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INFORMATION

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CASE REPORTS

LETTER TO THE EDITOR

PESTICIDE POISONING – AN EPIDEMIOLOGICAL AND HISTOPATHOLOGICAL STUDY

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ABSTRACT:

The objectives of this hospital based cross-sectional study were to evaluate the socio-demographic profile, manner of death and histopathological changes in the lungs, liver and kidneys of individuals who died of pesticide poisoning. All fatal cases of pesticide poisoning from February 2011 to January 2012 were evaluated. Socio-demographic profile, type of exposure and manner of death were recorded for each of the cases. Autopsy was performed with detailed internal and external examinations. Random portion of Lung, Liver and Kidney were collected and fixed in 10.0% Formalin. Hematoxylin and Eosin stained sections were examined and findings recorded.

The total number of deaths due to fatal pesticide poisoning was 9.6%. Highest frequency of poisoning (23.4%) was seen in the age group 20 - 29 years. The peak time of consumption of poisoning was between 6.00am and 12.00noon. The manner of poisoning was suicidal in majority of the cases. Histological findings indicated that congestion was the most common histopathological change; being observed in 60.0%, 66.0% and 74.0% of cases of liver, lung and kidney respectively. Histopathological features are supportive in establishing the diagnosis but further studies with larger sample size may be more illuminative in explaining the histopathological changes occurring due to these chemicals.

Keywords: Pesticide poisoning, histopathology, lung, liver, kidney

Submitted: May 2013; Accepted: October 2013

INTRODUCTION:

Acute poisoning by Pesticide compounds is a major global clinical problem, with thousands of deaths occurring every year. Most of these pesticide poisoning and subsequent deaths occur following an intentional self ingestion of the poison [1]

The potential adverse impact on human health from pesticides exposure is likely to be higher due to easy availability of highly hazardous products, and low risk awareness. Overexposure to pesticides can occur because of easy access, lack of adequate labeling and during mixing and spraying of pesticides.. Spray operators and bystanders can be affected [2]. Hospital- based studies from five major hospitals across Nepal in 1999-2000 showed that OP (organophosphorus) compounds were the most common forms of poisoning [3]. The increasing use of various pesticides for insect control has attracted much attention to extensive investigations on the toxic actions of pesticides [4]. Hence in the present study, we evaluated whether any specific histopathological changes occur in the lung, liver and kidney of individuals who died of pesticide poisoning.

The objectives of the study were to find out the Proportion of individuals who died of Pesticide poisoning out of the total number of unnatural deaths which were subjected to Medico legal autopsy at the police morgue of the hospital. Their social and demographic profile and manner of death; whether it was suicidal, homicidal or accidental. To find out if there was any specific morphological and histopathological alteration in the lung, liver and kidney in those individuals who died due to pesticide poisoning.

MATERIALS AND METHODS:

This was a hospital based cross sectional prospective study and was commenced after approval by Institutional Ethical Committee. All fatal cases of pesticide poisoning either admitted to the Emergency department or brought dead to the Police Morgue, in Department of Forensic & State Medicine of the hospital during February 2011 to January 2012 were evaluated. Decomposed bodies and death due to other disease condition were excluded from the study. Detailed history was taken from inquest report and from relatives of the deceased. Further toxicological evaluation reports confirmed the type of pesticides. Socio-demographic profile, type of exposure and manner of death were recorded for each of the cases. Autopsy was performed with detailed internal and external examinations. Random portion of Lung, Liver and Kidney were collected and fixed in 10% formalin and sent for Histopathological evaluation. Hematoxylin and eosin stained sections were examined and the findings recorded. Statistical evaluation was done by appropriate statistical method.

RESULTS:

The total numbers of autopsies carried out from February 2011 to January 2012 were 2131. Among all these, the total number of deaths due to fatal pesticide poisoning was 205 (9.6%). Of these, 177 (86.3%) were Hindus and 28 (13.7%) were Muslims. Age range varied from 1 to 80 years whilst the highest frequency of poisoning (23.4%) was seen in age group 20-29 years old. 86.8% of deceased were married. Gender distribution of the victims indicated 140 (68.3%) males and 65 (31.7%) females. A total of 161 (78.5%) were from the rural areas and 44 (21.5%) were from the urban areas. Out of the 205 fatalities, 157 (76.6%) received initial treatment in the emergency department before death and the remaining 48 (23.4%) were brought dead to the morgue. The peak time of consumption of poisoning was between 6.00am and 12.00noon. (Time wise distribution of poison intake is shown in Table-1).

Organo-phosphorus pesticides were the major poison chemical used as shown in Table 2.

Table 1: Time Wise Distribution of Poison Intake

Groups	Time Periods	Number (%) of victims
A	12.01 a.m.-6.00 a.m.	47 (22.9%)
B	06.01 a.m.-12.00noon	94 (45.9%)
C	12.01 p.m.-6.00 p.m.	39 (19.0%)
D	6.01 p.m.-12.00 midnight	25 (12.2%)
	TOTAL	205 (100.0%)

Table 2: Distribution According to Type of Poison Consumed

Pesticide Used	Number of Cases
Organo-phosphorus	160 (78.0%)
Carbamates	25 (12.2%)
Organo-chlorine	16 (7.8%)
Miscellaneous	4 (2.0%)
TOTAL	205 (100.0%)

The major manner of poisoning was suicidal in 187 (91.2%) cases, followed by accidental in 14 (6.8%) cases and homicidal in 4 (2.0%) of cases. Fifty of the 187 cases of organo-phosphorous poisoning were chosen after excluding any other associated illness. Random sections from Lung, liver, and kidney were taken for histopathological evaluation. It was seen that congestion was the most common gross and histopathological change; being observed in 60.0%, 66.0%, 74.0% of cases of liver, lung and kidney respectively. Details of predominant histopathological findings are presented in Table 3.

Table 3: Histopathological Features in Liver, Lung and Kidney in OP Poisoning

Microscopic features in liver	**No. of cases (n = 50)**	**Percent**
Congestion	30	60.0
Microvacoualization	26	52
Hydropic degeneration	22	44
Mononuclear infiltration	24	48
Micro & macro-vesicular steatosis	22	44
Bile pigment in the cytoplasm	12	24
Sinusoidal dilation	5	10
Centrilobular necrosis	8	16
Hemorrhage	10	20
Patchy necrosis	7	14
Microscopic features in lung	**No. of cases**	**Percent**
Congestion	33	66
Edema	31	62
Hemorrhage	31	62
Collapse of Alveoli	22	44
Alveolar thickening	16	32
Alveolar wall disturbance	6	12
Dilated capillaries	8	16
Microscopic features in kidney	**No. of cases**	**Percent**
Glomerulus congestion	37	74
Intraparenchymal congestion	32	64
Tubular degeneration	16	32

DISCUSSION:

In the present study, organo-phosphorus poison (monocrotophos, dimethoate) was the most common type of poison consumed for both homicidal and suicidal purposes. Studies from other regions have also reported organophosphates [5] as common causes of poisoning.

In the present study the highest numbers of deceased (23.4%) were in the age group of 20–29 years followed by 15.1 per cent in below 20 years age group. Since most of the cases were suicidal in nature, the distribution pattern illustrates the psychological vulnerability in this age group. Similar patterns have been reported in a number of other studies. [5-8]

Males (68.3%) outnumbered females (31.7%) in this study. As males are major bread earners in Indian society, possibly they suffer from stress due to financial difficulties. This was the reason that is given in other studies where male were preponderant. [5, 9]

Suicide (91.2%) was the most common mode of poisoning in this study. Poisoning was more common in the married group irrespective of the gender. This is comparable with other studies, and shows that married persons may become victims of greater stress than single individuals in their day-to-day lives. The different causes of the stress culminating in poisoning ranged widely from marital and family discords to financial and job related problems to educational and other matters. [5, 9, 10]

Organophosphates act as irreversible cholinesterase inhibitors. The inhibition of cholinesterase activity leads to the accumulation of acetylcholine at synapses, causing overstimulation and subsequent disruption of transmission in both the central and peripheral nervous systems. [11] This leads to hyper secretion and paralysis of respiratory muscles. Liver is the organ where bioactivation and detoxification of OP compounds takes place. But they are eliminated primarily through kidneys [12]. Thus the lung, liver and kidney were selected for Histopathological evaluation. Very few studies are available about organophosphorus compounds causing histopathological changes of various organs in humans [13]. However, many studies have been conducted in past on animals and humans to assess the effect of different types of pesticides on the histology of cells and tissues [14-19].

In present study we found several histopathological changes in victims of fatal pesticide poisoning. Seema S. Sutay [13] studied the pattern of histo-pathological changes of liver in poisoning. Out of a total of 78 cases affecting liver organophosphorous was the poison used in 43 of the cases. According to the author congestion was seen in 20 (46.5%) and fatty changes in 15 (34.9%) cases; centrilobular necrosis in 4 (9.3%), and

Sinusoidal dilatation in 3 (7.0%) cases. In another study by G. Lemercieret al [14], the effect of Soman, a powerful organophosphorus (OP) cholinesterase inhibitor, was investigated in the central nervous system (CNS) of Wistar rats, the surviving rats exhibited neuronal changes similar to those of hypoxic encephalopathy. Studies on the Effects of OP compounds on pancreas have also been published. [15]

Another study [16] in year 2010 in Jarzouna, Tunisia shows Impact of dieldrin on liver morphological and biochemical parameters on the liver of Wistar rats. The dieldrin effect on rats was tested after a single intraperitoneal injection of two doses: 3 and 6 mg/kg and observations were made 4 days later. Histological examination of the liver of dieldrin-treated animals revealed cytoplasmic vacuolation, focal necrosis and nuclear enlargement of hepatocytes.

Congestion of the liver and other vital organs, in gross and microscopic pathology examination were observed in most of our cases.

In liver, common microscopic finding were portal and sinusoidal congestion (60%), microvacoualization (52%), hydropic degeneration (44%) and mononuclear infiltration (48%), micro & macro-vesicular steatosis (44%).These findings differ in percentage compared to the study by SS Sutay. [13]

In the lung microscopy, congestion of alveolar capillary walls was the most common finding in our study (73.3%), followed by interstitial oedema, hemorrhage and alveolar wall thickening. No data is available on Histo-Pathological changes in lung in OP poisoning. Studies on aluminum phosphide poisoning are available. [17, 18]

Major histopathological findings of the kidney showed glomerular and interstitial congestion. Satar S et al [19] studied the ultrastructural effects of acute organophosphate compound methamidophos poisoning on rat kidney and found no ultrastructural changes.

CONCLUSION:

Pesticide poisoning is a major health problem in rural Bengal leading to significant fatalities. Adult married males constitute the highest number of victims and suicide is the most common mode of poisoning. Diagnosis of poisoning is based on characteristic clinical features and history of exposure to a known OP compound. Chemical analysis is done to confirm the diagnosis. Histopathological features are supportive in establishing the diagnosis but further studies may be more illuminative in explaining the histopathological changes occurring due to these chemicals.

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HIV/AIDS AMONG YOUTHS IN GULU: A POST-CONFLICT NORTHERN UGANDA

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ABSTRACT:
HIV/AIDS is one of the commonest reasons for admission of youths in Gulu Hospital. There are no specific studies that have been carried out to determine the prevalence of HIV/AIDS among the youths in this post-conflict region. This study aimed to describe the characteristics of HIV positive youths attending care in Gulu Hospital. A cross-sectional study was conducted among youths aged 13 to 24 years in the specific clinics of Gulu Hospital from January to December 2010 to identify and describe those youths that were HIV positive. A total sample size of 280 HIV positive patients was calculated using the Kish & Leslie formula. Ethical approval was obtained from Gulu Hospital Committee. Majority of respondents 174 (62%) who re-tested for HIV knew their HIV status and most tested between April and June 90 (32%). HIV infection was more prevalent among females 252 (90%), particularly those who were single 118 (47%). HIV infection is more common among female youths in the post-conflict northern Uganda.

KEY WORDS: HIV/AIDS, youths, Gulu Hospital, Post-conflict region, Northern Uganda.
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INTRODUCTION:

The prevalence of HIV infection in the war affected northern Uganda is higher than the national average of 6.5% [1]. In Uganda, the Ministry of Health statistics indicate that about 110,000 children are living with HIV/AIDS out of an estimated population of 33 million people [1] and out of these, 50,000 were in urgent need for antiretroviral treatment and only 12,000 of these children were receiving this essential treatment [1]. These children sooner than later grow into adolescence and adulthood and increase further the infection force to their uninfected cohorts, thus further driving up the HIV/AIDS epidemic [1]. Some of the social and environmental factors that make youths more vulnerable or place them at a special disadvantage are attributed to unsuccessful or inadequate development process disrupted by war or major pandemics [1, 2]. It has been shown previously that population movements, sexual violence and break down of established social values dramatically increase the spread and transmission of sexually transmitted diseases including HIV/AIDS [1, 2]. It was also further observed that reduced access to reproductive health services increases the vulnerability of the adolescents in particular to HIV/AIDS [1,2]. Unprotected sex makes adolescents vulnerable to STDs including HIV/AIDS and in the case of girls, to unwanted pregnancies and the possibility of unsafe abortion [3]. There is evidence to suggest that despite a significant decline in HIV/AIDS prevalence between 1992 and 2002 in Uganda from about 18% to less than 10%, HIV/AIDS prevalence has stagnated over the last 5-9 years at between 6.1 and 6.5% and may be rising in some parts of the country or specific population groups [4, 5, 6]. The experience of idleness coupled with the high levels of poverty, illiteracy and indiscriminate unprotected commercial sexual intercourse could have exposed many youths to HIV/AIDS infections in northern Uganda [1,5,7,8]. Whereas the Internally Displaced Peoples (IDPS) camps situation has been claimed by many scholars and researchers to have been a protective factor against HIV/AIDS spread by isolating this community from other cultures and regional influences [7, 8], such hypothesis may only be logical against common observation especially if the communities got cut off from the rest when there was already HIV infection within it, and where Aid workers and soldiers continued to frequent these communities and forceful sexual encounters were sometimes reported [8]. In addition, down-staging the probable effect of war which is the only main exception to the northern Uganda compared to other regions of Uganda given the fact that the HIV/AIDS prevalence in the north is much higher than most regions except the central region of Uganda may perhaps create a false impression that war had no effect in the spread of HIV/AIDS [1,7,8]. Therefore, the encampment could have cushioned this society from other threats such as physical security but

not social threats such as HIV/AIDS [8]. It has also been truly observed that the effect of conflict on the rate of HIV/AIDS infection has been equivocal in many studies [9]. In Angola for example, it was argued that the restricted mobility due to war could have accounted for low prevalence of HIV/AIDS compared to their neighbouring countries such as South Africa, Namibia, and Lesotho [10]. A more recent study in seven countries including Uganda concluded that there was insufficient evidence to support or deny that HIV incidence increases in conflict situations [11]. It is further not clear whether or not HIV infection rates sky rockets soon after the end of conflict when relative peace may have encouraged more sexual activity akin to the child boom following World War II [12]. Therefore, one may argue that since most of the studies that failed to demonstrate high HIV infections in the conflict areas were prevalence rather than incidence studies, the equivalently high rates of death in the conflict regions could have accounted for their failure to show excess HIV/AIDS infection in these regions.

However, with all this background information, HIV/AIDS remains a major public health problem all over the world, but particularly in Uganda where it has caused in-calculable human suffering, social and cultural disruption and huge economic losses [1,2,18]. Almost three decades after the first reported AIDS cases in Uganda [1, 37], AIDS has continued to pose a significant public health and development challenge especially among the most productive age group including the youths [1,18]. Uganda has a generalized HIV epidemic with a prevalence of 6.5% in adults and 0.7% in children [1, 38]. Approximately 1.1 million people in Uganda are HIV infected and estimates indicate that over 100,000 new infections occur annually [2, 38].

In 2008 alone, an estimated 110,694 new HIV infections occurred countrywide and approximately 61,306 people died from HIV/AIDS-related illnesses [1, 38]. So far, prevention is the only viable method that is used to control the spread of HIV as there is no definite cure for the infection [1, 39]. In Uganda, much effort has focused on prevention messages to curb the spread of HIV through prevention messages so as to curb the spread of HIV/AIDS through heterosexual activities, blood transfusion, mother-to-child transmission, post-exposure prophylaxis (PEP) for health workers and rape survivors [1, 40]. One factor that has been unique for Northern Uganda and particularly Gulu has been the civil conflict for the last 20 years and this caused disruption of services and population were displaced in to Internally Displaced peoples Camps (IDPS) for safety from the insurgency [1,7,8]. The population of over 2 million people were being fed and looked after by the United Nations World Food Program in their displaced camps for over 10 years [1, 8] and this led to several other socio-economic, health and cultural decline in this part of the Country [1, 37]. The

prevalence of HIV/AIDS in Northern Uganda has since 2000s increased and more especially among the youths [1, 38].

The lack of agreement on civil conflict as a driver of HIV infections, inadequate information on HIV incidence in immediate post conflict region and role of relative peace in driving HIV infections and the centrality of the youths in the socioeconomic and cultural longevity of society motivated us to perform this cross-sectional study to evaluate the influence of HIV/AIDS infection on disease profile amongst the youths attending clinics in Gulu hospital.

Gulu Hospital where the study was conducted is a Regional Referral Hospital, which is a teaching hospital for Gulu University Medical School and it has 350 beds. This Hospital is a public hospital which is funded by the government of Uganda and does not charge fees for its services except in private clinics and wards. It has several Departments including Out Patients department (OPD), Psychiatry, Surgery, Internal Medicine, Voluntary Counselling & Testing (VCT), Paediatrics, Obstetrics and Gynaecology, ophthalmology, Ear Nose &Throat (ENT), Casualty, Ante Natal Clinic (ANC) and several other specialized clinics which are headed by a specialist.

Our study was conducted in this hospital in the OPD, VCT and Casualty unit for the youths who reported to the hospital for medical advice and treatment.

SUBJECTS AND METHODS:

We conducted a cross- sectional study on 280 HIV/AIDS positive youths who attended specific clinics in Gulu Hospital from January to December 2010. Questionnaires were used to obtain medical information from the VCT, OPD, and casualty units. From the previous hospital reports, most youths attended these clinics compared to the others and therefore these clinics were selected purposively to be the research sites and a representation of the other clinics. The clients were recruited as and when they arrived at those clinics and consent/Assent was an inclusion criteria. Independent variables studied included age, gender, residence, occupation, marital status and the level of education, while the dependent variables were positive HIV status and month when VCT was conducted.

Gulu Regional Referral Hospital is at the center of Gulu municipality which is about 343km north of the capital, Kampala. Northern region where the hospital is situated is just recovering from over 20 years of civil war. Gulu district is one of the regional centers for northern Uganda and draws mainly rural population; many of whom were displaced into camps famously known as the internally displaced peoples camps (IDPS) for safety from insurgency. According to Gulu District Development Plan 2007/2008, the district has a total population of about 380,000 people [13]. It is estimated by

the health centre reports at the District Health office that over 10% of the populations in the district were infected with HIV/AIDS. It is also reported that the majority of the population of Gulu (over 60%) are composed of youths who are less than 30 years of age [13].

Gulu Municipality where the study was conducted is also one of the highway towns along the Great North Road which traverses the entire sub Saharan Africa from Cape Town in South Africa to Cairo in Egypt. There is a great interaction between the long distance heavy truck drivers on this highway to South Sudan and the population of Northern Uganda. Brisk trade also occurs between the border points in Gulu and South Sudan. The majority of the population in the post conflict region particularly Gulu are youths and many of whom missed the chance for formal education.

Participants were selected consecutively as and when they arrived at the hospital for medical care in these selected departments. Their data were recorded on a proforma which was designed to capture the variables being investigated(socio-demographic characteristics, positive HIV status and month when the tests were taken). Informed consent was obtained from the youths that attended the various clinics before the HIV tests were conducted. Those who accepted the HIV test but declined from being included in the study were excluded (23 youths). Pre and post-test counseling was provided to each of the youths and those who were found positive, referred to the relevant departments for further HIV/AIDS management and Care (340 youths). Those who were negative were advised to take care and avoid risky sexual behaviour and thereby prevent themselves from acquiring the virus (320 youths). Those below 18 years of age who came without accompanying adults were asked to return with an adult the next day and those who could not come back with the parent/guardian (35 youths) were excluded from the study. In addition, youths that did not consent to the tests and those that had not lived in Gulu in the last one year (37 youths) were excluded. None of the youths who were eligible was too ill to participate in the study.

Data was collected from the youths after they had all been treated for their various illnesses. Each individual would be asked to freely accept or decline to participate in the study after receiving their treatment with assurance that their decision would not in any way affect the access to care from the hospital. Questionnaire was used to collect data on the socio-demographic characteristics and knowledge about HIV status. This questionnaire was interviewer-rated and two trained research assistants, who were clinical officers, collected the data. The questionnaire was pre-tested among students from the Gulu clinical officers' training school. The time for the collection of data was from 10:00am in the morning to 4:00pm in the evening with a lunch time break from 12:00pm to 2:00pm from Monday to Friday. Data collection was not carried out on

Saturdays and Sundays as these were rest days for the researchers. After the pretest, the questionnaire was improved to help respondents recall some of the information which was relevant and not previously included in the questionnaire. The pre-tested questionnaire was then administered to these respondents individually so as to maintain privacy and ensure accuracy of information given. The questionnaire was written in simple English and translated into Luo, the regional language which is widely spoken by the majority of the population in this region by the investigators in conjunction with trained interpreters. The interviewers were clinical officers, whom Luo was their first language and therefore the administration of the questionnaire and the interpretation of the information was not a limiting factor. Each interview took an estimated 20 minutes from the beginning up to the end of the session.

Dependent variable: HIV positive status of the youths and month when VCT was carried out

Independent variables: Gender, age, level of education, marital status and residents.

SPSS statistical software package version 15.0 was used for the univariate analysis of the socio-demographic characteristics and other proportions. The data was presented in charts and graphs for easy interpretation.

The study was approved by the Research and Ethics Committee of Gulu Hospital. Individual informed consent and assent were obtained from each participant and confidentiality of information was maintained for all participants.

RESULTS:

The sample size was 280 HIV positive youths and there were 252 females (90%) and 28 males (10%). These participants were selected from 3 out of more than 10 clinics in the hospital. The study described the socio-demographic characteristics of those that were found HIV positive during the study period.

The ages: The ages of the youth ranged from 13 to 24 with a mean of 22 $\pm$ 1.5 years.

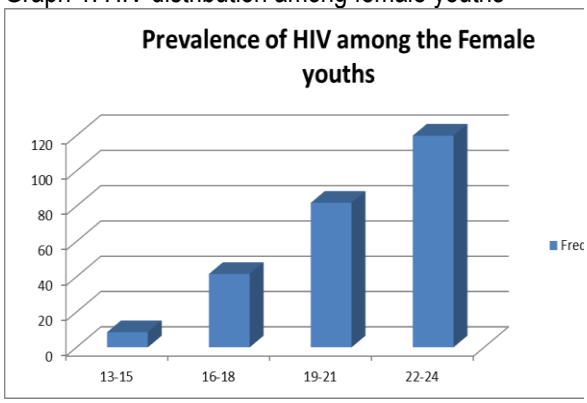
Graph 1: Shows the HIV distribution by age among female youths: The majority of the females 120 (47.6%) were aged between 22-24 years; while 82 (32.5%) aged 19-21 years; 42 (16.5%) aged 16-18 years; 9 (3.4%) aged 13-15 years.

Graph 2: Shows the HIV distribution by age among male youths: The majority of the males 17 (60.5%) were in the age group 22-24 years; 7 (24.5%) aged 19-21years and 4 (15%) aged 16-18 years.

Gender: The majority 252 (90%) of the youths who were recruited and tested for HIV were females.

Marital status: Figure 1(a) shows the marital status of female youths: Of the female youths tested 113 (45%) were single, 63 (25%) were widowed; while 33 (13%) were married; 18 (7%) divorced; 25 (10%) have a boyfriend.

Graph 1: HIV distribution among female youths



Graph 2: HIV distribution among male youths

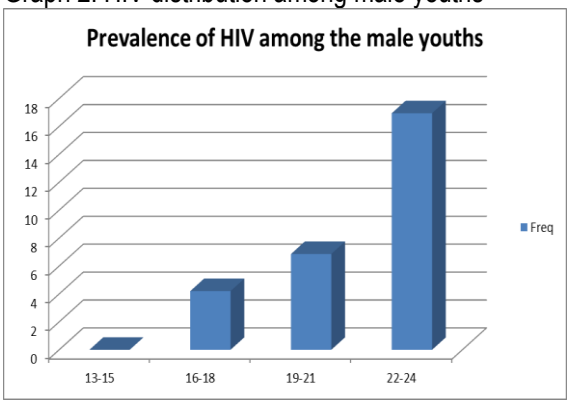


Figure 1(a) marital status of female youths

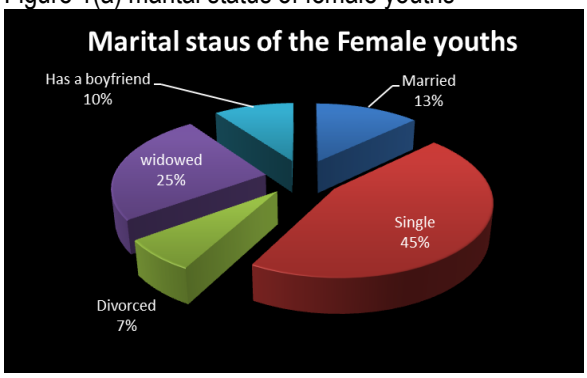


Figure 1(b) marital status of male youths

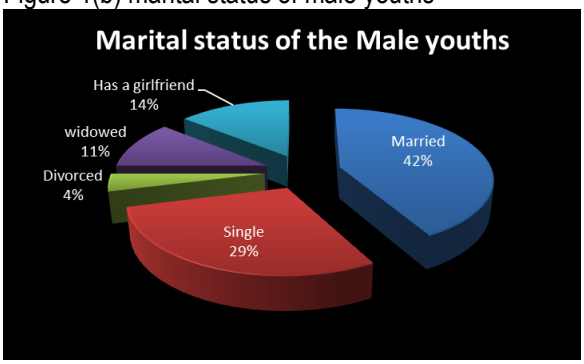


Figure 2a: Residents of the male youths

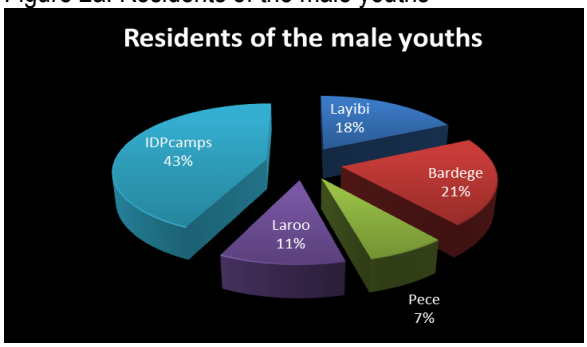


Figure 2b: Residents of the female youths

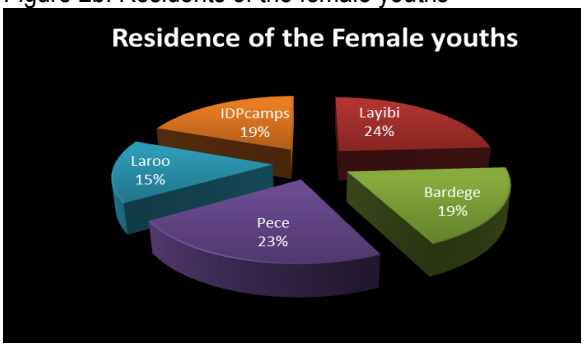


Figure 3: Period when VCT was undertaken

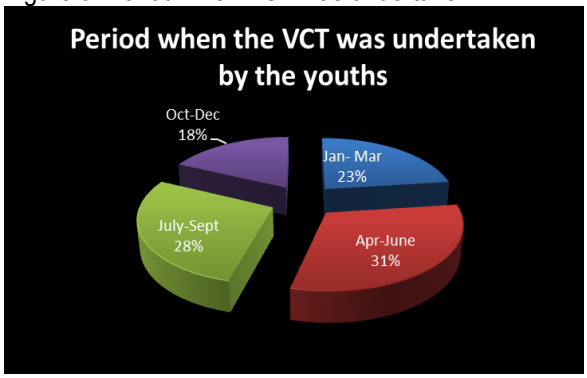


Figure 4: Level of Education of the youths

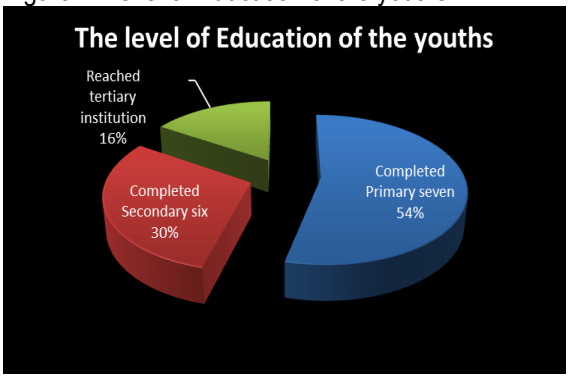


Figure 1(b) Shows the marital status of male youths: Of the male youths tested 12 (42%) were married; 8 (29%) single; 3 (11%) widowed; 4(14%) have a girlfriend and 1(4%) divorced.

Knowledge of their HIV status before undertaking counseling and testing: The majority of the youths 174 (62%) knew their HIV status before re-testing while 106 (38%) had not tested before and did not know their HIV status. None had been tested and was not given their HIV test results.

Figure 2 (a): Residents of female youths: The majority 60 (24%) from Layibi; 58 (23%) from Pece; 48 (19%) from IDP Camps; 38 (15%) from Laroo and 48 (19%) from Bardege.

Figure 2 (a): Residents of male youths: 12 (43%) of youth from IDP camps, 6 (21%) from Bardege; 5 (18%) from Layibi, 3 (11%) from Laroo and 2 (7%) from Pece.

Figure 3: The period when VCT was undertaken: Most tests were recorded between April to June 87 (31%), followed by July to September 78 (28%), January to March 64 (23%) and the least was between October to December 50 (18%).

Figure 4: Level of Education: Most youths 151(54%) had completed primary education; 84 (30%) secondary six and 45(16%) tertiary education.

DISCUSSION:

Our study found that a great proportion of the youth in this study knew their HIV infection status before accepting to enroll in the study. The prevalence of infection amongst these youth is dauntingly high. Female youths were more affected and were more willing to test and participate in VCT compared to males. According to recent studies conducted in Africa, young people are disproportionately affected by the HIV pandemic [14, 18, 19, 20] however, in areas where the young people were aware of HIV risk factors and prevention strategies, they changed their behaviour in ways that reduce their vulnerability [14, 15, 16].

In general young people remain at the center of HIV/AIDS epidemic in terms of rates of infection, vulnerability and impact of the disease [14-20]. Although the current youth have grown up in a world changed by HIV/AIDS, recent studies have shown that many youths still lacked comprehensive and correct knowledge about how to prevent HIV/AIDS infection [14-18].

Notably despite national and local strategies to reduce HIV infections in Uganda, HIV/AIDS epidemic continues to threaten the political, social, economic and development issues in this country with a population of between 26-34 million [15, 16,17] and more specifically the post-conflict northern Uganda.

Socio-demographic characteristics:

In this study, a disproportionate number of females were represented in clinics attendance and tested to determine their HIV status. This however seems to reflect the better pattern of health care seeking behaviour among females in the region rather than a bias in the study. More females seemed to attend care in this hospital as compared to males [16, 17, 21,41]. The females were also more responsive to the post-test care and management. Similar finding of reluctance of younger males in taking up HIV testing was earlier shown in a study conducted in Western Uganda [22, 24,41].

The highest prevalence of HIV infections was among the age-group 22-24 years. This age group coincides with the age of maturity and probable onset of sexual activity but may also represent a contribution from vertically transmitted HIV infections amongst adolescence as the HIV epidemic matures. It is also probable that these adolescents could have started to engage in unprotected sexual activity rather early and indiscriminately while in the highly congested IDP camps. In that case therefore, the observed age and gender distribution may therefore reflect the aftermaths of the civil conflict on HIV infection and age distribution in this post-conflict region. In addition, youths at these age groups missed their opportunity for education while in the IDP camps and may therefore be exposed to HIV infections as they engage in casual and sex for money with high risk men such as truck drivers along the Great North Road that traverses Gulu Municipality.

This finding of a high HIV prevalence amongst youth in post-conflict region with high vulnerability factors is in agreement with a recent analysis which has shown that civil conflict increases incidence of HIV infection even after adjusting for confounding variables [25]. It is our humble view that policy makers may therefore wish to evaluate this effect of war long after the guns have gone silent and plan to mitigate populations affected by prolonged civil conflicts [26].

This study also revealed a high prevalence of HIV among single females (45%) as compared to single boys (29%). This was likely to be because the majority of the females at this age would have not been employed and had no sources of income and could therefore have been engaging in sex for money business so as to cater for their basic needs. This was similarly observed by several studies in Africa which showed that women were more socially vulnerable to HIV infections than men because of poverty, cultural and sexual norms, lack of education, and violence [27].

Many youths in Northern Uganda lost their parents during the war and were left to take charge of their families and to look after the other younger siblings [7, 8]. These child headed families were generally run by the female child who then got exposed to abuse as she attempted to fend for their families [8]. Similarly in a multi-centre study including

Kisumu in neighboring Kenya, HIV prevalence was higher among girls and this was associated with their higher vulnerability due to several factors [28, 29] such as girls had older sexual partners than boys and higher rates of herpes simplex type 2, which are both risk factors for HIV transmission [28, 29].

In this study, sub analysis among the girls showed that Layibi and Pece divisions contributed 47%, Bardege contributed 19% while the least prevalence was in Laroo division (15%). Among the male youth; Layibi and Bardege contributed the highest and Pece and Laroo divisions contributed the least. In the case of Layibi division which had the highest prevalence of HIV is likely to be because this is the area where the Great North Road passes through Gulu Municipality and heavy truck drivers mainly pack and spend nights in this division on their way to South Sudan. It was also further observed that the majority of the HIV/AIDS hotspot areas in the Municipality including trans-night bars and dance halls were situated in this division. It is perhaps likely that these exposure factors were responsible for the high prevalence of HIV/AIDS in this division of Gulu Municipality.

The majority of the youth that tested for HIV knew their HIV status. This was perhaps because the study population was mainly from the Municipality where information on HIV/AIDS was readily available and could be easily accessed through the numerous FM radio stations with excellent reception within Gulu municipality which routinely gives out information about voluntary counseling and testing (VCT) and VCT sites. There were many Non-Governmental Organizations (NGO) such as; The AIDS Support Organization (TASO), World Vision, Good Samaritan, Caritas Counseling centre Gulu, Teenager care center in Laroo and Marie Stopes which had fully developed counseling units and freely giving out health information on HIV and adolescent reproductive health. They greatly supplemented the efforts of government to educate the population about HIV/AIDS and provide VCT to the youth in this region.

The minority of the youths that had not undertaken VCT before feared the reality of a positive test results and HIV stigmatization [41]. This is no surprise because even Global AIDS epidemic contained in the UNAIDS report of 2008 revealed that seeking HIV counseling and testing was not an easy step to take because HIV testing could be a difficult task to take and this might explain why some of the male youth were unwilling to take the necessary step to get tested [41]. Some youth showed unwillingness to be tested for HIV/AIDS because of the fear of HIV stigmatization [30-32, 41].

Furthermore, a multi-center study on factors determining the differential spread of HIV in African towns showed that in Kisumu, male HIV prevalence was 19.8% and that for the female was higher at 30.1% [28] highlighting the high HIV prevalence (23%) in young women aged 15-19 years, compared with that in young men

(3.5%) [28]. The majority of the males at this age were unemployed and had no sources of income and therefore most of them did not to enter into relationship because of the fear of the expenditures involved [28]. The situation was slightly different among the female youth of the same age group who got involved with older male sexual partners who had the financial resources. Such a contrasting HIV prevalence between boys and girls is a pattern observed in many parts of sub-Saharan Africa [28, 29]. The poverty situation often forced females into an unprotected commercial sex in the hope of getting money for survival and to cater for their basic needs [28, 29]. Furthermore, recent studies throughout the sub-Saharan Africa have indicated that, HIV infection rates among teenage women were over five times higher than the rates for teenage males [29, 32, 33]. In Kenya for example, nearly one teenage woman in four is living with HIV, compared to one in twenty five teenage males [33]. These differences between the prevalence of HIV among females compared to males were based on the broad information from the study area giving a fair representation of the study population [33]. The physical immaturity of younger women and women's "lower status" in society may contribute to these disproportionate differences in the HIV infection rates among the two sexes [34, 35]. Women's "lower status" may prevent them from having control of their sexual relationships. For example, studies on women's first sexual experience showed that over half of young women in Malawi and over 20 percent of young women in Nigeria experienced forced sexual intercourse [34, 35]. This factor may perhaps be a major driving factor to the spread of HIV/AIDS among these youths and the significant differences between the 2 sexes.

In this study, the majority of clients tested for HIV during April to June period. Most youths were willing and ready to test during the mid-year after celebrating the festive seasons like Christmas, New Year and Easter celebrations. It is probable that they feared, "a positive test result" prior to those celebrations because it would interfere with their happiness and merry-making. It is also possible that they could have engaged in unprotected sexual intercourse during the festive seasons and were concerned about the possibility of infections and they therefore sought testing and care in the aftermaths of the celebrations.

This study revealed that despite the strategies the government of Uganda and the NGOs are putting in place for prevention and widespread of HIV, the virus has continued to infect the youth. To some extent, HIV control and prevention suffers from budgetary constraints just like other health conditions in sub-Saharan Africa. Limited budgets, problems imposed by the HIV epidemic and few health care providers mean that improving reproductive health services is still a major challenge for most sub-Saharan African countries [36]. The factors that make the youths much more vulnerable despite

the massive efforts made by all stakeholders need further exploration.

More still, it has been observed in previous studies that many African parents were uncomfortable talking about sexuality with their children while others lack accurate sexual health knowledge [34]. In Africa, cultural barriers, age and gender differences have been found to contribute to inadequate or complete reluctance for the parents to discuss sexual matters in their families [14, 36] and these could impact negatively in the sexual and reproductive development of their children.

In conclusion, the majority of the youths were females and the prevalence of HIV/AIDS was highest among 22-24 years and least among 13-15 years. Higher prevalence was observed among single females and most youths accepted VCT between April and June.

Recommendations: The challenges facing Northern Uganda are enormous and especially given the severity of HIV/AIDS epidemics among the youths. The Ministry of Health needs to introduce and strengthen the monitoring of VCT services in all health facilities. Focused VCT and adolescences friendly reproductive health services needs to be strengthen too. The effect of the 23 year old war in Northern Uganda should be explored as a possibility for making the youths resistant to behaviour change messages and with resultant high prevalence of HIV/AIDS among them.

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DOCUMENTING CHALLENGES AND VIABLE STRATEGIES IN THE MEDICAL SUPPLY SYSTEM OF THE CENTRAL PROVINCE, PAPUA NEW GUINEA

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ABSTRACT:
Central province is one of twenty two provinces that make up Papua New Guinea (PNG). With varied vegetation from mountainous terrains to coastal plains, limited basic infrastructure, growing population and lack of scheduled air services to remote areas make distribution of medical supplies a challenging task for the province. Medical supply logistics studies have mostly been from government reports which have deemed both the push and pull distribution systems as not fully functional. In addition, the media has frequently pointed to shortage of medical supplies in Health centres (HCs), Health Sub-Centres (HSCs) and provincial hospitals in PNG. There have been limited research reports in this area of interest. Hence the need to study and document challenges facing the medical supplies procurement and distribution system in the Central province as a typical setting area and suggest a viable interventional system. This was a descriptive cross-sectional study designed to assess the extent of in-province distribution of medical supplies and to identify viable strategies to improve the current system. The study was conducted in Central province which is located along the south-east coast of mainland PNG. Semi-structured questionnaires were used to carry out interviews with personnel's at HCs and HSCs. In addition, two sets of structured questionnaires were developed to interview key informants within the supply system and compare other distribution systems working within the province. Furthermore, a tracking and monitoring form was used to assess the overall supply process of the province. The findings indicated limited funding, non-availability of a reliable transport system, inadequate storage space and limited adherence to standard operating procedures (SOPs) of inventory control systems. In addition, fragmented communication and collaboration among the different parties that use the system and the ill-defined roles and responsibilities of personnel along the pipeline contributed to the current breakdown of the supply system in the province. There are medical supplies reaching the rural HCs of Central province however, not as efficiently and effectively as anticipated. Overall the whole medical supply distribution system lacked proper reporting and feedback mechanisms to provide up-to-date logistics information from HCs to Area Medical Store (AMS) and vice versa. The current pull distribution system should be maintained with viable strategies of introducing 'delivery teams' to provide the link between HCs and AMS; in doing so better advancements would be seen in the medical supply distribution system.

KEYWORDS: Medical Supplies, Distribution, Supply System, Central Province, Papua New Guinea

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INTRODUCTION:

Central province is one of the twenty-two provinces that make up Papua New Guinea (PNG). The province consists of four districts: Abau, Rigo, Kairuku-Hiri and Goilala [1]. Vegetation varies from mountainous terrains to coastal plains, limited basic infrastructure and a population of about 237,016 with a growth rate of 2.3% [2,3]. In addition there is lack of scheduled air services to remote areas, which makes distribution of medical supplies a challenging task for the province. There are a total of ten health centres (HCs); twenty-five health sub-centres (HSCs) of which one was closed down due to vandalism; two urban clinics (UCs) and one hospital [2,4]. Over the years the province rates poorly with respect to the National Health Indicators; most HCs and HSCs have deteriorated buildings over the years that they rarely admit patients [2]. The top five leading causes of morbidity and mortality in the province are: pneumonia for children < 5 years, malaria, accidents and injuries, simple cough and other respiratory tract problems [2, 5].

Logistics is defined as "the science (and art) of getting the right amount of the right things to the right places at the right times" [6] and consists of four main components: selection, procurement, distribution and utilisation. This study will focus on the distribution aspect of logistics; which begins when health commodities are dispatched by the manufacturer or supplier and ends when drug consumption information is reported back to the procurement unit [6]. Distribution of medical supplies involves storage facilities and transport links at various levels throughout the supply system; there are two broad distribution systems: pull and push systems. A distribution system is considered a pull system when each lower level of the system determines the types and quantities required, hence determined by the patient whilst a push system is when the supply source at higher levels in the system determine the types and quantities of health commodities required for the patient. There have been considerable number of studies conducted worldwide varying from district, state/province to national and multi-country reports; recognising and finding ways of improving accessibility and availability of essential medicines at an affordable cost [7-11]. In the Central province as well as in PNG as a whole, information on medical supply logistics have mostly been from government reports which have deemed both push and pull distribution systems as not fully functional [12-14]. While media reports have emphasised that health facilities around the country experience chronic shortage of medical supplies [15-19]. There are little or no published reports on the scientific literature about distribution of medical supplies in PNG [20-23]. This apparent lack of scientific data prompted this study to document challenges

with the current system in the Central province and to suggest viable strategies for medical supplies distribution system in the Central province in order to eliminate the perennial medicines shortages. The objectives of this study were: to assess the current medical supplies distribution activities in the Central province with the aim of identifying the gaps and the strengths of the system and to propose viable strategies to improve the medical supplies distribution system for the province.

MATERIALS AND METHODS:

Ethical clearance and approval to conduct the study from the School of Medicine and Health Science-University of Papua New Guinea, Central Provincial Government and Medical Research Advisory Committee-National Department of Health were attained before carrying out the study in Central province.

The semi-structured questionnaire from Jahre et al [24] was modified and developed. The questionnaire consisted of eight sections: general information detailing interviewee and health facility characteristics; human resource and staff capacity; procedures for ordering medicines and supplies; receiving procedures and transportation links; storage checklist; communication tools and recommendations. Convenience sampling was used for selection of HCs, HSCs and UCs in the province which at the time of data collection was the most applicable sampling method as bad weather conditions, deteriorating road infrastructure and safety mitigations prevented an initial randomised sampling method. The inclusion criteria required study units to be HCs, HSCs and UCs and the facility had to exist and operating, thus the hospital and a closed HSC were excluded from the study. Interviews were conducted using this health facility questionnaire and a total of 23 health facilities (HFs) out of 36 HFs were surveyed in the province.

In addition, a HC requisition order tracking form was developed to determine lead-times, distribution costs incurred and modes of transport used. Data were collected over a period of eight months from 1st November 2011 to 30th June 2012. All completed HC requisition order forms from Area Medical Store (AMS) were collected, dates were used to determine the ordering process from HCs to AMS and back to HCs. Other data sources included the supply section logbook and transport logbook at the AMS. The content of each HC requisition order form were collected to determine order value and compare with distribution costs incurred for each HC order transported. Two other qualitative questionnaires were developed. One set of questionnaire focused at collecting data from church agencies perspective. The other set of qualitative questionnaire was used to interview key informants in the private sector for comparison with other distribution systems.

The data collected from the health facility questionnaire were categorised under three

main variables: transportation, storage conditions and inventory control. Analysis was carried out using SPSS creating frequency tables and cross-tabulating indicators. While data gathered from the tracking of HC requisition order form was analysed using MS Excel 2007 application. The qualitative questionnaires responses were categorised according to key words prepared for each question, then there were entered on to separate master sheets.

Study strengths and limitations:

The study concentrates in providing current issues of the distribution of medical supplies at the provincial level. In doing so, provides viable strategies that under current certain conditions, these strategies if implemented can improve the distribution of medical supplies in the province. The results indicate at the provincial and district levels, the current challenges faced in providing an effective and efficient medical supply distribution system. While the study as attempted to include a holistic overview of the medical supply distribution system, funding limitations to travel to all surveyed health facilities and verify storage conditions was challenging. In addition, tracking of health centre order forms by dates only gives relative lead-times which would need to be verified using other forms of tracking tools or devices.

RESULTS:

The results are structured according to the three main variables: inventory control, transportation and the storage conditions. It begins with the overview of the distribution activities and pathways found in the province. In figure 1, sub-section 1, 1A and 1B illustrate the pull system as the main source of medical supplies to rural health facilities. The collection of HC orders was seen to be the main method of indicating distribution activities in the province. The majority of medical supplies were purchased by the government and distributed by the AMS according to Medical Stores Catalogue [25]. The church agencies run their collection system independently from the Provincial Health Office (PHO) with limited liaison and collaboration.

All HC requisition orders forms need to be approved by the PHO before been sent to AMS. The vertical programs, such as, the National TB program are managed at the national level whereby overall coordination and procurement are dealt with at this level however, the distribution of these health commodities utilise the pull system. Therefore figure 1 shows that these vertical programs come under PHO when been distributed in the provinces.

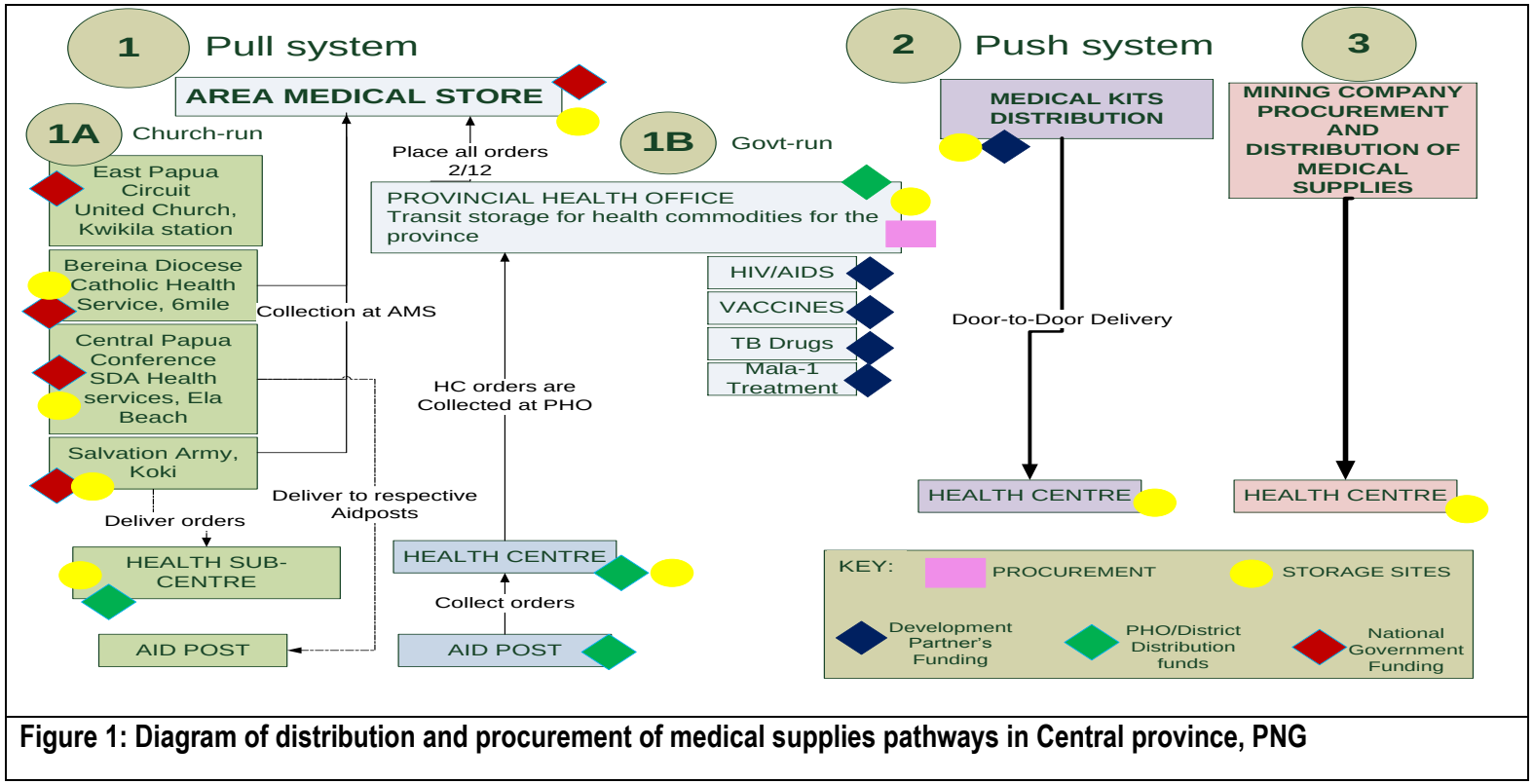

Figure 1: Diagram of distribution and procurement of medical supplies pathways in Central province, PNG

The push system designated as number 2 in Figure 1 is a separate government sanctioned program aimed at delivering essential medicines directly to HCs, HSCs and aid posts. At present, the medical kits are organised by the Australian Agency for International Development (AusAID) and distributed on a door-to-door delivery schedule which is simply considered as supplementary supplies by HCs and HSCs. The third distribution system in figure 1, designated as number 3 operates completely independent of the other two distribution systems. This system targets health centre communities of immediate interest to the mining sites and was therefore not covered in this study.

Inventory Control:

Personnel in-charge of storeroom had additional knowledge of medicines supply management and or Standard Operating Procedures (SOPs). The province showed that slightly more than half (55%) of the officers had SOP knowledge and drug supply management against 45% who lacked this knowledge. With adherence to SOPs a larger proportion of HC-Dispensary workers with additional SOP knowledge 7 (58.3%) usually used re-order levels as opposed to 5 (41.7%) who did not observe the rule. Over-ordering was seen to be practiced at HCs and HSCs although SOP knowledge was seen to be demonstrated in the province, however only 11 (47.8%) indicated this practice while 12 (52.1%) indicated otherwise. Frequency of HC orders received from AMS showed 9 (39.1%) HCs/HSCs received 3 orders in a year, 7 HCs indicated that orders were received 4 times in a year, whilst only two HCs/HSCs showed that all 6 orders made to AMS were received in a year.

In proper management of stock and inventory control, judicious stock rotation must be carried out to ensure the usage of old stock first to avoid losses due to premature expiry of medicines. The data in Table 1 indicates that almost all or 19 (86.4%) of the HCs/HSCs stored and organised medicines in a manner accessible for First-Expiry-First-Out (FEFO) arrangement. Although only 3 (13.6%) deviated from this practice and FEFO concept must therefore be emphasised to the affected HCs.

Transportation:

The most used mode of transporting orders was seen to be the usage of HC ambulances (31%) followed by private transport (22%) and mission vehicles (13%).

Table 2 depicts the comparison between distribution cost ratio, mode of transport used, costs incurred per order for all HC orders obtained from the AMS between 1st November 2011 and 30th June 2012. The Relatively high ratio indicates the mode of transport and route used is expensive to maintain while a relatively low ratio indicates the efficient route with low

transport costs incurred. HCs requiring two or more modes of transport to collect HC orders from AMS showed relatively high distribution ratios, for instance, Boru HSC in abau district (0.50) and Tapini HC in Goilala district (1.23, 0.72 and 0.41). Road transport showed relatively low distribution ratios, for instance, Bereina HC (0.01) and Agevairu (0.01). During the eight month period, two aid post orders were supplied, indicating that aid posts are not receiving supplies from supervising HCs. Supplementary HC orders showed relatively higher distribution ratios when compared to HC main orders, for instance, Kwikila HC and Kokorogoro HSC supplementary HC orders had relatively high distribution ratios 0.44 and 0.81 respectively then the main HC orders which had relatively lower distribution ratios 0.23 and 0.08.

Storage conditions:

Table 3 outlines the type of storage space found in HCs/HSCs in the province. Most HCs or 11 (47.8%) showed adequate storage space for medical supplies, whilst 12 (52.2%) HCs indicated inadequate storage space. Shelves and cupboards are essential for proper storage of medical supplies. The table also depicts that medicines are stored appropriately at HCs on shelves and in cupboards which provides access to retrieve the correct medicines and rather not placed on the floor.

Table 1: General layout of storage area and stock rotation methods applied at HCs in Districts

		Products are separated by using the AMS Catalogue numbers and usage of FEFO	
		Yes	**No**
District	Abau	4	0
	Rigo	3	1
	Kairuku	5	2
	Goilala	3	0
	Hiri	4	0
Total		19	3

Table 2: Comparison between distribution ratio, mode of transport used, costs incurred per order for all health centres orders obtained from AMS during the period between 1st November 2011 to 30th June 2012 and the population it serves

District	Health facility	Operating Agency	Population catchment (2012)	Order Type	Transport mode	Distance from AMS Km	Total cost of transporting commodities[b] Kina (K)	Total value of commodities transported Kina (K)	Distribution Ratio[a]	Total Transport cost x 6[c] Kina (K)
Abau	Iruna HC	M	10,640	MAIN	R,S	328.1	5,555.68	22,004.78	0.25	33,334.08
Abau	Boru SHC	M	3,351	MAIN	R,S	269.3	5,555.68	11,209.35	0.50	33,334.08
Abau	Moreguina HC	G	9,198	MAIN	R	225.2	5,464.78	369,502.92	0.02	32,788.68
				MAIN			5,464.78	18,248.19	0.30	
Abau	Kupiano HC	G	25,141	MAIN	R	193.9	2,959.18	23,322.95	0.13	17,755.08
				MAIN			2,959.18	25,979.79	0.11	
Abau	Upulima SHC	G	2,089	MAIN	R	157.9	1,423.98	10,359.92	0.14	8,543.98
Rigo	Kwikila HC	G	29,350	MAIN	R	85.8	1,155.15	42,987.98	0.03	17,755.08
				MAIN			1,155.15	4,930.90	0.23	
				SUPP			1,155.15	2,648.40	0.44	
				MAIN			1,155.15	11,455.84	0.10	
Rigo	KAK SHC	G	1,835	MAIN	R	101.8	1,371.73	4,935.25	0.28	8,230.38
Rigo	Hula SHC	M	9,545	MAIN	R	117.4	1,388.20	8,429.20	0.17	8,329.20
Rigo	Boregaina SHC	M	3,724	MAIN	R	102.5	1,213.34	6,824.48	0.18	7,280.04
				MAIN			1,213.34	1,364.50	0.89	
Rigo	Kokorogoro SHC	M	1,276	MAIN	R	250	1,213.34	15,931.94	0.08	7,280.04
				SUPP			1,213.34	1,492.00	0.81	
Goilala	Tapini HC	G	6,894	MAIN	R or A	123.4	2,659.18	2,156.61	1.23	15,955.08
				MAIN			2,659.18	3,691.20	0.72	
				MAIN			2,659.18	6,483.78	0.41	
				MAIN			2,659.18	3,700.77	0.72	
Goilala	Tororo SHC	M	1,443	MAIN	A & T	138	2,449.27	19,742.70	0.12	14,695.62
Kairuku	Akufa SHC	M	2,827	MAIN	R &S	205.2	2,667.44	10,398.79	0.26	16,004.64
				MAIN			2,667.44	8,466.01	0.32	
Hiri	RMC UC	G	20,300	MAIN	R	4.1	24,320.38	-		Delivered by AMS
				MAIN				19,414.87	-	
HQ	PHO-Disease	G		SUPP	R	4.1	14,063.70	-		Delivered/collec

	Control									ted from AMS
				MAIN				4,775.75	-	
Hiri	Sogeri HC	G	8,451	MAIN	R	48.6	1,147.00	33,198.26	0.04	6,884.64
Kairuku	Veifa'a HC	M		MAIN	R	172.4	1,035.20	57,770.22	0.02	6,211.20
			11,422	MAIN			1,036.20	20,260.66	0.05	
Kairuku	Yule Is. SHC	M	3,869	MAIN	R &S	101	832.53	6,290.75	0.13	4,995.18
				MAIN			686.93	6,041.96	0.11	
Kairuku	Inauaia HC	M	6,918	MAIN	R	152.4	907.18	35,080.36	0.03	5,443.08
				MAIN			907.18	20,800.70	0.04	
Kairuku	Agevairu SHC	G	7,506	MAIN	R	97.2	185.60	39,045.45	0.01	1,113.60
				MAIN			185.60	15,550.24	0.01	
				MAIN			185.60	14,134.10	0.01	
Hiri	Kuriva SHC	G	3,757	MAIN	R	56.8	185.60	5,907.90	0.03	1,113.60
Hiri	Doa SHC	G	3,215	MAIN	R	81.2	285.60	5,033.91	0.06	1,713.60
				SUPP			285.60	4,582.28	0.06	
Rigo	Gabagaba Aid post	G	2,130	MAIN	R	52.5	211.80	121,764.44	0.00	1,270.80
				MAIN			211.80	616.00	0.34	
Kairuku	Mainohana Aid post	M	1,329	MAIN	R	NA	211.80	3,372.24	0.06	1,270.80
Hiri	PAU Clinic	M	2,057	SUPP	R	17.6	117.67	3,097.45	0.04	706.02
				MAIN			117.67	3,943.15	0.03	
Hiri	Goldie Brks Clinic	G	2,808	SUPP	R	20.5	117.67	2,401.34	0.05	706.02
Kairuku	Bereina HC	G	11,618	MAIN	R	162.2	688.78	70,374.03	0.01	688.78
Kairuku	Bakoidu SHC	M	4,476	MAIN	R	164.6	1,523.98	17,120.51	0.09	9,143.88
TOTAL										**262,547.08[d]**

G = Government M= Mission NA = Not available; R = Road S = Sea A = Air T = Trekking; MAIN = main orders; the scheduled bimonthly orders placed by health facilities to AMS SUPP = Supplementary orders; unscheduled orders or emergency orders placed by health facilities to AMS which is not according to the ordering cycle

a = "Ratio of distribution cost to value of commodities distributed" is defined as the transport cost divided by the total value of commodities per order. Relatively High ratio indicates the mode of transport and route used is expensive to maintain thus an alternative route will need to be identified. Relatively Low ratio indicates the efficient route with low transport costs incurred.

b = Cost of transport includes; hire for vehicle/dinghy + fuel + officers' travel allowances for a maximum of 3 officers

c = Transport cost multiplied by factor of 6 – the extrapolated distribution costs for health facilities tracked (1st Nov 2011 to 30th June 2012) to determine relative distribution costs for a year.

d = compared with the annual recurrent provincial medical supply distribution budget allocation of PGK 298,900.00 (2010)

Table 3: The parameter of ample storage space with regards to the type of storage space used at health centres

		Adequate space		Allocated storage space			Presence of shelves and cupboards		
		Yes	No	dedicated building (stand-alone)	Room	shared room	Shelves	Cupboards	Shelves + cupboards
Districts	Abau	2	2	1	3	0	4	0	0
	Rigo	2	2	1	2	1	3	0	1
	Kairuku	2	5		6	1	6	1	0
	Goilala	3	1	1	2	1	4	0	0
	Hiri	2	2	0	4	0	3	0	1
Total		11	12	3	17	3	20	1	2
Percentage (%)		47.8	52.2	13.0	73.9	13.0	86.9	4.3	8.6

The organisations providing products and services were assessed to evaluate their supply systems in the province. The findings showed that grocery items, fuel and other products were the responsibility of the consumer to determine their value and necessity to their community and not their distributor. Therefore the distribution systems were pull systems for which customers determined demand by travelling into the city to access products and services. Warehousing and storage were identified as the organisations' own infrastructure, whilst transportation was contracted out depending on the mode of transport such as road, sea freight and air freight. Nevertheless, health commodities are products which are not chosen by the customer but chosen for the customer, and in this case, medicines are chosen to treat the patients' illness. These distribution systems have teams of logistics officers coordinating distribution, this team work feature lacks in the current medical supplies distribution system in the province.

DISCUSSION:

Challenges and gaps in the current medical supplies system in Central province

We found that medical supplies do reach the HCs however not as effective and efficient as anticipated even with the pull and push systems operating concurrently in the province. Medical supplies accounts for 3% of the total PGK 3 million health budget and 18% of the total recurrent budget of the province [26]. The allocations include: funds for conducting SOP-training in the province, conducting supervisory visits, distributing medical supplies to rural health facilities including aid posts and funds for procuring medical equipments and maintenance. This allocation is only for government managed HCs and HSCs. Church

agencies receive health grants for overall operational costs from the government – this includes distribution costs. Comparing the extrapolated relative distribution costs incurred to the annual provincial health allocation (table 2) this apparently showed limited funds are allocated for funding distribution in the province. Therefore, PHO and respective church agencies re-direct other funds towards distribution costs. For instance, funds earmarked for supervisory visits are re-directed to transport charges. While for example in Nigeria, it was found that there was a lack of interest in funding the supply system which contributed to low access to medicines and supplies at health facilities [9].

The study showed that supervision along the supply system was lacking thus logistics data collection at health facilities contributed to lack of reporting and feedback mechanisms. For example, in Vanuatu, Brown and Gilbert found similar issues of the lack of supervision among actors in the distribution supply system [11]. They also observed that lack of supervision was predominant amongst Pacific Island Countries [11]. The findings suggest that there was a lack of reporting and feedback mechanism in the whole medical supplies distribution system in the province. This showed weakness in the proper distribution and delivery planning, poor audit tracking and monitoring of HC orders from AMS to HCs. For instance, once a HC order leaves AMS premises responsibility of the safe transporting of HC orders were passed to PHO. Whether the HC order was received in full or partial on a timely manner to HCs was the responsibility of PHO, which in turn was passed down to the HCs. Logistics data gathered at HCs do not reach the AMS. There were no processes or procedures in place for lodging formal complaints, feedbacks, dissatisfaction with health commodity quality by HCs to the AMS. In addition, all HC orders received from AMS had 50% of items not available, frustrating HCs. The findings showed that the bimonthly ordering cycle for HCs favoured HCs with closer proximity to the AMS while remote HCs experienced difficulties in submitting and collecting HC orders. There were relatively long lead-times experienced (99 days ≈ 3 months) which was found to be longer than the bimonthly ordering cycle. The relatively long lead-time was influenced by: non-availability of transport, slow submission of orders to AMS, long picking and packing and slow collection of orders by the HCs. The vertical programs such as the National TB program also experienced long lead-times between PHO to the HCs [27]. Although there were stock cards and stock ledger books found at HCs, inventory was not up-dated regularly: due to slackness of HC dispensary worker, unavailability of stock cards to be replenished and the lack of supervision from PHO and AMS.

Viable strategies to improve the medical supply distribution system in Central province

The medical supplies distribution system should be simple with the purpose of obtaining and moving medical supplies in a timely fashion at a reasonable cost. An essential decision must be made as to which levels of the distribution system will order medicines and supplies. Either a pull or push distribution system are equally effective but to have both systems run concurrently is seen has costly to manage. However both push and pull distribution systems can be mixed into one supply system, the findings obtained would suggest having both distribution systems mixed into one supply system which would improve accessibility of medicines and supplies to the rural population. Whereby maintaining the current pull system between AMS and HCs and introducing the push system between HCs and aid posts.

Centralising the medical supply distribution system to the AMS, making AMS solely responsible for distribution by placing reliable ordering cycle schedules, tracking of HC orders leaving AMS premises down to HCs, provide good monitoring and surveillance practices with strict adherence to SOPs. According to Bossert et al, [28] a more centralised supply system was found to be associated with better performance in inventory control and information systems.

One strategy is to create 'delivery teams' that would form an important aspect for strengthening the medical supply system. This 'delivery teams' would consist of at least 3-4 trained officers; a driver and two assistants with the roles to check stock status, make adjustments and return expired stock to AMS, provide training and supervision to HCs, and ultimately deliver HC orders. This would minimise over ordering incidences which were observed, over stocking and re-distribution of slow moving items, prevent losses through expiration of stock, improve supervision, better logistics information collected and increase availability of medical supplies at HCs/HSCs. This would successively provide quality reporting and feedback information in the whole medical supply system. The proposed "Delivery teams" system in this study is similar to a successful Delivery Team Topping-Up (DUTT) system in Zimbabwe that saw effective distribution of condoms for the prevention of HIV/AIDS in the country. Since its introduction in 2004 the DUTT system is still operating effectively and has yielded positive results in increasing the availability of products in difficult environments by guaranteeing direct delivery to health facilities and creating systematic accountability at all points of procurement, delivery and receipt of commodities [29,30].

We found that an unreliable transportation system, lack of supervision from higher levels of the supply system and limited adequate storage space resulted in an inefficient and ineffective medical supply distribution system in the province. Therefore to improve the current system, the establishment of delivery teams as an important aspect which would provide the

link between HCs and AMS. This creates supervised goods flow and information flow along the supply system. Successively, this would prompt adherence to SOPs, provide on-the-job training for isolated officers and overall better reporting and feedback mechanisms along the supply system. This study has greatly opened up opportunities for more investigations in the other aspects of pharmaceutical commodity logistics in the country. Therefore, further research and monitoring activities would be needed to further investigate issues such as availability, rational usage and other aspects of medical supplies distribution systems in the country.

CONCLUSION:

There are medical supplies reaching the rural HCs of Central province however, not as efficiently and effectively as anticipated. There are good operating procedures in place across the province with a satisfactory level of drug supply management knowledge however, supervision from higher levels of the supply system was lacking. Overall the whole medical supply distribution system lacked proper reporting and feedback mechanisms to provide up-to-date logistics information from HCs to AMs and vice versa. The current pull distribution system should be maintained with viable strategies of introducing 'delivery teams' to provide the link between HCs and AMS; in doing so better advancements would be seen in the medical supply distribution system.

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COMPARISON OF ADENOSINE DEAMINASE ACTIVITY, SERUM C-REACTIVE PROTEIN AND RHEUMATOID FACTOR IN MID AND FAR WESTERN NEPALESE PATIENTS WITH RHEUMATOID ARTHRITIS

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ABSTRACT:

Adenosine deaminase (ADA) is introduced as helpful marker in diagnosis, prognosis and monitoring of treatment in rheumatoid arthritis (RA). The aim of this study was to investigate serum ADA activity in Nepalese patients with RA. The objective was to assess the diagnostic potential of serum ADA activity for routine diagnosis of RA. This was a Hospital based case-control study conducted between March 2012 and February 2013. A total of 58 diagnosed patients of RA and 58healthy controls were included in this study after obtaining their informed consent. All the patients fulfilled the criteria of the American rheumatism association. Blood samples were collected, analyzed for serum total ADA, C-reactive protein (CRP) and rheumatoid factor (RF). The serum total ADA activity was found to be significantly ($p<0.0001$) higher (34.10 ± 8.02 U/L) in all RA patients compared to healthy controls (15.21 ± 4.40 U/L). Among the 58 patients with RA,15 (25.9%)had elevated for CRP and 10 (17.24 %) were positive for RF test. Results showed, ADA catalytic activity in serum can be a useful biochemical marker for the diagnosis of RA in the Nepalese population with relevant clinical scenarios when there is absence of CRP and RF in the serum.

KEYWORDS: Rheumatoid arthritis, Adenosine deaminase, C-reactive protein, Rheumatoid factor.

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INTRODUCTION:

Rheumatoid arthritis (RA) is a systemic inflammatory disease which usually affects the joints of hands and feet as an erosive, symmetrical polyarthritis. Although the cause of Rheumatoid arthritis is unknown, it is considered as an autoimmune disorder involving other joints and organs [1]. The worldwide prevalence of RA was reported as approximately 1.0%, while it is more common in 7th decade of the life (60-69 age) [2]. One of the potential diagnostic markers that is actively being pursued for RA is Adenosine deaminase, an enzyme, which is present in red cells and the vessel wall catalyses the irreversible hydrolytic deamination of adenosine to inosine and 2'-deoxyadenosine to 2'-deoxyinosine. Inosine and 2'-deoxyinosine are converted to hypoxanthine, xanthine and finally to uric acid [3]. The enzyme exists in two isoenzyme forms: ADA1 and ADA2, coded for by separate genes [4].ADA is considered as a good marker of cell mediated immunity [5]. High lymphocyte ADA activities were found to be elevated in diseases in which there is cell mediated immune response [6].CRP an acute phase protein is synthesizedby hepatocytes in response to pro-inflammatorycytokines in particular IL-6. CRP has been shown tobe of great value as an inflammatory marker inRA and has been suggested to mediate part ofthe complement activation in RA [7].

As yet there has not been such study except one (In UCMS Bhairwa) which demonstrates the suitability of ADA as a potential diagnostic marker for RA in Nepalese population. Therefore the aim of this study was to investigate serum ADA activity in Nepalese patients with RA. The objective was to assess the diagnostic potential of serum ADA activity for routine diagnosis of RA

SUBJECTS AND METHODS:

This was a hospital based case-control study conducted at the Nepalgunj Medical College and Teaching Hospital, Banke, Nepal between March 2012 and February 2013. A total of58 diagnosed patients of RA without any medication and 58 (age and sex matched) healthy controls were selected for this study. Informed consent was obtained from each subject. All the patients included in this study fulfilled the criteria of the American rheumatism association (ARA)[8]. RA patients with tuberculosis, diabetes mellitus, cardiovascular diseases, HIV/AIDS and patients with other types of musculoskeletal disorders, osteoarthritis, osteoporosis, spinal disorders, severe limb trauma and gouty arthritis were excluded from the study. Ethical approval for the study was obtained from the institutional research ethical committee.

From each patient and control 5.0 ml of venous blood was collected in a sterile vial and allowed

to clot at room temperature. The sera were carefully separated from the clotted blot and either stored at -20°C for later analysis or analyzed immediately for total ADA activity, CRP and RF at the central laboratory of biochemistry of the Nepalgunj medical college. The total activity of serum ADA was assayed with a commercially supplied kit (Tulip Diagnostic (P) Ltd, Verna Goa, India) according to the protocol of the manufacturer. The assay was based on the colorimetric method described by Galanti and Guisti [9]. Reference interval of total ADA catalytic activities for using this method was 13.20–20.80 U/L [9]. One unit of ADA was defined as the amount of enzyme required to release three micromoles of ammonia per minute from adenosine in one hour at 37°C [9].

The presence of elevated CRP level in the serum was detected by a rapid latex agglutination test using a commercially supplied CRP-Latex kit (RFCL Limited, Uttarakhand, India). The test is based on the principle that CRP-Latex particles are coated with antibodies to human CRP and when the latex suspension is mixed with serum containing elevated CRP levels on a slide; clear agglutination is seen within 2 minutes. CRP-Latex had detection limit of 6.0 mg/L of CRP in serum. The test was considered positive when the CRP concentration was 6.0 mg/L or greater and negative when it was below than 6.0 mg/L. [10]

Serum RF was detected by using a commercially supplied RF latex reagent kit (RFCL Limited, Uttarakhand, India). The test was performed as per the protocol of the manufacturer. It is based on the principle of rapid latex agglutination slide test similar to the one described above for CRP. The sensitivity of this latex test was 10.0 IU/ml of RF. The test was considered positive if the agglutination was observed within two minutes. [11]

The results obtained from the above investigation were analyzed and expressed as mean ± SD by using Excel 2007 data pack. The statistical comparison was done by student t-test using SPSS version 16, Chicago, USA.

RESULTS:

In the present study patients with rheumatoid arthritis and the non-rheumatoid arthritis controls were in the age range of 20-60 years. Among the 58 patients with RA 20 (34.5%) were males and 38 (65.5%) were females as shown in Table 1. The mean ± SD of age of the males and females was 46 ± 13.08 years and in controls was 45 ± 14.01 years.

Table-1: Gender distribution and mean age of the Non rheumatoid arthritis controls and Rheumatoid arthritis patients

Groups	Males	Females	Mean age (years)
Non rheumatoid arthritis controls (n = 58)	29 (50.0%)	29 (50.0%)	45±14.01
Rheumatoid arthritis patients (n = 58)	20 (34.5%)	38 (65.5%)	46±13.08

Table-2: Serum CRP levels (mg/liter) of patients with Rheumatoid Arthritis and Controls

Groups	Gender distribution		Elevated serum CRP
Non rheumatoid arthritis controls	Males	29	0
	Females	29	0
Rheumatoid arthritis patients	Males	20	9 (45.0%)
	Females	38	6 (15.8%)

Table 3: RF test of patients with Rheumatoid Arthritis and Controls

Groups	Gender distribution		RF test (positive)
Non rheumatoid arthritis controls	Males	29	0
	Females	29	0
Rheumatoid arthritis patients	Males	20	6 (30.0%)
	Females	38	4 (10.53%)

Table 4: Serum Adenosine deaminase (ADA) levels (U/L) in patients with Rheumatoid Arthritis and Controls

Parameters	Non rheumatoid arthritis controls (n=58)	Rheumatoid arthritis patients (n=58)	P value
ADA(U/L)	15.21 ± 4.40	34.10±8.02	<0.0001

Our results show that among the 58 RA patients, only 15 (25.9%)had elevated serum CRP level and 10 (17.2%) had positive RF test (Tables 2 & 3).The results clearly indicate the limitation and inadequacy of using serum CRP level and the RF test parameters for the diagnosis of RA.

The mean total ADA activity for all the RA patients was significantly ($p<0.0001$) higher (34.10±8.02 U/L) as compared to that of the healthy controls (15.21 ± 4.40 U/L). (Table 4)

DISCUSSION:

RA is the most common inflammatory arthritis, affecting about 1.0% of the general population worldwide [12]. Pathogenesis of RA is still not fully understood, there is evidence that CD4+ T cells play a central role in initiating, perpetuating and precipitating chronic inflammation in synovial tissue [13, 14]. Another role of activated CD4+T cells is stimulation of B cells to differentiate into plasma cells producing RF (Rheumatoid Factor) and other auto antibodies [15,16]. ADA is one of the most essential immune enzymes. Its function gives a clear picture of the immune status of the body. [16,17]. A close correlation has been found between the severity of inflammation and local increase in both expression and activity of ADA [18]. ADA plays a crucial role in lymphocyte proliferation and differentiation [19] and shows its highest activity in T- lymphocytes [20].The high plasma ADA activity might be due to abnormal T-lymphocyte responses or proliferation [19].The increased serum level of ADA is indicator of stimulation of cellular immunity. For instance, this condition can be seen in lymphoblastic leukemia, acute hepatitis, human immunodeficiency (HIV) virus infection, infectious mononucleosis, tuberculosis, pneumonia and rheumatoid arthritis. Some have suggested that the major source of the prevalent form of ADA (ADA2) in serum is the monocyte/macrophage cell system [21].The increase in serum ADA level in RA patients can be explained by immunity status changes. In this case, the ADA level reflects the monocyte/macrophage activity or turnover [22]. Many studies demonstrated the elevated serum level of ADA in RA patients [23-25].Rheumatoid arthritis is more common in female as compare to male [26]. RA is likely to affect females approximately two times more than males[26]and 80% of people with RA develop signs and symptoms of the disease between 35 and 50 years of age [27]. Our current study showed that almost 1.9 times more females (65.5%) are affected than males (34.5%) in Nepalese population which is closely similar to the results reported by N. Gautam et al .[28]. Our result indicated that among the 58 RA patients, only 15 (25.9%) have elevated serum CRP and 10 (17.24 %) tested positive for RF. The result obtained in our present study illustrates clearly the limitation in using serum

CRP and RF as parameters for the diagnosis of RA. Our result is closely related with the N. Gautam et al [26], study conducted at the Universal College of Medical Sciences Teaching Hospital, Bhairahawa, Nepal. According to these authors out of 69 RA patients, only 16 (23.1%) have elevated serum CRP level and 11 (15.9%) tested positive for RF.

CONCLUSION:

There was a significant difference in the levels of ADA activity between the RA patients and healthy controls, which may indicate its usefulness in diagnosing the disease in the Nepalese populationwhen taken in the context of clinical background data.

However, this is a hospital based study confined only to mid and far western part of Nepal and do not represent the whole Nepalese population.

There must be a more detailed study on large sample number from the various parts of the country to generalize the suitability of serum ADA for the early diagnosis of RA in Nepalese population.

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RISK FACTORS FOR DEATH IN UNDER-FIVE CHILDREN PRESENTING WITH ACUTE DIARRHOEA IN AN URBAN TEACHING HOSPITAL IN NIGERIA

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ABSTRACT:

Dehydration is believed to be the primary cause of acute diarrhoea-related mortality. However, it is likely that a number of demographic and clinical risk factors may also interact to create the continued mortality due to acute diarrhoea. This study sought to explore the contributory role of some of these risk factors on diarrhoea-related mortality. This was a descriptive cross-sectional study involving 135 children between 29 days and 59 months admitted into the Diarrhoea Treatment and Training Unit during the period of July 2010 and January 2012. A range of demographic and clinical variables as well as outcome were obtained using a structured interviewer-administered questionnaire.

To identify risk factors that were independently associated with mortality, a multivariate analysis was done after controlling for confounders. Fourteen (10.4%) children, nine males and five females died following admission. The odds of a child dying of an acute diarrhoea disease following admission was increased in children with co-diagnosis of pneumonia (AOR = 16.38, p = 0.03), non-usage of ORS (AOR = 16.52, p = 0.00), diarrhoea episodes > 6 times in 24 hours (AOR = 23.63, p = 0.00) and Duration of diarrhoea > 3 days before admission (AOR = 3.63, p = 0.04).

Acute diarrhoea related mortality can be further reduced if awareness is created concerning these risk factors such that high risk children can easily be identified and targeted for intensive intervention.

Keywords: Diarrhoea, Mortality, Hospitalized Under-fives

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INTRODUCTION:

The Millennium Development Goals (MDG 4) call for a reduction of child mortality by two thirds between 1990 and 2015 [1]. As the deadline approaches, the reality is that although progress is being made, much more remains to be done especially in sub-Saharan Africa [2]. Worldwide, nearly nine million children under five years of age die each year and diarrhoea contributes about 17% only second to pneumonia [3]. The burden of disease is greatest in the African region, which accounts for 46% of the deaths from diarrhoea despite only contributing to 18% of the world under-five population [4]. Nigeria is ranked second in the world among the countries with the highest diarrhoea related deaths among under-five children. It accounts for over 16 % of under-five mortality and an estimated 194,000 deaths annually [5].

In the 1970s and 1980s, the international community committed itself to reducing child mortality from diarrhoea largely by scaling up the use of oral rehydration therapy (ORT) – a low-cost and highly effective solution – coupled with programmes to educate caregivers on its appropriate use [6]. This effort which was very successful has since dwindled. Now, only about 39% of children with diarrhoea in the developing world receive ORT [3]. The implication is that less effective home treatment modalities such as the use of antibiotics, herbal concoctions and sometimes "watchful waiting" are now being used [7]. These inappropriate home management approaches may be partly responsible for the increasing mortality from acute diarrhoea. Some other risk factors that have been reported to be significantly associated with diarrhoea-related mortality include, lack of breast feeding, lack of immunization, under nutrition [8]. Although, government and nongovernmental bodies have formulated policies and programmes aimed at reducing diarrhoea-related mortality, the situation has remained virtually unchanged. It is therefore possible that other than dehydration, a number of other risk factors interact to create the continued mortality from acute childhood diarrhoea. Given the importance of diarrhoeal diseases as a major contributor to childhood mortality in Nigeria, and to support a policy redesign, there is a clear need to further explore the role of some demographic and clinical risk factors on reported mortality of hospitalized children with acute diarrhoea.

The purpose of the present study was to determine the contribution of demographic and some clinical risk factors to diarrhoea-related mortality in under-five children admitted into the diarrhoea treatment and training unit (DTTU) of the University of Benin Teaching Hospital in Nigeria.

SUBJECTS AND METHODS:

This was a descriptive cross-sectional study undertaken at the DTTU of the University of

Benin Teaching Hospital. The DTTU is a subunit of the Children Emergency Room and provides care for children with acute diarrhoea and training on home management of acute diarrhoea to mothers, nurses, medical students, house officers and resident doctors. The study population consisted of children between 29 days and 59 months admitted into the DTTU with a diagnosis of acute diarrhoea either singly or with co-morbidities.

The study was conducted between July 2010 and January 2012. The sample size for the study was calculated assuming an exposure rate of 10% with 80% power and 5% significant level [8]. Acute diarrhoea in this study was defined as the passage of unusually loose or watery stool at least 3 or more times in a 24 hour period lasting less than 14 days [9].

Ethical approval for this study was obtained from the Ethics Committee of the University of Benin Teaching Hospital and written informed consent obtained from parents/caregivers of subjects.

The data collection instrument was a structured interviewer-administered questionnaire that was pre-tested; appropriate modifications were made prior to its use in the study. Information was collected by the researchers and trained junior paediatric residents on a range of demographic, some clinical risk factor(s) and outcome variable that included age and sex of child, weight, social status using the classification proposed by Olusanya et al [10], nature of stools, number of episodes, duration of diarrhoea before presentation, vomiting and number of times as well as the presence or absence of fever. Other variables included home treatment, ORT preparation and application as well as laboratory or radiological evidence of co-morbidities such as malaria, pneumonia and hypoglycaemia. Home treatment that excluded the use of ORS was classified as non-usage of ORS.

The level of dehydration was assessed and categorized as severe dehydration (> 10% body weight loss), some dehydration (5-10% body weight loss) or no sign of dehydration (<5% body weight loss) using World Health Organization (WHO) criteria [11]. Weight-for-age Z-scores for boys and girls respectively, from birth to five years (WHO child growth standards), were used to classify children as being malnourished or not. The weight and age of each participant on admission was compared to the corresponding weight-for-age Z-score. Those with weight-for-age less than minus two standard deviations were classified as being malnourished on admission. All patients were appropriately evaluated and management instituted as per unit protocol. The primary outcome variable was mortality following admission.

Statistical Analysis:

Data collected was entered into Statistical Package for Scientific Solutions (SPSS) version 16 software. Key punching errors were rectified and logical errors corrected. Recoding of

existing variables into dichotomous variable was done while descriptive and inferential statistics were employed in the analysis of the data. A range of demographic and clinical variables recorded for children with and without the primary outcome variable were compared using a chi-square test or fisher exact where applicable. Strength of association was determined by calculating Odds ratio (OR), and 95% confidence interval. To identify risk factors independently associated with the primary outcome, a multiple logistic regression analysis was done after controlling for confounders

RESULTS:

During the 18-month study period, 153 children, constituting 8.9% of all patients under- 5 years of age were admitted to the DTTU with acute diarrhoeal disease. Of these, questionnaires were successfully administered on 135, which is equivalent to a response rate of 88.2%.The mean age of the study population was 13.5 months and a median of 11.0 months with a male female ratio of 1.3: 1. Fourteen children, 9 males and 5 females of the 135 study subjects died following admission.

The distribution of the demographics and clinical risk factors in children with or without the outcome variable is shown in Table 1. The univariate analysis of risk factors associated with diarrhoea-related death shows that diarrhoea of more than three days before admission was significantly associated with death, (p= 0.01).

Other risk factors associated with death included age less than 12 months, low socioeconomic status, under nutrition,, non-usage of ORS pre-admission, diarrhoea episodes of more than six times in 24 hours as well as moderate/severe dehydration as shown in Table 2

However, to identify variables independently predictive of death, we performed a multivariate logistic regression. The results of which are shown on Table 3. The odds of dying of a diarrhoeal disease following admission in this study was increased by 16.52 times in children who had inappropriate home management (non-usage of ORS), (AOR = 16.52, P =0.00) as well as those with co-diagnosis of pneumonia (AOR = 16.38, p= 0.03).

The result also showed an increased odd of a diarrhoea related death in children who had had diarrhoea for more than 3 days before admission and those with more than 6 diarrhoeal episodes in 24 hours. The confidence intervals were, however wide due to small numbers in some of the cells after categorizing the variables.

Table 1: Characteristics of Study Population

Characteristics	**Number (%)**
Gender	
Male	80 (59.3%)
Female	55 (40.7%)
Age	
≤ 12 months	77 (57.0%)
>12 months	58 (43.0%)
Nutritional Status (*WFA z-score)	
< 2SD	24 (17.8%)
>2SD	111 (82.2%)
Mother's Educational Status	
None/Primary	21 (15.6%)
Secondary/Tertiary	114 (84.4%)
Family Socio-economic Status	
Lower	57 (42.2%)
Middle/Upper	78 (57.8%)
Frequency of Diarrhoea in 24 hours	
≤6 times	91 (67.4%)
>6 times	44 (32.6%)
Diarrhoea Duration at admission	
≤3 days	70 (51.9%)
>3 days	65 (48.1%)
Associated Vomiting	
Present	117 (86.7%)
Absent	18 (13.3%)
Home Treatment	
Oral Rehydration Therapy (ORT)	66 (48.9%)
Drugs/Nothing	69 (51.1%)
Co-diagnosis of Pneumonia	
Present	5 (3.7%)
Absent	130 (96.3%)
Co-diagnosis of Malaria	
Positive	82 (60.7%)
Negative	53 (39.3%)
Serum Glucose Level	
<40mg/dl	8 (5.9%)
≥40mg/dl	127 (94.1%)
Dehydration	
Mild	51 (37.8%)
Moderate/Severe	84 (62.2%)

**WFA: Weight for Age*

Table 2: Demographic and Clinical Risk Factors Associated with Mortality among Hospitalized Children with Acute Diarrhoea: Univariate Analysis

Factors	**Clinical Outcome following admission**		**OR* (95% CI)**	**p-value**
	Died (n=14) N (%)	**Discharged (n=121) N (%)**		
Male	9 (64.29)	71(58.68)	1.27 (0.36-4.67)	0.69
Age ≤ 12 months	12 (85.71)	65(53.72)	5.17 (1.03-35.03)	0.02
Under nutrition (WFA z score <3SD) **	9 (64.29)	14 (12.40)	12.72 (3.29 – 51.64)	0.00
Mother's educational status ***	4(28.57)	15 (12.40)	2.83 (0.65-11.67)	0.10
Low social class	11 (78.57)	46(38.02)	5.98 (1.44-28.68)	0.00
Diarrhoea episode > 6 times in 24 hours	11(78.57)	33(27.27)	9.78 (2.32-47.48)	0.00
Duration of diarrhoea > 3 days	12(85.71)	53 (43.80)	7.70 (1.53-52.20)	0.00
Associated vomiting	11(78.57)	106 (87.60)	0.52 (0.11-2.66)	0.35
Non-usage of ORS pre-admission	12(85.71)	57(47.11)	6,74 (1.34-45.65)	0.00
Co-diagnosis of pneumonia	3(21.43)	2 (1.65)	16.23 (1.90-60.12)	0.00
Co-diagnosis of Malaria	10 (71.43)	72 (61.16)	1.70 (0.45-6.88)	0.39
Hypoglyceamia	3 (21.43)	5 (4.13)	6.33 (0.39-10.41)	0.30
Moderate/Severe Dehydration	13(92.86)	71(58.68)	9.16 (1.18-93.46)	0.01

OR: Odds ratio; ***Mother's educational status below secondary school

Table 3: Demographic and Clinical Risk Factors Associated with Mortality among Hospitalized Children with Acute Diarrhoea: Multivariate Analysis

Factors	B	Adjusted Odds ratio	p-value	95% CI
Moderate/Severe dehydration	1.41	4.10	0.14	1.62 – 16.93
Under nutrition (WFA z score <3SD)	1.12	3.06	0.11	1.79 – 11.89
Co-diagnosis of pneumonia	2.80	16.38	0.03	3.36 – 97.54
Non usage of ORS pre-admission	2.82	16.52	0.00	3.81 – 41.58
Diarrhoea episodes > 6 times in 24 hours	3.16	23.63	0.00	6.50 – 55.94
Duration of diarrhoea > 3 days	1.29	3.63	0.04	1.07 – 12.33

DISCUSSION:

A reduction in diarrhoea-related mortality is paramount if we are to attain the MDG goal 4. This study has brought to the fore some risk factors associated with diarrhoea-related mortality in hospitalized under-five children in Nigeria. The clinical risk factors identified include under nutrition, more than 6 diarrhoea episodes in a 24 hour period, duration of diarrhoea of more than 3 days before hospitalization, non-usage of ORT before hospitalization, co-diagnosis of pneumonia and moderate/severe dehydration; the sociodemographic factors were age less than 12 months and low socioeconomic class.

However, more than 6 diarrhoea episodes in a 24 hour period, duration of diarrhoea more than 3 days before hospitalization, non-usage of ORT before hospitalization, and co-diagnosis of pneumonia were more predictive of mortality after controlling for confounders.

The non-usage of ORT pre- admission conferred on the child about sixteen fold risk of mortality. Although the low usage of ORT by mothers for treatment of childhood diarrhoea has been previously reported [12], its contribution to diarrhoea–related mortality in hospitalized children has not been adequately highlighted. As was the case in a previous report [3], only about half of the mothers in this study gave ORT prior to presentation. The reason for this practice may be traced to the mother's perception of the causes of childhood diarrhoea. The mothers often consider teething, bad water, amongst others as the reasons for their child's illness [12, 13], as result consideration is given to antibiotics as the preferred choice of treatment.

Furthermore, this study has also shown that a diarrhoeal illness lasting more than three days before presentation is associated with significant mortality. Late presentation to the hospital is very common in Nigeria [14], more so in children with diarrhoea. It is generally believed that only very serious illnesses are treated in the hospital. As a result, at the onset of illness, most mothers will attempt to manage at home or visit the patent medicine sellers who more often than not prescribe antibiotics. In addition, as noted previously, some of the mothers believe that teeth eruption is the cause of their child's illness and therefore anticipates a self limiting course. The children are only taken to a health facility when their conditions worsen, sometimes with unpleasant consequences. The result of this study therefore underscores the need for parental education on prompt presentation to a health facility for cases of childhood diarrhoea

In this study, another risk factor for a fatal outcome was diarrhoea episodes of more than 6 times in a 24 hour period. A previous study looked at frequency of diarrhoea episodes as it affects degree of dehydration and may be by implication its effect on mortality [15]. Although, in our study, dehydration failed to predict mortality in the multivariate analysis, one is still tempted to conclude that the deaths may have resulted from dehydration. Victoria et al [16] reported that frequent passage of stool (> 6 episodes) and repeated vomiting were associated with the development of life threatening dehydration.

The presence of pneumonia as a co-morbidity increased the odds of a diarrhoea death in the present study. This is consistent with findings of other studies [8, 17]. Although, the number of children with pneumonia in this study was small, it impact on mortality was very evident. It is believed that the hypoxaemia, which is often experienced by affected children, is responsible for the deaths [18]

Various studies have shown undernutrition as an independent risk factor for diarrhoea related mortality [8, 19]. Although, it was found to be significantly associated with mortality in the univariate analysis, it however failed to retain its significance after controlling for confounding variables in the multivariate analysis. The plausible reason for this could be the non-adjustment of the weight measured on admission for the level of dehydration present. Acute gastroenteritis presents with dehydration which can cause acute weight loss. Some of the children may have been misclassified as having malnutrition, as the corrected weight (after rehydration) may have been slightly higher, and may no longer have met one of the criteria (< 2 SD weight-for-age) for malnutrition. There was also the possibility of falsely classifying ex-premature infants as being malnourished when using their chronological age. This may have overestimated the number of participants classified as having malnutrition.

Data obtained in this study, supports the general clinical opinion that diarrhoea is one of the major causes of under-five mortality, and that it is of considerable public health importance. The case fatality rate was 10.4%, a finding that is similar to that of Ibeziako et al in south eastern part of Nigeria about 10 years ago [20], suggesting that perhaps not much progress has been made to reduce the incidence of diarrhoea and diarrhoea-related deaths in Nigeria.

In conclusion, the study has brought to the fore some risk factors that contribute significantly to diarrhoea-related mortality. Considering the limited resources available in developing countries, a reduction in diarrhoea –related death may be possible by identifying high risk children and targeting them for intensive intervention.

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ASSESSMENT OF PULMONARY FUNCTION IN HEALTHY STUDENTS AGED 19 TO 25 YEARS IN THE NATIONAL CAPITAL DISTRICT, PAPUA NEW GUINEA.

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ABSTRACT:

Pulmonary function tests are among the groups of tests that can be used for assessing the physical status of healthy individuals. This prospective observational cross-sectional study assessed the pulmonary function of healthy students aged 19 to 25 years in higher learning institutions in the National Capital District, Papua New Guinea. A total of 156 students volunteered to participate in the study. Of these, 116 (74.4%) students were randomly selected and requested to complete a pretested questionnaire before assessing their pulmonary function. A computerised spirometer, SpiroUSB, run with Spida5 software was used to determine the parameters FEV_1, FVC, FEV_1/FVC, PEF and FEF_{25-75}. After analysis of the 116 questionnaires and implementing the American Thoracic Society guidelines and criteria for assessing the spirometry results, the data obtained from 77 (66.4%) students were suitable for analysis. Of these 77 students, 34 (44.2%) were males and 43 (55.8%) were females. The mean FEV_1 for the male students (3.70 ± 0.43L) was significantly higher (p = 0.001, 2-tailed) than that for the female students (2.91 ± 0.39L); the mean FVC for males (4.18 ± 0.54L) was also significantly higher (p = 0.001) than that for the females (3.25 ± 0.53L). The PEF and FEF_{25-75} also showed significantly higher (p = 0.001) results for males compared to the females. The FEV_1/FVC, however showed no statistically significant (p = 0.275) difference between the values obtained for the male and female students. Strong inverse statistically significant correlation was found between the Body Mass Index of male students in the overweight category and their FEF_{25-75} (rho = -0.695, p = 0.004).

The data indicated that gender was a significant determinant of lung function with the male students showing greater mean values for FEV_1, FVC, PEF and FEF_{25-75}, suggesting greater lung volumes compared to the female students.

KEY WORDS: *Pulmonary function, Students, National Capital District*

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INTRODUCTION:

Pulmonary function tests (PFT) are carried out to objectively assess the pulmonary function status of an individual [1]. The PFT provide good indication of the health status of an individual. In a study begun in 1960 by Shunemann et al [2], FEV_1 expressed as the normal percent predicted (FEV_1% pred) proved to correlate well with the longevity of life.

PFT using a spirometer have been shown to be efficient in clinical use for diagnosing and managing respiratory disease, like monitoring patients who have asthma and chronic obstructive pulmonary disease (COPD) [1, 3, 4]. Factors such as gender, age, height and ethnicity have been proven to impact on the results obtained in PFT [5 – 8].

In the Oceania Region including Papua New Guinea (PNG) very limited studies have been done to identify lung function determinants and the amplitude of their effects. There is no published set reference range for spirometry lung volumes in PNG. Some studies carried out in PNG on apparently healthy individuals have compared betel nut chewers with non – chewers, smokers to non – smokers and highlanders to coastals [9, 10]. Datta and Yanga showed that betel nut chewing and smoking are detrimental to lung function [9]. Anderson et al [10] showed that New Guineans from the highlands had larger FEV_1 and FVC values than those from the coast. However, there is still a great need for more research on the pulmonary function among healthy Papua New Guineans.

One of the major objectives of the present study was to assess and compare the pulmonary function of healthy male and female students of similar age group in higher institutions in the National Capital District Papua New Guinea.

SUBJECTS AND METHODS:

The study was carried out in the National Capital District (NCD) PNG and was conducted between April and June 2013. Three institutions of higher learning in NCD were selected because of their proximity, convenience, accessibility by road and assumed willingness of the students to participate in the study. The institutions were, the Taurama and Waigani campuses of the University of Papua New Guinea (UPNG), the Port Moresby Business College (PBC) located at 6-mile, and the Don Bosco Technological Institute (DBTI) located at East Boroko.

The sample size was calculated using a design effect of one, a relative precision of 10%, and confidence level of 95 per cent and predicted non-response rate of 20 per cent [11]. A sample size of 150 students was considered appropriate for this study because of the rigid criteria for inclusion.

This was a prospective observational cross-sectional study. All the students in the three institutions were eligible for enrolment in the study. Students in the three institutions were invited to participate through posters and fliers posted on notice boards and also by announcements made during their regular lectures and practical classes. Simple random sampling was used for selecting the participants among the students that volunteered. However, final approval for a selected student to participate in the study was based on the inclusion criteria, which was determined by the exclusion criteria indicated in a questionnaire.

A self-designed pre-tested questionnaire was used to collect demographic data and other information. Each selected student was requested to read and sign an informed consent form before completing the questionnaire. Students with history of chronic cough, recurrent respiratory tract infection, chest or spinal deformity, asthma, emphysema, COPD, TB or cardiac illness were excluded from the study.

The weight of each student was taken to the nearest 0.1kg using an electronic scale. The height was measured using a standard stadiometer to the nearest 0.1cm with the student standing erect and upright. The body mass index (BMI) for each student was calculated as appropriate.

Pulmonary function tests were carried out only in the morning (between 8.00am to 12.00 noon) to reduce circadian rhythm variation in the data [12]. The tests were done using a computerised spirometer, SpiroUSB model run with Spida5 software [13]. The spirometer was calibrated each morning according to the protocol in the manufacturer's instruction manual [13].

The procedure was explained and demonstrated to each of the students before allowing them to proceed with the test. For each student, the test was repeated until three "good blows" gave acceptable recordings. Testing was stopped if a student did not wish to continue or if after 8 attempts failed to give sufficient number of acceptable recordings. The three "good blows" measured had to be within 150ml of each other to satisfy reproducibility criteria [14]. The best of the three acceptable manoeuvres was recorded as the final result. Spirometry tests were assessed using the American Thoracic Society (ATS) guidelines and criteria [6, 13, 14].

The pulmonary function parameters recorded for each student were: Forced Expiratory Volume in one second (FEV_1), Forced Vital Capacity (FVC), FEV_1/FVC, Peak Expiratory Flow (PEF) and Forced Expiratory Flow 25% and 75% (FEF_{25-75}).

Statistical analysis of the data was carried out using Microsoft XP Excel Data Package and

the Statistical Package for Social Sciences (SPSS) Version 20. The Shapiro-Wilks test was used to assess normality of data. Student's T-tests and Mann-Whitney U tests were used as appropriate. P-value of <0.5 was considered as significant.

Ethical clearance and permission were obtained from the Ethics and Research Grant Committee of the School of Medicine and Health Sciences (SMHS) University of Papua New Guinea (UPNG). Consent was obtained from all the institutional heads including permission for the setting up of the instrument to be carried out in secure areas in their institutions. Signed informed consent was obtained from each student.

RESULTS:

A total of 156 students volunteered to participate in the study. Of these, 116 (74.4%) students were randomly selected and requested to complete a pretested questionnaire before performing the spirometry.

After analysis of the 116 questionnaires and implementing the American Thoracic Society guidelines and criteria for assessing the spirometry results, a total of 39 (33.6%) students were excluded, because they did not fulfil the inclusion criteria. The reasons for exclusion of these 39 students are presented in Table 1. The reasons for failure to meet ATS criteria included insufficient number of blows (failure to give three good blows after eight or more attempts) and greater than 150 ml variations between blows for FEV_1 or FVC values.

Of the 77 students whose questionnaires and spirometry results were selected for analysis 34 (44.2%) were males and 43 (55.8%) were females. No specific reasons can be given for higher number of female students compared to male students that participated in this study.

The Mean age of the female students was 22±1.6 years (Mean ± SD) and for the male students was 22±1.5 years.

The anthropometric data and BMI classification for the male and female students are presented in Table 2. Although the male students were on average slightly taller and heavier than the female students, the differences were not statistically significant.

The WHO recommended categories for BMI was used to classify the BMI status which is an indication of the nutritional status of individuals [15]. None of the male students were underweight compared to 9.3% among the female students.

Table 1: Reasons for exclusion

Reason for Exclusion	Number (%) Excluded
Discrepancies in answers in the questionnaire.	2 (1.7%)
Spirometry results showing signs of mild-moderate restriction.	3 (2.6%)
Outside age range of 19-25 years.	7 (6.0%)
History of Lung/Cardiac Disease/Injury only.	14 (12.1%)
ATS Criteria not met only.	6 (5.2%)
Both ATS Criteria not met and History of Disease.	7 (6.0%)
Total (%) Excluded	39 (33.6%)

Table 2: Anthropometric data and BMI categories of male and female students

Parameters	Males (n = 34)	Females (n = 43)	
Height (cm)			
Mean	167.4	160.4	*P = 0.001*
Standard deviation (SD)	6.1	5.3	
Range (cm)	156.0-177.0	148.0-172.0	
Median (cm)	167.0	161.0	*P = 0.001*
Weight (kg)			
Mean	69.4	60.1	*P = 0.001*
SD	10.5	7.9	
Range (kg)	48.0-96.0	48.2-78.3	
Median (kg)	70.5	60.5	*P = 0.001*
BMI (kg/m2)			
Mean	24.7	23.4	*P = 0.093*
SD	3.2	3.4	
Range	19.5-31.7	17.1-30.8	
Median	24.4	23.5	*P = 0.741*

BMI (kg/m2)	Nutritional status	Males (n = 34)	Females (n = 43)
<18.5	Underweight	0	4 (9.3%)
18.5 – 24.9	Normal	18 (52.9%)	26 (60.5%)
25.0 – 29.9	Overweight	15 (44.1%)	12 (27.9%)
≥30	Obese	1 (2.9%)	1 (2.3%)

Table 3. Summary statistics of the Pulmonary Function Indices for the male and female students.

Parameters	FEV_1 (Litres)		FVC (Litres)		PEF (Litres/min)		FEV_1/FVC (%)		FEF_{25-75} (Litres/sec)	
	Males	**Females**	**Males**	**Females**	**Males**	**Females**	**Males**	**Females**	**Males**	**Females**
Mean	3.70	2.91	4.18	3.25	595.1	453.8	88.9	90.1	4.85	3.87
SD	0.43	0.39	0.54	0.53	99.7	72.1	4.2	4.6	1.03	0.73
Range	2.87-4.51	2.35 - 3.79	3.23 - 5.52	2.56 - 4.81	415.0 - 785.0	326.0 - 655.0	79.0 - 96.0	75.0 - 99.0	2.50 - 6.54	2.58 - 5.77
95% CI	3.55 - 3.85	2.79 - 3.03	3.99 - 4.37	3.09 - 3.41	560.4 - 629.9	431.6 - 476.0	87.4 - 90.3	88.7-91.5	4.49 - 4.80	3.65 - 4.10
Median	3.77	2.82	4.18	3.10	598.5	458.0	89.0	91.0	4.80	3.84
IQR	3.45 - 3.97	2.63 - 3.28	3.74 - 4.55	2.86 - 3.64	519.5 - 650.8	398.0 - 499.0	86.8 - 92.0	86.0 - 93.0	4.26 - 5.49	3.41-4.39
Mann Whitney	*P=0.001*		*P=0.001*		*P=0.001*		*P=0.275*		*P=0.001*	

95% CI: 95% Confidence Interval; IQR: Interquartile Range

Table 3 shows the summary statistics of the pulmonary function indices for the male and female students. The Shapiro-Wilk test for normality of distribution indicated that the FEV_1 results for the males were normally distributed ($p = 0.553$, $df = 34$) but not normally distributed for the females ($p = 0.025$, $df = 43$). Similar distributions were obtained for some of the other parameters. The Mann-Whitney U and Student's-T tests show that the mean FEV_1 for the male students (3.70 ± 0.43L) was significantly higher ($p = 0.001$; 2-tailed) than that for the female students (2.91 ± 0.39L).

The mean FVC for the male students (4.18 ±0.54L) was significantly higher ($p = 0.001$; 2-tailed) than the mean (3.25 ± 0.53L) for the female students. Tests for normality of distribution of the PEF results for both male and female students indicated that both were normally distributed (males, $p = 0.42$, $df = 34$; females, $p = 0.274$, $df = 43$). A statistically significant difference was obtained when the PEF results was compared between the males and the females ($p = 0.001$, 2-tailed).

The mean $FEV_1/FVC\%$ for the male students was 88.9 ± 4.2% and for the female students was 90.1 ± 4.6%. There was no statistically significant difference ($p = 0.275$) between the values obtained for the male and female students.

The mean FEF_{25-75} for the male students was 4.85 ± 1.03L/sec and for the female students was 3.87 ± 0.73L/sec. Comparison of the results indicated that the mean FEF_{25-75} for the

male students was significantly higher (p = 0.001) than the mean for the female students.

The non-parametric data (median values and Interquartile ranges) for the pulmonary function tests parameters are presented in Table 3.
The coefficients of correlation between BMI and spirometry parameters for male and female students are presented in Table 4.

For the male students with normal BMI, the Spearman's rho indicated strong positive statistically significant linear correlation between BMI and FEV_1, BMI and FVC, and also BMI and FEF_{25-75}. For the female students with normal BMI, the spearman's rho shows very weak inverse non-statistically significant correlation between BMI and FEV_1, BMI and FVC, and BMI and FEF_{25-75}.

The male students in the BMI overweight category, Spearman's rho indicates weak inverse correlation that was not statistically significant, between BMI and FEV_1, BMI and FVC. However, a strong inverse statistically significant correlation was obtained between BMI and FEF_{25-75}. For the female students in the overweight BMI categories, Spearman's rho shows weak inverse non-statistically significant correlations between BMI and FEV_1, and also BMI and FEF_{25-75}, but a weak linear non-statistically significant relationship between BMI and FVC.

Table 4: **Coefficients of correlation between body mass index (BMI) and spirometry parameters for male and female students**

	Normal		Overweight	
Correlation between	**Spearman's rho**		**Spearman's rho**	
	Males	**Females**	**Males**	**Females**
BMI and FEV1	0.609 (p=0.007)	-0.074 (p=0.720)	-0.202 (p=0.471)	-0.225 (p=0.483)
BMI and FVC	0.491 (p=0.039)	-0.006 (p=0.976)	-0.111 (p=0.693)	0.035 (p=0.914)
BMI and FEF25 – 75	0.689 (p=0.002)	-0.218 (p=0.284)	-0.695 (p=0.004)	-0.403 (p=162)

Coefficient of correlation: Spearman's rho
P < 0.05 indicates statistical significance.

DISCUSSION:

In the present study the rigid screening procedures that included the exclusion criteria and implementation of the ATS Guidelines reduced the total number of 116 randomly selected students to the sample size of 77 (66.4%) students. The anthropometric measurements revealed that the mean height and weight for the male students (167.4 ± 6.1cm and 69.4 ± 10.5kg) were significantly greater than those for the female students (160.4 ± 5.3cm and 60.1 ± 7.9kg) respectively. These results support the findings reported in the PNG National Nutritional Survey (PNG NNS) conducted in 2005 [16]. According to the PNG NNS 2005, the mean height (164.9 ± 7.3cm) and weight (61.1 ± 7.5kg) of males in the 20-29.9 years age group were greater than the mean height (154.5 ± 5.3cm) and weight (54.1 ± 8.7kg) of their female counterparts in the same age group [16]. Body Mass Index results however showed no significant difference across gender. Statistical tests for normality of distribution showed that some of the spirometry parameters of interest had normal distributions for both male and female results, except the FEV_1 and FVC, where only the male groups had normal distributions. No specific reasons can be given for the skewed FEV_1 and FVC results obtained for the female students. Comparison of spirometry results obtained for male and female students revealed significant differences between the genders for FEV_1, FVC, FEF_{25-75} and PEF. FEV_1/FVC% was the same across the gender groups. Because FVC is a measure of lung size it is possible to suggest that the male students have larger lung volume than the female students of the same age group in the present study. This may be a result of a genetically greater thoracic size, which allows for greater expansion and development of the lungs.

FEV_1 is a measure of both lung size and airway resistance. Our results suggest smaller lung volumes and/or narrower airways in the female students compared to the male students. FEV_1/FVC% was not different among males and females (89 ± 4% and 90 ± 5% respectively); therefore the difference of FVC in the two groups was proportionate to the difference of their FEV_1. A narrowing of the airways would have resulted in lowering of the FEV_1 only and not the FVC. Thus, the smaller mean FEV_1 seen in the female students is more likely to be a result of a smaller lung volume rather than narrower airways.

PEF is dependent on effort and lung volume [14]. The PEF results may also imply larger lung size in the male compared to the female students.

Mean height was significantly higher in males compared to females. Therefore, this difference in anthropometry could have contributed to the difference in spirometry since height is known

to be a significant determinant of measured lung volumes and capacities.

Even though few studies have focused on comparing male and female spirometry, review of the findings of numerous studies focusing on other variables show consistently that males have higher mean values than females of similar age groups. Schwartz et al [17] reported that males tended to outperform females with the same anthropometric characteristics in all age groups, except in the height range of 130 to 160cm, where female flow and volumes were superior. Pellegrino et al [18] also stated that for the same standing height, young males have greater lung function values than young females; while Neder et al [19] found that males presented with higher total lung capacity values than females in all age groups with the exception of the 50-59 year group where the height difference was the lowest.

Obesity is becoming a greater burden on health systems in the Pacific as a result of changes in diet and lifestyle [20, 21]. The effects of weight gain on body systems have been extensively studied [22]. Obese individuals frequently complain of respiratory symptoms [23,24]. Various studies have investigated correlation between BMI and various lung volumes [25-27]. Jones et al demonstrated significant linear relationships between BMI and vital capacity and total lung capacity [26]. On the other hand, functional residual capacity and expiratory reserve volume decreased exponentially with increasing BMI [26]. Park et al found no BMI correlation with FVC and FEV_1 in males while a positive correlation was found between BMI and FVC and FEV_1 in females [27]. Results of a work by Jaltade and co-workers showed mean values of FVC, FEV_1 and FEF_{25-75} were lower in overweight subjects than normal weight subjects [25].

In our present study, there was a statistically significant positive correlation between BMI and FEV_1, FVC and FEF_{25-75} for male students with normal BMI, while a negative correlation was observed for FEF_{25-75} in overweight BMI male students. Results for the females showed no significant correlation between BMI and the spirometry parameters. The results in our present study were similar to those reported by Jones et al [26], but different from those reported by Park et al [27].

Our results suggest that BMI does not have much of an effect on airway diameter and therefore on forced expiratory volumes. Much of the reduced lung function seen in obesity may be attributed to the burden of weight (fat build up) placed on the respiratory pump and the airways. In less heavy individuals the burden may not be great enough to exert an obvious effect, possibly explaining why we did not find any effects of BMI on lung function in our results.

However, the negative correlation between BMI and FEF_{25-75} for the overweight male students hint at an increased risk of developing asthma in this group since FEF_{25-75} may be reduced in obstructive lung disease [18].

CONCLUSION:

Our findings indicate that gender was a significant determinant of lung function with the male group showing greater mean values for FEV_1, FVC, PEF and FEF_{25-75}. These suggest greater lung volumes in the male students compared to the female students. Negative correlation was found between FEF_{25-75} and being overweight in the male group. It is hoped that these results may serve as baseline data and set the stage for further detailed research in assessing the normal pulmonary function among the various age groups in PNG.

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CASE REPORT

CAVERNOUS HEMANGIOMA OF THE BUCCINATOR MUSCLE- MRI FEATURES

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Running Title: Cavernous Hemangioma

ABSTRACT:

Intramuscular cavernous hemagiomas represent less than 1% of all hemangiomas and consist of benign proliferations of blood vessels. Typical presentation is an enlarging painful soft-tissue mass without cutaneous changes. We report a case of cavernous hemangioma of the buccinator muscle presenting as an asymptomatic unilateral swelling. The rarity of a cavernous hemangioma in such a location and its presentation as a unilateral swelling without cutaneous changes made the case unique. In addition we highlight the MRI features that guided us to arrive at a diagnosis.

Key words: Cavernous hemangioma, hamartomas, intramuscular, MR imaging.

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INTRODUCTION:

Hemangiomas are benign tumours that are characterized by a rapid growth phase with endothelial cell proliferations followed by gradual involution [1]. Cavernous hemangiomas occur at a deeper plane and have been described in most of the head and neck locations in a variety of presentation [2]. Very few cases of Cavernous haemangioma of the buccinator muscle has been reported. A case of cavernous hemangioma is described because of its uncommon location and its

confusing clinical presentation as a unilateral soft tissue swelling of the buccal mucosa. The importance of MRI in the diagnosis of such a lesion cannot be overemphasized. The ethical clearance for the publication of the case report was obtained from the university ethics committee.

CASE REPORT: A 15 year old male patient presented to our institute with a complaint of swelling on the left side of the face since childhood. The patient's father revealed that the swelling was noticed since childhood which gradually increased in size and reached the present form. Esthetic was the prime concern of the patient, the swelling was otherwise asymptomatic. Medical and family histories were noncontributory. Patient appeared to be in overall good health other than the presence of the swelling. Extra oral examination revealed a diffuse swelling in the left middle third region of the face [Figure 1]. The swelling was smooth surfaced and measured 4.0cm X 5.0cm X 5.5cm extending from 1.0cm below the infra orbital margin to 1.0cm below the ala tragus line superior-inferiorly and medio-laterally 1.0cm from ala of nose to 1.0cm anterior to the tragus. Color over the skin of the swelling was normal. On palpation there was no rise in temperature. The swelling was nontender, non fluctuant, non pulsatile and did not blanch.

Intraoral examination revealed no soft tissue abnormalities on the left side on inspection but on bimanual palpation there was an increase in soft tissue mass on the same side when compared to the contralateral side. Based on the long standing history and clinical presentation, the swelling was provisionally diagnosed as myohypertrophy of the buccinator . On investigation, MRI study revealed diffuse soft tissue thickening over the left buccal mucosa region with ill defined lesion in the soft tissue plane [figure2]. The lesion displayed hypointense signal intensity on T1 weighted images with adjacent hyperintense areas. T2 weighted images shows inhomogenously hyperintense images [figure3]. Finally Short Tau Internal Recovery [STIR] sequence with fat suppression was performed and the lesion appeared bright [figure 4]. There was no obvious extension into masseter and underlying bones. Rest of the visualized soft tissues of the face was normal. The MRI features were highly suggestive of cavernous hemangioma.

In the management of this case the factors considered was age, site and size of the lesion. Since the patient was 15 years old and considering the possibility of regression of growth after puberty in these hemangiomas we decided to wait and watch. The patient was kept on 6 month recall basis. The patient reported after a year for a checkup and no complaint was reported by the patient.

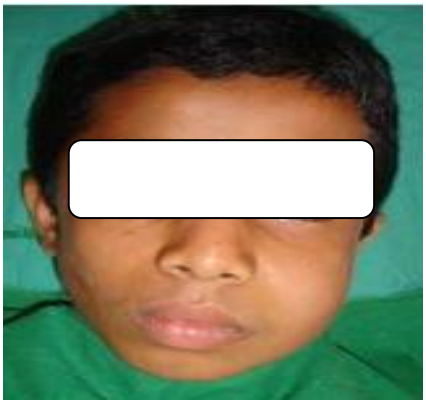

Figure 1: Diffuse swelling of the left middle third region of the face.

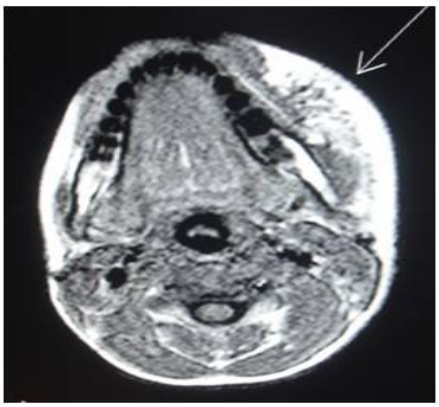

Figure 2: Diffuse soft tissue thickening with hypointense signal intensity on T1 weighted images with adjacent hyperintense areas.

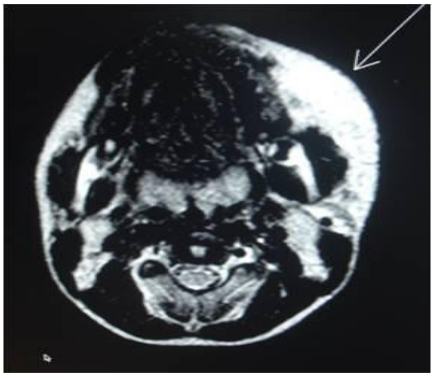

Figure 3: T 2 weighted images shows in homogenously hyperintense images

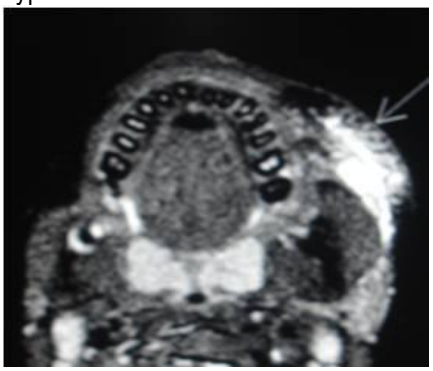

Figure 4: STIR sequence with bright images.

DISCUSSION:

In 1843, Liston was the first to report a case of intramuscular cavernous hemangioma naming it as an "erectile tumor".[3] Skeletal muscle hemangiomas accounts for less than 1.0% of all the tumors out of which hemangiomas in the masseter muscle are most common and next being in the trapezius muscle. [3,4] In the present case the tumor appeared to be arising from the buccinator muscle. Intra muscular hemangiomas are considered hamartomatous lesions and thought to arise from abnormal embryonic rests [5]. Based on the vessel size intramuscular hemangiomas can be classified into capillary, cavernous and mixed with capillary form being the most common. Cavernous hemangioma is a histological variant with numerous dilated venous channels. Vascular features such as visible pulsations, audible bruit, discoloration of overlying skin is usually not present in cavernous hemangioma. These features were also observed in the present case. Phleboliths are characteristically seen in cavernous hemangiomas [6,7]. However it was not seen in the present case.

Diagnosis of hemangiomas in the head and neck regions is usually not complicated due to its classic presentation with discoloration. However in the present case, because of the uncommon location and nonspecific clinical presentation, diagnosis was challenging.

Aspiration is not very useful because it yields only blood [8]. Radiographs are useful to evaluate pheboliths [8]. Ultrasound and Color Doppler flow studies are useful in studying the vascular nature of the lesion [9]. MRI is the ideal tool for diagnosis of soft tissue tumors, especially hemangiomas because they are able to delineate the vascular lesion from fatty tissue & muscle [7]. Characteristically hemangiomas in MRI shows a light bulb pattern which was seen in the present case. Angiography provides information about the feeding artery in larger hemangioma that can be embolised, however they are associated with complications [9].

Management of intramuscular hemangiomas depends on factors like age of the patient, extent, accessibility, rate of growth, size of the lesion after puberty and cosmetic considerations. Various treatment methods are discussed in literature of which surgery being the main modality [10]. Corticosteroids, sclerosing agents, radiotherapy have been adopted as adjunctive modalities of treatment [10].

In conclusion, cavernous hemangioma of the buccinator muscle although rare, should be considered in the differential diagnosis of soft tissue tumors of the orofacial region. The role of advanced imaging modality such as MR imaging in the accurate diagnosis is a highlight in our present case.

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CASE REPORT

HYPERPOSPHATAHEMIC TUMORAL CALCINOSIS SUCCESSFULLY TREATED WITH SURGICAL EXCISION AND ACETAZOLAMIDE

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ABSTRACT:

Tumoral Calcinosis (TC) is a rare disease of obscure aetiology. In its classic form, it is characterised by solitary or multiple large foci of mineralisation in the soft tissue adjacent to the bone around large joints in the absence of disorders of calcium metabolism and visceral calcification. We present a rare case of tumoral Calcinosis associated with hyperphosphataemia in a 27-year old Sudanese woman. Histological findings confirmed the diagnosis of tumoral calcinosis. Laboratory investigations showed hyperphosphataemia with normal levels of serum calcium and parathyroid hormone (PTH). The patient was treated successfully with surgical excision and acetazolamide.

Key words: Hyperphosphataemia, Tumoral Calcinosis, Acetazolamide

Submitted: October 2013; Accepted: November 2013

INTRODUCTION:

Soft tissue calcifications are found in different diseases such as milk alkali syndrome, hypervitaminosis D, primary and secondary hyperparathyroidism and tumoral calcinosis (TC) [1]. Among these conditions, TC remains a poorly understood disease in which either solitary or multiple benign calcifications are usually found near large joints, without any involvement of the synovium itself or the adjacent bone in patients with normal serum calcium levels.

Although the aetiology of TC is unknown, some authors have associated this disease with metabolic disorders or with trauma [2]. TC seems to be more common in the tropics [3]. A case of TC associated with hyperphosphataemia in a 27-year old Sudanese female who had been followed up for 8 months is presented.

CASE REPORT:

A healthy 27-year old Sudanese woman presented in October 2012 with a 4-month history of a painless swelling in the right upper lateral aspect of the hip region. It was insidious in onset, gradually increasing in size.

The patient had no fever and no pain, numbness, or weakness of the leg. There was no family history of any similar disease. Whereas it was not possible to recall any cause of the swelling (particularly trauma) the patient affirmed that she tended to lie on her right side while sleeping.

Physical examination revealed an oval, firm, subcutaneous tumour measuring about 5x6 cm. The skin over the mass exhibited an orange-peel appearance.

Her right hip had a normal range of motion. The anteroposterior radiograph of the right hip revealed a lobulated, calcified soft tissue mass (Fig. 1). There was no fracture or periosteal change, and the soft-tissue thickness was normal.Fine needle aspiration cytology was done, but it showed no abnormality. The patient was planned for surgical excision of the mass. Wide local excision was done (Figure 2) with primary closure.

Histopathological examination revealed diffuse and extensive areas of spotty calcification in the subcutaneous tissue surrounded by fibro-fatty connective tissue and interspersed with macrophages and mixed inflammatory cell infiltrate (Figure 3). These findings confirmed the diagnosis of Tumoral Calcinosis. The margins were free and there was no evidence of malignancy.

Chemical analysis showed calcium phosphate crystals. Laboratory investigation of the blood revealed; serum calcium level of 2.43 (normal range: 2.20–2.70) mmol/l, serum phosphate level of 6.83 (normal range: 0.81–1.94) mmol/l, serum parathyroid hormone level of 2.8 (normal range: 1.6–6.9) µmol/l.

Hyperphosphataemia was treated with acetazolamide 500 mg/day [4]. Serum phosphorus of 1.6mmol/l was obtained within 4 weeks. During the follow-up period of 8 months there was no recurrence.

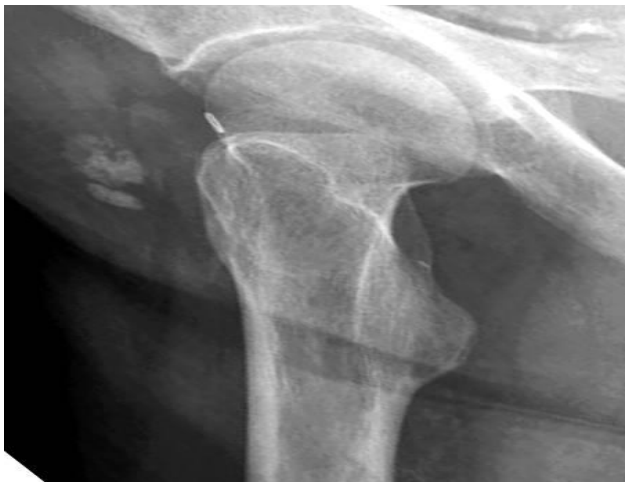

Figure 1:
Anteroposterior radiograph of the right hip showing a lobulated calcific mass in the lateral region of the right hip. No joint or bone involvement is seen.

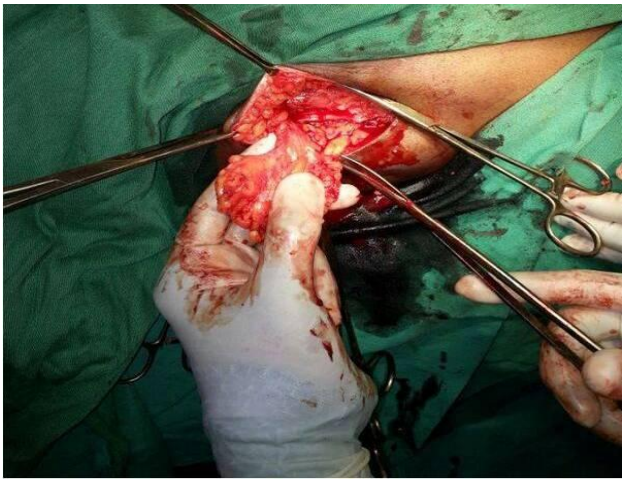

Figure 2:
Macroscopic appearance of the completely excised mass: the lesion consists of an encapsulated, firm, lobulated soft tissue mass (5x6 cm) consisting of fibrous septa surrounding areas containing chalky material.

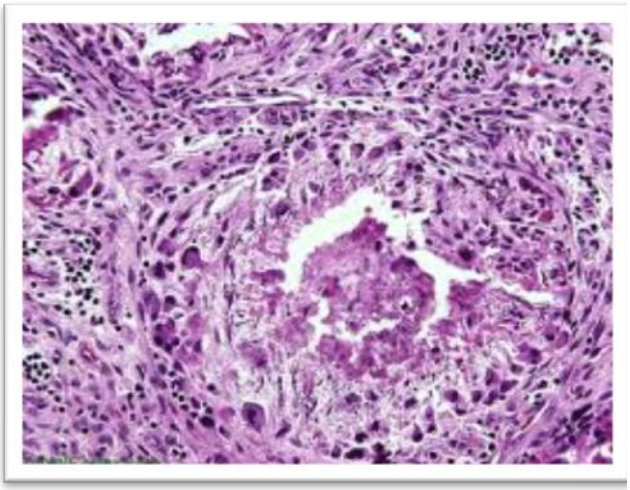

Figure 3:
A photomicrograph of the biopsy-specimen showing areas of calcification surrounded by fibro-fatty connective tissue.

DISCUSSION:

The term tumoral Calcinosis (TC) define a condition in which either single or multiple tumour-like calcified masses are present without any associated calcium or phosphate metabolism disorder [5]. The calcifications normally adhere to the surrounding tissue and frequently appear in the vicinity of joints. Although hyperphosphaternia has been described in few patients, TC in the presence of a normal circulating phosphate concentration is the rule rather than the exception [6].

TC is a rare disease which has been recognised as a clinical entity since 1899 [7]. The pathogenesis of TC remains unclear and several theories have been proposed. Some authors consider it a hereditarymetabolic dysfunction of phosphate regulation (with normal serum calcium levels) and distinguish it from calcification associated with renal osteodystrophy [8]. The presence of lesions around pressure points suggests the possibility of local trauma as a causative factor [9]. Cases of familial tumoral calcinosis generally are observed in younger patients, who tend to have multiple areas of calcification. A positive family history is encountered in 30% to 40% of cases [10]. The literature includes about 100 reports of familial tumoral calcinosis. In these reports, the disease results from disruptions in phosphate metabolism and is characterized by a high serum phosphate level. Recently, the genetic basis of familial tumoral calcinosis has been clarified [11]. The kidneys' ability to excrete excess phosphorus from the body depends on the phosphaturic factor known as fibroblast growth factor 23 Nacetylgalactosaminyltransferase 3 (GalNAc-T3) isoform. A mis-sense mutation in the GalNAc-T3 gene is thought to constitute the genetic basis of this disorder [12].

The clinical presentation and radiographic features in our patient were quite typical, although the diagnosis could only be confirmed by a histological study. Even though some authors have shown that, in addition to radiography, other diagnostic modalities such as computed tomography and magnetic resonance imaging can also be helpful in making a correct preoperative diagnosis of TC [13], these examinations could not be performed in our case due to lack of sophisticated facilities at our small hospital.

A complete surgical resection of the calcium phosphate deposits thus remains the treatment of choice in patients where TC is not associated with any metabolic disorder, yet recurrence is frequent if removal is incomplete [14]. Our patient, who demonstrated hyperphosphstemia, was therefore treated with a wide local excision of the calcified mass in addition to acetazolamide and no recurrence was evident during 8 months of follow-up.

CONCLUSION:

The young age of our patient together with the presence of subcutaneous calcified mass, high serum phosphorus and histopathology allowed us to make the diagnosis of Tumoral Calcinosis and treat the patient successfully. Surgical excision should be complete in order to avoid local recurrence. This diagnosis should be kept in mind when dealing with subcutaneous calcified masses.

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EROSIVE VARIANT OF ORAL LICHEN PLANUS – A CASE REPORT

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Running title: Erosive Lichen Planus

ABSTRACT:
Lichen planus (LP) is a chronic mucocutaneous disorder in which auto-cytotoxic T lymphocytes trigger apoptosis of epithelial cells leading to chronic inflammation. Oral Lichen Planus (OLP) is a disease which has a slight malignant potency. The diagnosis of OLP can be made from the clinical features if they are sufficiently characterized, but biopsy is recommended to confirm the diagnosis and to exclude dysplasia and malignancy. This is a case report of erosive lichen planus in a female patient, aged 45 years.

Keywords: Lichen planus, Oral, dysplasia
Submitted: October 2013; Accepted: November 2013

INTRODUCTION:

Oral Lichen planus (OLP) is a common immunologic mucocutaneous inflammatory disease that varies in appearance from keratotic to erythematous and ulcerative. It affects 0.5% to 1% of the world's population. Approximately half of the patients with cutaneous lichen planus have oral involvement [1]. The mean age of onset is the fifth decade of life, and is more predominant in females [2]. This article is a case report of erosive lichen planus located in the buccal mucosa of a 45 year old female patient. The diagnostic

approach, clinical feature and various treatment modalities are presented below.

CASE REPORT:

A 45 year old female patient reported with chief complaint of burning sensation over her right cheek region. She gave a history of burning sensation since 6 months that usually aggravates upon consumption of spicy and hot substances. She underwent no medications for the same.

On visual analog scale (VAS) rating scale, patient reported burning sensation of 6. She also reported difficulty in mastication due to burning because of which her consumption of food was minimal. She had a habit of using snuff since 2 years with a frequency of 2-3 times per day. Extra oral examination revealed no abnormality.

On intra oral examination of the patient, the right buccal mucosa revealed diffuse erythematous areas interspersed with whitish lace like striae (Fig. 1) measuring approximating 1.5cm in diameter with irregular borders around. The lesion extends anteriorly 1.5cm from the right corner of mouth, posteriorly 2.0cm from the retro molar region, superiorly 0.5 cm above the occlusal plane and inferiorly 1.0 cm above the lower buccal vestibule. Surface appeared to be smooth and glossy with no signs of bleeding. The lesion on palpation was tender (Visual Analog Scale 6), and non scrapable. The left buccal mucosa showed lace like whitish striae near the corner of the mouth.

As a chair side investigation Toluidine blue staining on right buccal mucosa (Fig. 2) was done.

Based on the history given by the patient and the clinical examination carried out, a provisional diagnosis of Erosive lichen planus on right buccal mucosa was made.

Incisional biopsy was taken from the lesion under local anesthesia, and the specimen was sent for histopathological examination. Histopatholgic picture showed hyperparakeratotic, atrophic stratified squamous epithelium exhibiting basal cell degeneration in some areas. Sub epithelial connective tissue was densely infiltrated with inflammatory cells, predominantly lymphocytes (Fig. 3).

Final diagnosis of lichen planus was made. The patient was asked to apply triamcenolone acetonide 0.1% ointment over the lesion three times a day for 3 weeks. Patient reported back after 3 weeks with regression in the size of the lesion. The patient was also advised to discontinue the use of snuff.

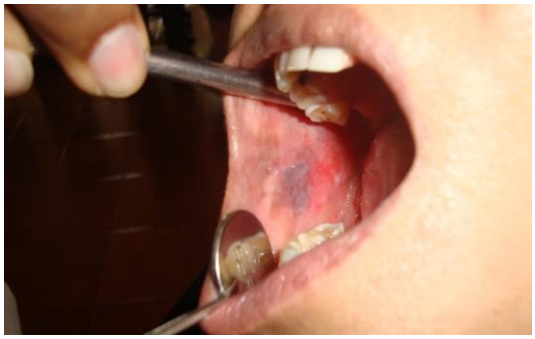

Figure 1: right buccal mucosa showing erythema with striae and sparse pigmentation

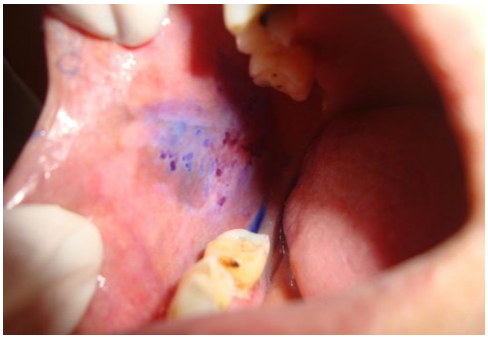

Figure 2: Toluidine blue staining on right buccal mucosa

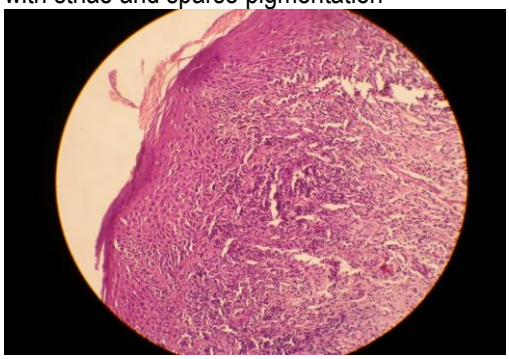

Figure 3: Histopathologic picture

DISCUSSION:

OLP is a chronic inflammatory oral mucosal disease of unknown etiology. It is a benign condition that affects both the skin and the mucosa. Erosive lichen planus, although not as common as reticular form, it is significant for the patient since it is symptomatic. It is characterized by the presence of vesicles, bullae or irregular shallow ulcers of the oral mucosa [2]. The periphery of the atrophic regions is usually bordered by fine, white radiating striae [3]. Atrophic lesions and erosions are the forms most likely to cause pain. The most frequently affected sites are the buccal mucosa, tongue and the gingival [4]. Approximately 10 % of cases of oral lichen planus are confined to gingiva. It has been reported that most cases of erosive lichen planus may be associated with desquamative gingivitis [2]. Regarding the malignant potential rate of erosive lichen planus, previous studies have reported that it has a significant high risk of malignant transformation to squamous cell carcinoma [5]. Erosive lichen planus has the higher rate of malignant potency when compared to other types of oral lichen planus. It

has been suggested earlier, the association of lichen planus with viral lesions that lichen planus may be triggered by hepatits c virus (HCV) infection.

HC virus mainly affects the keratinocytes in lichen plaus lesions. The association of erosive lichen planus and HCV infection depends on geographic factors because of its varied incidence. So serology for HCV should be made in suspected lesions, especially those with erosive variants [6].

It has been reported that less than 5% of OLP patients develop oral cancer, most frequently in erosive and atrophic type the cause of increased oral cancer risk is unknown but the chronic inflammatory and epithelial wound healing response in these patients may increase the likelihood of oral cancer forming gene mutations [7].

Diagnosis: Erosive lichen planus should be suspected when typical lichenoid white lesions accompanies erosive lesions. Biopsy of erosive lesion is mandatory to confirm the clinical diagnosis and particularly to exclude dysplasia and malignancy.

Management: The main aim of treatment of oral lichen planus is to eliminate mucosal erythema and ulceration, alleviate symptoms and reduce the risk of oral cancer in OLP patients. The treatment mainly depends on the symptoms, extent of the lesion, medical history and other factors. A patient with reticular forms and other asymptomatic forms of lichen planus does not usually require treatment. Symptomatic lesions require treatment and this mainly depends on their severity which can be divided into 3 steps – primary, secondary and tertiary line of treatment [8]. Mild to moderate symptomatic cases are given primary line of treatment.

Triamcinalone acitonide 0.1% cream or Fluocinonode 0.05% gel or Dexamithazone 0.5mg/5ml in orabase are given topically [6]. Ecksrdt et al in their study has mentioned that erosive lichen planus can be very effectively treated by topically applied tacrolimus and results in rapid symptom relief [9]. Lesions that do not respond to topical therapy are given secondary line of treatment which involves corticosteroid injections.

Mostly given are 0.2 to 0.4ml Triamcinalone acitonide or Systemic Prednisolone 40 to 80 mg daily that are sufficient to achieve a response [8]. Due to drug toxicity it is mostly given in lowest dose. Systemic Prednisolone should be taken either for brief periods of time, (5–7 days) and the dose should be reduced by 5–10 mg/day gradually over 2–4 weeks [8].

On the other hand more severe cases are given tertiary line of treatment. These cases do not respond to short term prednisolone. More protracted course of Prednisolone should be

given [10]. Immunosuppressant such as Azathioprine 50 to 100mg / day, cyclosporine 50mg should be prescribed, so as to minimize the side effects of corticosteroids in the treatment of oral lichen planus [11].

CONCLUSION:

Oral lichen planus is an immunologically mediated chronic disease that has characteristic clinical appearance. Erosive lichen planus is one form of oral lichen planus in which malignant potential rate is on the higher side. Thus it is necessary to identify the lesion clinically and histopathologically and treat the condition at the earliest. Prior informed consent was obtained from the patient before the lesional approach.

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LETTER TO THE EDITOR

MORE STUDIES NEEDED ON BETEL NUT CHEWING AND POOR HEALTH OUTCOMES AMONG PAPUA NEW GUINEANS

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Dear Editor-in-Chief,

Betel (areca) nut chewing is the fourth commonly used psychoactive substance behind alcohol, smoking and caffeine use globally [1]. It is also a common habit in Papua New Guinea [PNG] but limited research has been done on its association with poor health outcomes by PNG medical scientists. Betel nut quid chewing and its association with oral pre-cancerous and cancerous lesions are well recognized and documented [2]. The betel quid is now recognized by WHO as a carcinogen [3]. In the 2013 annual PNG Medical Symposium held in Lae, Ome et al at PNGIMR showed contrasting evidence from this habit and birth outcomes [4]. More work needs to be done to show conclusive evidence that betel nut chewing have a negative effect on birth outcomes such as birth weight.

Isi Kevau et al at the Sir Buri Kidu Heart Institute in Port Moresby General Hospital, PNG, studied the cardiovascular effects of betel nut chewing and found that the acute effects are, transient rise in baseline heart rate lasting about 20 minutes, variable blood pressure response and transient myocardial ischaemia in patients with coronary artery disease [5]. The exact mechanisms of these observed clinical effects are yet to be elucidated.

Betel nut quid chewing has also been shown to be associated with poor glycaemic control and metabolic syndrome [6, 7].

According to other researchers there are various acute and chronic effects which seem to be negatively associated with betel nut chewing [8 – 13].

It is recognized by many in PNG that betel nut chewing is an integral part of PNG culture and will be a mammoth task to ban the habit in PNG. To assist with the ongoing efforts to control the habit of betel nut quid chewing in

PNG, health professionals and researchers in PNG need to do more in-depth both clinical and laboratory based studies to examine the effects of betel nut quid on various systems of the body. Information generated from such studies can be incorporated into public health messages to create awareness among the public that may assist to control the habit of betel nut chewing and ultimately reduce its negative effects.

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