Impaired Bone Quality Induced by Methamphetamine Use in Young Men

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Abstract: Objectives: This study was to investigate the bone quality in young men with long-term methamphetamine use history and its determinants, compared with age matched normal ones. Methods: 111 males, who had the history of long-term methamphetamine consumption, and 125 non-drug dependences were recruited as normal control. Bone quality was tested and collected from participants by a quantitative ultrasound scan device. Independent t test and multivariate regression model were used to do data analysis. Results: The mean stiffness-index of individuals with methamphetamine use history was 88.25 (16.04), which was significantly lower than that of normal ones, 100.02 (23.86), $p<0.05$. In multivariate regression model, Body mass index (BMI) and smoking years were positively correlated with bone quality and fat mass was negatively did, $p<0.05$. Conclusion: Young men with methamphetamine use history had abnormally low bone quality compared with individuals with non-drug use history. In addition, their bone health may be also affected by smoking and overweight or underweight. This special population may be in the risk of bone loss and of fracture.

1 INTRODUCTION

Peak bone mass is the greatest amount of bone tissue that individuals can obtain in their life time. Normally, people reach their peak bone mass around 30 years old (Bonjour, 2009), and then it might be decreasing with aging (Bonjour, 2009; Hendrickx, 2015; Vashishth, 2005). Higher peak bone mass would decrease the risk of osteoporosis later in life (Nalla, 2004). High peak bone mass in young age can benefit bone health in later years.

Methamphetamine (MA) addiction has become a worldwide issue and, in some regions, it was considered as one of the most worry threats of drug abuse (World Drug Report 2018). Previous studies reported that MA is associated with neurological and cardiovascular diseases (Cruickshank, 2009; Tolliver, 2012) and growing violent behaviors (McKetin, 2014). This substance has not been directly linked with bone health, but some other drugs do. Gotthardt et al. and Ding et al. state that long-term opioid dependences are more likely to have low bone mass (Gotthardt, 2017; Ding, 2017). Gozashti et al. reported that opium use may be risk factor for bone quality (Gozashti, 2011).

Body composition is associated with bone health. Fat mass (FM), low body weight (BW) and low fat-free mass (FFM) are reported as the risk factors of low bone quality (Lima, 2009; Morin, 2008). However, this correlation has not been tested in MA-dependences. Taken together, MA use has not been researched in bone field and the determinants or risk factors of MA-dependences' bone health were not

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clear as well. Thus, this study was to investigate the bone quality in young MA-dependent men and to analyze the determinants of bone quality.

2 MATERIALS AND METHODS

This study was approved by local Ethic Committee. Every participant in this study was informed about the content of this study by written consent prior the assessments and they had right to reject any of them.

2.1 Participants

Both young men with meth use history and normal ones were recruited from the middle area of China. 150 MA-dependent men, aged from 23 to 43, were recruited from Men Specific Drug Rehabilitation Center, Hefei, Anhui, China. Normal males, aged from 24 to 42, were recruited from Hefei, Anhui. The exclusion criteria were 1.) HIV infection; 2.) fractures in last 12 months; 3.) type 1 diabetes; 4.) significantly impaired renal or hepatic function, or chronic kidney diseases; 5.) in acute detoxification; 6.) abstinent time was more than three months; 7.) polydrug use.

After the exclusion, there were 111 participants left in the patient group and 125 in control group. In addition, 46 patients provided their information of history of drug use, including the duration of MA use (years), the frequency of MA use (times per week) and withdrawal time (weeks). Other background information included smoking time (years) and drinking (times per week).

2.2 Measurements

All participants accepted bone quality assessment, which was tested by a quantitative ultrasound scan (QUS) device. Speed of sound (SOS; m/s) and broadband ultrasound attenuation (BUA; dB/MHz) were measured on the right calcaneus of the participants in an upright seated position.

QUS, an alternative of Dual Energy X-ray Absorptiometry, can provide structural information (Njeh, 1997). It expresses bone strength as bone quality, rather than density or content of bone minerals (Holi, 2005). QUS is considered as an accurate technique to show the bone strength and the risk of fracture (Marín, 2006; Knapp, 2001; Miller, 2002). Stiffness-index (STI) shows the bone strength and is calculated through the formula:

STI = 0.67 × 'BUA' + 0.28 × 'SOS'– 420 (Njeh, 1997; Holi, 2005)

Higher STI value represents stronger bone strength. In addition, another indicator T-score, which is based on STI and calculated in the QUS device, was used to distinguish osteoporosis or osteopenia from the normal. The Object will be classified into the normal, when T-score is more than −1.0, and put into the osteopenia, when T-score is between −2.5 and −1.0. If T-score was less than -2.5, the individual will be osteoporosis.

In addition, there were height, BW, FFM, and FM assessments. Body height (BH) tested by stadiometer and the others were measured by bioelectrical impedance analyzer. Participants were standing on bare feet with the heel and toe of each foot in contact with the metal footpads, with arms hanging on each side, lightly holding the analyzer handgrips. Coefficient of variance (CV) of the impedance measure was 0.4%. The values were supported by skinfold measurements, through harpenden calipers.

2.3 Analysis

This study utilized a confidence interval of 95%. Independent t test was to compare the differences between two groups. Multivariate regression model was used to analyze the correlation between STI and each factor. The mean value and standard deviation (SD) are shown as mean (SD) in this paper. In this study, the result will be considered as significant, if p value is less than 0.05. All results were performed by SPSS (version 25).

3 RESULTS

Table 1 shows the background information of control and patient groups and the drug using history of patient group. Control group's STI, BUA and SOS were 100.02 (23.86), 50.95 (6.07) and 1584.44 (145.84), respectively, which were significantly higher them of patient group, 88.25 (16.04), 48.31 (5.29) and 1566.39 (149.84), respectively.

The percentage of osteoporosis and osteopenia was demonstrated in Table 2. Around 32% participants had osteoporosis or osteopenia in control group, but around 55% in patient group.

Table 3 demonstrates the relationship between bone quality (STI) and risk factors. In multivariate regression model, smoking and FM had significantly negative correlation with STI and the standard beta was -0.41 and -1.04, respectively, $p<0.05$. BMI was positive correlated with STI, standard beta=1.28, $p<0.01$. Other factors did not show significant association with bone quality.

Table 1: Background information of participants.

	Control Group (mean SD)	Patient Group (mean SD)
Age	32.30(6.23)	31.84(5.90)
Withdrawal time (weeks)	-	4.91(1.60)
Duration of MA consumption (years) (n=46)	-	7.13(3.83)
High frequency of MA use a(n=46)	-	56%
Drinking	31%	36%
Smoking	38%	91%
Body height (cm)	173.20(16.31)	172.94(17.00)
Body weight (kg)	74.34(13.85)	76.61(11.96)
Body mass index (kg/m2)	24.74(4.29)	25.63(3.98)
Fat Free mass (kg)	59.66(8.76)	61.97(8.13)
Fat mass (kg)	14.70(8.32)	14.67(5.01)
Muscle (kg)	56.64(8.32)	58.84(7.73)
STI	100.02(23.86)	88.25(16.04)
BUA	50.95(6.07)	48.31(5.29)
SOS	1584.44(145.84)	1566.39(149.84)

Table 2: The percentage of osteoporosis and osteopenia.

Bone quality	T-Score	% of the Controls (n=125)	% of the Patients (n=111)
Osteoporosis	< =−2.5	1.60% (2)	0.90% (1)
Osteopenia	<−1.0 and>−2.5	30.40% (38)	54.96% (61)
Normal samples	> =−1.0	68.00% (85)	44.14% (49)

Table 3: Multivariate regression model in patient group.

Factors	standard Beta	t	p value
Constant		2.256	0.030
BMI	1.281	3.074	0.004
Fat free mass	-0.288	-1.372	0.178
Fat mass	-1.044	-2.740	0.009
Duration of MA use(years)	0.055	0.302	0.764
Frequency of MA use (times per week)	0.044	0.291	0.772
Duration of smoking (years)	-0.408	-2.112	0.042
Drinking (times per week)	-0.135	-0.817	0.419
Age	-0.184	-1.201	0.238

MA: methamphetamine

4 DISCUSSION

4.1 Main Finding

This study assessed 111 young MA-dependent men's bone quality and anthropometric characteristics and compared them with 125 normal people. MA-dependent men, whose abstinent time was no more than three months, had significantly lower bone quality than normal individuals. BMI, FM and smoking may also affect the bone quality of MA-dependent men.

Young MA-dependent men, average aged 32, should have reached the peak bone quality. However, their bone quality was in an unhealthy state, which also reflected on the higher percentage of osteopenia. The results indicated that their bone quality was affected by MA use. Bone health has not been researched on MA-dependent men by previous studies. Some of them investigated on other drugs. Gotthardt et al. reported the bone loss in opioid-dependences, and 29.2% objects were osteoporosis and 48.1% were osteopenia (Gotthardt, 2017). Gozashti et al. claim that men with opium use history are more susceptible to bone loss (Gozashti, 2011). The possible explanation of the abnormally low bone quality in MA-dependences would be the hormone disorders. The disordered hormone may change the speed of the absorption of bone minerals, calcium, magnesium and phosphorus, from bone to other organs, such as kidney (Deftos, 1998; Blaine, 2015). The faster absorption may result in bone loss. Gotthardt et al. reported that bone loss in opioid-dependences may be partially caused by the deficiency of androgen (Gotthardt, 2017).

Smoking would contribute to bone loss in MA-dependences. In this study, the duration of smoking time was negatively correlated with bone quality. The longer smoking years may have lower bone quality. Previous studies have not reported the effect of smoking on drug-dependences' bone health. Smoking can affect the metabolism of bones (Yoon, 2012) and decrease the intestinal calcium absorption (Krall, 1999).

Body composition was correlated with bone health in MA-dependences. BMI was positively correlated with bone quality, but FM was negatively. In normal individuals, both overweight/ obesity and underweight can result in bone loss. Paniagua et al. claim that overweight/ obese men are more likely to have osteoporosis (Paniagua, 2006). Low BMI is also considered as a risk factor of bone loss (Morin, 2008; Ravn, 1999).

4.2 Limitation and Further Study

Considering the difficulty of sample recruitment and assessment, this study did not use global gold standard, Dual Energy X-ray Absorptiometry.

4.3 Conclusion

In young age, male individuals should grow their bone mass and reach the peak in life time. However, long-term MA use might undermine their bone quality. Young MA-dependent men had lower bone quality and higher prevalence of osteopenia than the age matched non-drug dependences. Weight change was associated with bone health and smoking was also a risk factor of bone loss in MA-dependent men. Early screening and treatment for bone loss in this special group should be considered.

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