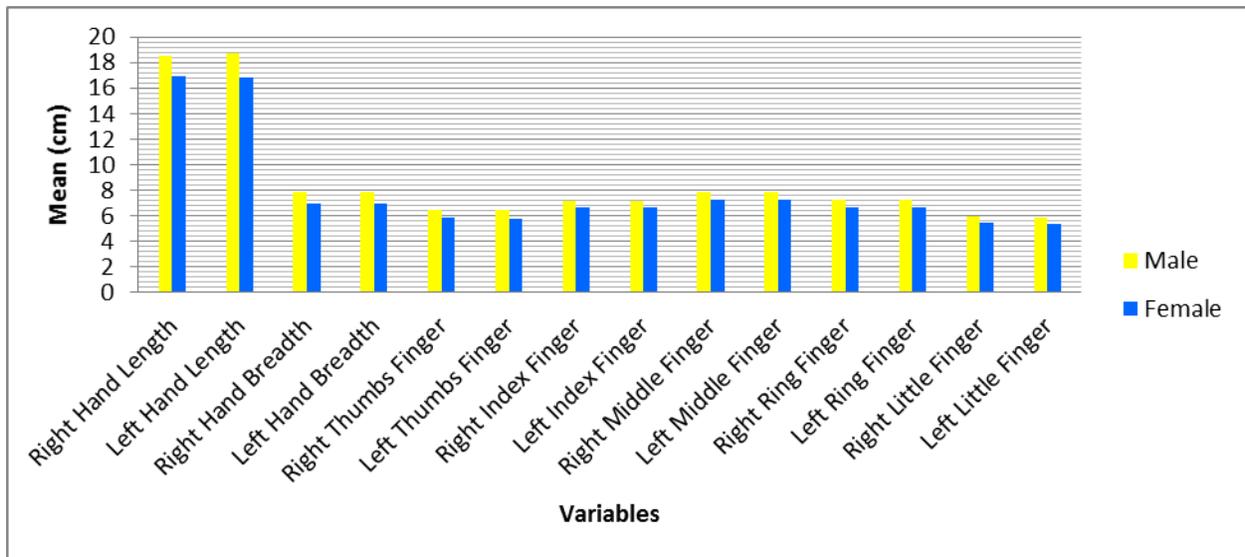
**Table 6: Linear regression equations for stature determination from female hand measurements of Malaysian Malays (in cm)**

| Hand measurement     | Female right hand      |       | Female left hand       |       |
|----------------------|------------------------|-------|------------------------|-------|
|                      | Equations              | SEE   | Equation               | SEE   |
| Hand length          | $S=81.423 + 4.415HL$   | 4.690 | $S=75.897 + 4.765HL$   | 4.465 |
| Hand breadth         | $S=136.813 + 2.784HB$  | 5.878 | $S=139.478 + 2.428HB$  | 5.449 |
| Thumb length         | $S=121.244 + 6.016TFL$ | 5.363 | $S=124.402 + 5.503TFL$ | 5.546 |
| Index finger length  | $S=103.637 + 7.947IFL$ | 5.095 | $S=104.127 + 7.848IFL$ | 4.976 |
| Middle finger length | $S=101.431 + 7.581MFL$ | 5.128 | $S=103.110 + 7.376MFL$ | 5.110 |
| Ring finger length   | $S=111.690 + 6.668RFL$ | 5.335 | $S=101.281 + 8.237RFL$ | 5.080 |
| Little finger length | $S=118.443 + 6.992LFL$ | 5.502 | $S=116.396 + 7.457LFL$ | 5.324 |

S: Stature; SEE: Standard error of estimate; HL: Hand length; Hand breadth; TFL: Thumb length; IFL: Index finger length; MFL: Middle finger length; RFL: Ring finger length; LFL: Little finger length.



*Figure 1: Various hand and finger measurements*



*Figure 2: Bar chart showing gender variation among hand measurements of Malaysian Malays*

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# NECROTIZING SOFT TISSUE INFECTION CAUSED BY COMMUNITY ACQUIRED METHICILLIN RESISTANT *STAPHYLOCOCCUS AUREUS*: AN EMERGING DEADLY ENTITY

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## ABSTRACT

A 42 year old male presented with a 5 day history of minor trauma to the left upper limb, followed by progressively increasing pain, swelling and discoloration of skin. On examination, the patient was found to be septic and died within 24 hours of admission, despite aggressive surgical management. Postmortem examination revealed extensive necrosis of the upper limb and chest wall muscles. Culture of swabs taken from spleen and affected muscle groups yielded a pure growth of Methicillin resistant *Staphylococcus aureus* (MRSA).

The necessity for early diagnosis and appropriate antibiotic treatment in necrotizing soft tissue infections as well as the emergence of community acquired MRSA as a potential pathogen highlighted in this case.

## KEY WORDS:

Necrotizing fasciitis, Deliquescent Spleen, Methicillin resistant *Staphylococcus aureus*

## CASE REPORT

Mr. MP was a previously healthy 42 year old labourer with no history of Diabetes Mellitus. He sustained blunt trauma to his left hand from a falling piece of wood with no evident breach of skin. By evening he had developed pain and swelling around his left wrist joint for which he was treated by a

local general practitioner with pain medication. On day three following injury, the swelling was marked and pain unbearable. The patient was treated by a traditional ayurvedha physician with oils and remained at home. Due to the worsening condition he sought allopathic treatment at the local hospital on day 5 after the trauma.

On admission he was severely ill, dyspneic and had cold extremities. Pulse rate was 116 beats per minute and blood pressure was 90/60mm Hg. Peeling of the skin on his left forearm and hand with blackish discoloration and blistering was noted. He was treated for septic shock with intravenous fluids, Cefuroxime and Metronidazole. Fasciotomy of the left upper limb was done within hours of admission. Tissue necrosis was noted, and debridement was done. He was transferred within hours of surgical intervention to the intensive care unit of a tertiary care hospital. As the patient was deteriorating further, disarticulation of the left upper limb at the shoulder was done soon after admission. Extensive tissue gangrene involving the muscles of the limb was noted at surgery. No pus was seen. The patient died seven hours after admission to the ICU; about twenty hours after the initial hospital admission. A private laboratory isolated Methicillin sensitive *Staphylococcus aureus* (MSSA) on culture of the blister fluid.

Post mortem examination of the body and amputated limb revealed severe muscle destruction in the amputated limb and upper

1/3 of the left anterior chest wall. (Fig 1 & 2) The Spleen and liver were enlarged and the spleen was deliquescent. (Fig 3) All features were compatible with septicemia while the kidneys showed features of acute renal failure. Histology of tissue revealed hemorrhagic myositis with severe fasciitis.

Swabs were taken for culture from multiple muscle groups in the amputated limb and a deep swab from the spleen. Pure growths of Methicillin Resistant *Staphylococcus aureus* (MRSA) were cultured from all swabs.



**Figure 2: Necrotic muscles of amputated upper limb**



**Figure 1: Skin necrosis on left chest wall**



**Figure 3: Enlarged deliquescent spleen**

## DISCUSSION

Necrotizing infections of the skin, subcutaneous tissues and muscle are described using many, somewhat confusing, terms (ie: necrotizing fasciitis, synergistic necrotizing cellulitis, anaerobic cutaneous

gangrene, necrotizing cutaneous myositis, synergistic myonecrosis etc). These terms, based on anatomic location, depth of tissue involvement and type and number of causative organisms, often overlaps, and makes it difficult to identify a specific entity. The term “necrotizing soft tissue

infection' is now recommended for use since the management strategies for this group is essentially the same<sup>1</sup>.

Necrotizing soft tissue infections are both fortunately and unfortunately uncommon. Fortunately as the morbidity and mortality associated with it is very high. Unfortunately, as the rarity of the condition makes most primary care physicians, who often encounter the patient in the first instance, unfamiliar with its clinical presentation<sup>2</sup>. The delay in diagnosis and treatment is one of the biggest problems in necrotizing soft tissue infections with only 15-30% of cases having an accurate diagnosis on admission<sup>2</sup>. This is one of the main reasons for the high mortality, as illustrated in this case.

Risk factors for necrotizing soft tissue infections include diabetes mellitus, burns, obesity and trauma<sup>3</sup>. Rare cases of necrotizing infections following insect bites have also been reported from some countries, including Sri Lanka<sup>4</sup>. In many patients, however, no predisposing factor is found.

Clinically this patient showed the classical sub-acute progression of symptoms after minor trauma followed by pain that was out of proportion with the skin manifestations. The paucity of external signs at the beginning often misleads the first contact doctor. The infection spreads in the subcutaneous tissue, fascia and sometimes muscle, and the natural lack of fibrous attachments in the limbs and trunk facilitate spreading of infection along tissue planes. Skin manifestations of black/ blue discoloration (necrosis) and blister formation, occur late, with wide spread infection and dermal vessel thrombosis. By this time the patient will display signs of septicaemia, and treatment, even if rapid and aggressive, may be of no avail, as seen in this case.

Differentiation of cellulitis, erysipelas and necrotizing soft tissue infection by skin manifestation is possible. Erysipelas is a bacterial skin infection involving the upper dermis. It is seen as an intensely erythematous, indurated plaque with a sharply demarcated border that characteristically extends into the superficial cutaneous lymphatics, causing lymphangitis. The tenderness in necrotizing soft tissue infection often goes beyond the point of redness, unlike in cellulitis, where tenderness is usually limited to the affected area of skin. However these features occur relatively later on in necrotizing soft tissue infections and while they are fairly specific, are not sensitive indicators, with only about 10-40% of cases exhibiting these features. Areas of anesthesia due to dermal nerve ending necrosis and crepitus are also indicators of the more severe necrotizing infection<sup>3,5</sup>.

Microbiologically, the causative organisms of necrotizing soft tissue infection are divided into two groups. Type 1, that is caused by a mixed aerobe and anaerobe infection and type 2 that is mono-microbial and most commonly caused by group A beta hemolytic streptococci (*Streptococcus pyogenes*). While type 2 has been described as sometimes occurring as a mixed infection with *S. aureus*, *S. aureus* alone causing necrotizing soft tissue infection has been described as an emerging clinical entity only in the last decade<sup>6</sup>.

Necrotizing fasciitis caused by community acquired MRSA (CA-MRSA) or MSSA as a single pathogen was initially thought to be only seen in immune-compromised patients. However literature over the last 10 years, revealed that both CA-MRSA and CA-MSSA are causative agents in the immune competent population as well<sup>6,7</sup>.

In this patient's case, while it is possible that the initial trauma resulted in micro-trauma and inoculation of the organism, it is also possible that the tissue damage that resulted

from the impact, made the underlying muscle and soft tissue susceptible to infection of an already bacteremic patient. The initial identification of the organism as MSSA may not be accurate as the quality of antibiotic sensitivity testing in the most private sector laboratories is poorly controlled, and performed without the supervision of a consultant microbiologist. The isolate could not be obtained for re-testing. The second isolate was identified in the quality controlled university microbiology laboratory. The course of the disease is very similar to that described in the literature<sup>6</sup>, and although Miller et al<sup>8</sup> document a 100% survival rate in their cases and postulate that necrotizing fasciitis due to MRSA may be less virulent than infections with other organisms, this case shows that progression to septic shock and death can occur within days, if untreated.

The emergence of MRSA as a possible etiological agent in necrotizing fasciitis raises issues regarding the empirical treatment in terms of IV antibiotics, in addition to the mandatory surgical debridement. Recommendations now include treating for MRSA until causative organism/s can be identified. Therefore, IV clindamycin for anaerobes and aerobic gram positive cocci (and for reducing toxin production by organisms), metronidazole for anaerobes, aminoglycoside or fluoroquinolone for gram negative organisms and vancomycin or linezolid for MRSA are used until such infections can be excluded.<sup>5,6</sup>

## CONCLUSION

Necrotizing soft tissue infection needs to be considered as a possible diagnosis in patients presenting with fever, cellulitis and pain out of proportion to the physical findings. Since CA-MRSA is an emerging entity it is necessary to entertain a suspicion of CA-MRSA infection and treat

empirically as delay in therapy can lead to rapid death.

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## MEDICOLEGAL ASPECTS OF MATERNAL DEATHS DUE TO PULMONARY THROMBOEMBOLISM

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### ABSTRACT

A state of hypercoagulability protects pregnant women from bleeding tendency which leads to pulmonary thromboembolism and results in medicolegal issues.

#### *Case 01*

32 year old pregnant female who developed weakness of legs, and was suspected to have Spinal Tuberculosis. Lower Segment Caesarian Section was performed and Heparin was started as she was immobile. Vertebral surgery was performed and anticoagulants were stopped. She died due to sudden onset difficulty of breathing. Allegations of medical negligence were raised by the relatives at the autopsy. The autopsy revealed bilateral Deep Vein Thrombosis (DVT) and pulmonary embolism.

#### *Case 02*

A mother who presented with a first trimester abortion and pain in right leg died following sudden onset shortness of breath. She also had a history of a previous first trimester abortion. Autopsy revealed an embolus in the pulmonary artery with swollen and congested right leg without DVT.

### CONCLUSIONS

#### *Case 01*

Regarding the allegations of medical negligence, the legal authorities will consider whether the discontinuation of

prophylactic anticoagulants before the 2<sup>nd</sup> surgery was a necessity and whether it was for the best interest of the patient.

#### *Case 02*

Immunological syndromes and inherited thrombophilia could be considered as underlying causes for multiple first trimester abortions and Deep Vein Thrombosis. The Importance of performing the risk assessment of DVT when indicated is highlighted.

### KEY WORDS:

Deep Vein Thrombosis, immunological syndromes, inherited thrombophilia,

### INTRODUCTION

The two main embolic conditions that lead to maternal death are pulmonary thromboembolism and amniotic fluid embolism. Pulmonary thromboembolism occurs when a part of a thrombus, usually dislodged from a deep vein thrombus, passes into the pulmonary circulation, occluding the pulmonary arteries<sup>[1]</sup>. It is a leading cause of maternal death as the risk of venous thrombosis is increased five-fold in pregnancy<sup>[2]</sup>.

The state of hypercoagulability which protects pregnant women from bleeding tendency may lead to pulmonary thromboembolism<sup>[2]</sup> and result in medicolegal issues such as allegations of medical negligence and ascertainment of the cause of death.

### **Case 01**

A 32 year old pregnant mother developed weakness of legs. A caesarian section was performed and Heparin was started as she was immobile. Spinal tuberculosis was suspected and vertebral surgery was performed and anticoagulants were stopped for the surgery. She developed sudden onset difficulty of breathing and died. Autopsy revealed bilateral DVT and in-situ dissection of the heart showed an embolus extending in to the pulmonary artery (Fig.1). Cause of death was pulmonary thromboembolism due to DVT. Allegations of medical negligence were raised by the relatives at the autopsy.



**Figure 1 : An embolus extending in to pulmonary artery**

### **Case 02**

A 34 year old mother presented with a first trimester abortion and pain in right leg, died with sudden onset shortness of breath. She also had a history of a previous first trimester abortion. Autopsy revealed an embolus in the pulmonary artery with swollen and congested right leg without DVT. The immediate cause of death was pulmonary thromboembolism but the underlying cause of death was not ascertained. Probable cause of death was pulmonary thromboembolism due to DVT.

## **DISCUSSION**

Venous thromboembolism is one of the leading causes of maternal mortality<sup>[3]</sup>. The

incidence of pulmonary embolism during pregnancy is about 1 in 2500<sup>[4]</sup>. The maternal mortality is greater than 80% if left untreated and less than 1% if treated early. In about 70% of cases, DVT is the instigating factor<sup>[4]</sup>.

### **Case 01**

Predisposing factors of DVT found in this case were immobility, hypercoagulable state and vascular trauma due to surgery. In this case, prophylactic heparin was started but was not continued due to the second surgery.

Regarding the allegations of medical negligence, the legal authorities will consider whether the discontinuation of prophylactic anticoagulants before the 2<sup>nd</sup> surgery was a necessity, whether it was for the best interest of the patient or whether clinicians acted in accordance with accepted practice. ‘Bolam test’ would be applied for assessing the appropriate standard of reasonable care in negligence cases involving skilled professionals such as doctors. According to the Bolam test, a doctor is not guilty of negligence if he has acted in accordance with a practice accepted as proper by a responsible body of medical men skilled in that particular discipline<sup>[5]</sup>. Since the maternal mortality of pulmonary thromboembolism during pregnancy is high, whenever there is doubt, examination and investigation should be started early by clinicians in order to resume anticoagulant therapy<sup>[6]</sup>. The ‘Inquirer in to sudden deaths’ was made aware regarding the alleged potential negligence.

### **Case 02**

When the patient complained of leg pain, DVT had not been suspected probably because of the absence of obvious risk factors. Clinical assessment of pulmonary thromboembolism may be difficult due to nonspecific signs and symptoms, especially in pregnant women<sup>[1]</sup>.

Further, it is important to perform ‘Risk assessment of DVT’ when indicated. With

right limb pain, the performance of DVT risk assessment and features such as tenderness, warmth, positive Homan's sign, and a palpable cord over the course of the leg veins had not been elicited by clinicians. Homan's sign, (pain in the calf with dorsiflexion of the foot), is a clinical sign of DVT in the leg veins<sup>[4]</sup>. Therefore, the importance of performing 'Risk assessment of DVT' when indicated is reiterated.

Since she had multiple first trimester abortions, immunological syndromes and inherited thrombophilia could be considered as underlying causes for pulmonary thromboembolism.

Immunological syndromes (eg. Antiphospholipid syndrome) may lead to a variety of clinical manifestations due to venous and arterial thrombosis. It is also an important cause of early and late pregnancy deaths and morbidities<sup>[7]</sup>. The postmortem diagnosis of immunological syndromes is done by antibody tests.

Inherited thrombophilias are also associated with an increased risk of venous thromboembolism and also have been linked to adverse outcomes in pregnancy<sup>[8]</sup>. They are disorders with genetic defects and are detected at the postmortem by paraffin embedded tissues using PCR<sup>[9]</sup>.

In conclusion, when allegations of medical negligence are raised, the 'Inquirer in to sudden deaths' should be made aware regarding the alleged potential negligence. 'Bolam test' can be applied for legal purposes. If multiple first trimester abortions are found, immunological syndromes and inherited thrombophilias should be considered as underlying causes for pulmonary thromboembolism. Performing 'Risk assessment of DVT' when indicated is highlighted.

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**Journal article:** 1. Khong TY, Healy DL, McCloud P1. Pregnancies complicated by abnormally adherent placenta and sex ratio at birth. *British Medical Journal* 1991;302:625-6.

**Book:** 2. Sherlock S. *Diseases of the liver & biliary system.* Oxford: Oxford University Press, 1985.

**Article in book:** 3. Blumgart LH. Benign biliary strictures. In: Tandon BN, Nayak NC, Nundy S, eds. *Advances in liver diseases.* Delhi: Macmillan India Ltd, 1989:164-82.

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