Association of Bisphenol A with Hair Loss in Indian Patients

Abstract

Background

BisphenolA (BPA) is linked to number of clinical conditions that are associated with hair loss such as polycystic ovarian syndrome, diabetes, hypertension and metabolic syndrome. These clinical conditions are extremely common in Indian clinical settings. However, India-specific data on BPA is relatively scarce. Furthermore, data for the putative association of BPA and its associated complications with hair loss is relatively scanty.

Aims

To ascertain the association of BPA with hair loss in Indian settings and identify any putative predictors of this association.

Methods

In a case-control study, plasma BPA levels were measured using a HPLC in 40 patients with hair loss and 40 controls. Furthermore, life style factors, hypertension, glycemic and lipid parameters were assessed. Along with this, hormone levels and vitamin D levels were assessed in all patients. Chi-square test was used to compare proportions between groups. Means were compared between groups using Student *t*-test**.** Logistic regression models were employed to compute odds ratio.

Results

As compared to controls, a significantly higher proportion of patients with hair loss had BPA levels above the median of 1.43 ng/ml (p=0.001). However, metabolic syndrome and vitamin D deficiency did not attain significance as predictors in the logistic regression models.

Conclusions

BPA levels may be higher in patients with hair loss. Further studies are required to confirm these findings and verify the moderating and modulating effects of conditions such as metabolic syndrome and diabetes, which are common to hair loss and BPA exposure.

Keywords

Bisphenol A, Endocrine Disruptor, Hair loss, Alopecia

Introduction

BisphenolA (BPA), a known endocrine disruptor is reportedly associated with adverse clinical conditions. A study by Zhang *et al*. indicated that BPA was detected in 94.3% of the samples analyzed, at concentrations ranging from <0.1 to 30.1 ng/mL in Asian countries such as China, India, Japan, Korea, Kuwait, Malaysia, and Vietnam.[1] Thus it seems that population exposure to this endocrine disruptor is relatively high. In trichology contexts, BPA is linked to number of clinical conditions that are associated with hair loss such as polycystic ovarian syndrome[2], diabetes[3-4], hypertension[5] and metabolic syndrome.[6]These clinical conditions are extremely common in Indian clinical settings.[7-11]

Despite this, India-specific data on BPA is relatively scarce. Furthermore, data for the putative association of BPA and its associated complications with hair loss is scanty, if at all present. On these premises, we conducted a case control study to ascertain the association of BPA with hair loss.

Methods

A six-month long case–control study was conducted at Hairline International Hair Clinic and Research Centre, Bangalore, India from Feb 2014-July 2014. The study was approved by the institutional ethics committee. A total of 40 subjects (aged <25 years) with hairloss were included in the study. <In this study, hairloss was defined as subjects showing a hair loss of more than 100 per day>. The study also included 40 controls. Control group included patients visiting or clinic for complications other than hair loss. A signed informed consent was obtained from all the participants in the study.

<Hairloss was calculated by manual counting of the falling hair collected by patients.> Lifestyle factors such as materials of routinely used cooking utensils and routine source of drinking water was elicited from patients. Patients were assessed for stress using PHQ-9 patient depression questionnaire.[11]The current study assessed the serum levels of BPA in cases and controls. Furthermore, the current study assessed the putative links between BPA levels and lifestyle factors, metabolic syndrome, hormone levels and vitamin D.

Plasma levels of BPA were assessed using high performance liquid chromatography (HPLC) at our affiliate laboratory, <DiponEdBioIntelligence LLP>, Bangalore. Fasting blood sugar (FBS) and fasting insulin were determined using glucose hexokinase reagent and chemiluminescence immunoassay, respectively. The homeostatic model assessment-estimated insulin resistance (HOMA-IR) was calculated with a cut-off value of 1.7. High-density lipoprotein cholesterol (HDL-C) (by direct enzymatic method), low-density lipoprotein (LDL) (derived), very-low-density

lipoprotein (VLDL) (derived) and triglycerides (using GPO Trinder reagent) were all examined in the fasting state. Thyroid - stimulating hormone (TSH) and vitamin D were analyzed by electro-chemiluminescence immunoassay (E-CLIA). Metabolic Syndrome was assessed using NCEP-ATP-III criteria.[12]

The data were analyzed using Statistical Package for the Social Sciences version 22.0 (SPSS Inc., Chicago, IL, USA). The mean±standard deviation (SD), and the number and percentage of participants were tabulated. Means were compared across groups using *t*-test and proportions were compared with Karl Pearson's chi-square test. BPA exposure was divided into two groups according to the concentration examined. We defined persons as low exposure if their BPA level was less than median value and high exposure if their BPA level was more than or equal to median value. Logistic regression models were used to estimate the odds ratios (ORs) and 95% confidence intervals. Statistical significance was set at p value <0.05. The entire tests were sponsored by Hairline Research Center, Bangalore.

Results

A total of 80 subjects aged between 18 and 44 years were assigned to the study. Table 1 presents the mean (SD) of anthropometric measurements such as age, body weight, Height and BMI in the case and control groups. In the current study, the control group consisted of 9 females as compared to 7 in the case group. The differences in the proportions of males and females in the case and control groups were not significant (χ^2 = 0.313, df=1,p=0.576).

Table 2 presents the difference in lifestyle factors with reference to the presence of stress, plastic container usage, and packaged food consumption, along with source of routinely used

drinking water and material of routinely used cooking utensils between groups. Despite significant differences between cases and controls, proportion of subjects with BPA levels <1.43ng/ml were not significantly different from those with BPA levels >1.43 ng/ml with respect to the source of drinking water (except for water filter users) and the materials of routinely used cooking utensils(table 3). Table 4 presents the mean (SD) of blood pressure, glycemic and lipid parameters (except for Teflon users) along with levels of TSH, testosterone and Vitamin D in case and control groups. As compared to controls, patients with hair loss had significantly higher BPA levels (table 5). Despite differing between groups (tables1 and 6), age (p= 0.07), metabolic syndrome (p=0.721) and vitamin D deficiency (p=0.551) did not attain statistical significance as predictors in the current regression models.

Discussion

Results of the current study indicates that patients with hair loss may have higher levels of BPA as compared to controls. Scientific reports on the association of BPA exposure and hair loss is scanty, if at all present. Therefore the results presented herein should be treated as initial findings warranting further investigation.

A number of lifestyle factors especially those related to eating habits such as materials of routinely used cooking vessels and source of routinely used drinking water did differ between case and control groups. The possibility that these are just incidental findings cannot be overruled. Except for water filter usage and usage of Teflon-based cooking utensils, none of the other variables were significantly different in the lower and higher median halves of BPA values across groups. Stress is an important factor in lifestyle contexts. Although estrogenic mechanisms are known to induce behavioral changes, data is largely from animal studies.[13-14]In

the current study, the presence of stress as assessed using PHQ-questionnaire was not significantly different between patients with hair loss and controls.

BPA is reported to be associated with hypertension, diabetes, and metabolic syndrome, all of which may be higher in patients with hair loss.[3-6]In the current study, a significantly higher proportion of metabolic syndrome was noted in patients with hair loss as compared to controls. Among glycemic parameters, fasting insulin and HOMA-IR were significantly higher in patients with hair loss as compared to controls. Among lipid parameters, LDL-C levels were significantly higher in patients with hair loss as compared to controls. These findings are generally in line with other published data. Another notable difference between the case and controls groups was a higher proportion of vitamin D deficiency among those with hair loss as compared to controls. This again is in concordance with data reported by Erden*et al*.[14] However, neither metabolic syndrome nor vitamin D deficiency could attain statistical significance as significant predictors of the relationship between hair loss and higher levels of BPA.

Overall, these findings indicate that BPA levels may be higher in patients with hair loss. These results also are suggestive of public health policies to reduce BPA exposure. Nevertheless, future studies that address the limitations inherent to case-control designs may be essential to clearly identify clinically meaningful aspects of BPA-associated hairloss. Conditions common to hair loss and BPA exposure such as metabolic syndrome and diabetes may interact to moderate and modulate the effects of BPA effects on hair loss; understanding such putative interactions merit investigation.

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Table 1: Patient Characteristics at Baseline

	Control (Mean (SD))	**Case (Mean (SD))**	***p*-value**
Age (years)	25 (4)	29 (6)	0.001
Body Weight (Kg)	66 (7)	69 (10)	0.087
Height (Meters)	1.68 (0.08)	1.69 (0.08)	0.441
BMI	66.12 (6.79)	69.47 (10.18)	0.087

Table 2: Differences in Life style factors between groups

Lifestyle factors	**Control**	**Case**	***p*-value**
Presence of stress (%)	40 (16/40)	42.5 (17/40)	0.820
Plastic Container Usage/ Day (M, SD)	2.43 (2.417)	3.10 (1.482)	0.136
Packaged Food consumption/ day	1.05 (1.061)	1.40 (1.081)	0.148

Consumption of Microwave cooked food/ day	0.93 (1.071)	1.78 (1.050)	0.001
Usage of tap water (n (%))	(24/40)	(3/40)	<0.05
Usage of pre-filled water cans (%)	(5/40)	(13/40)	0.032
Usage of Water filter (%)	(11/40)	(24/40)	0.003
Usage of Steel utensils for cooking (%)	(14/40)	30/40	<0.05
Usage of Teflon utensils for cooking (%)	14/40	10/40	0.329
Usage of Aluminum utensils for cooking (%)	12/40	0/40	<0.05

Table 3: Proportion of patients in the two median halves of BPA with respect to source of drinking water and material of routinely used cooking utensils

		BPA <1.43 ng/ml	BPA >1.43 ng/ml	*p*-value
Tap water users	Control	11	13	0.681
	Case	1	2	
Pre-filled water cans users	Control	5	0	0.063
	Case	7	6	
Water filter users	Control	11	0	<0.05
	Case	6	18	
Steel users	Control	6	8	0.976
	Case	13	17	
Teflon users	Control	13	1	<0.05
	Case	1	9	

Table 4: Mean (SD) of blood pressure, glycemic indices, lipid parameters, hormones and vitamin D in case and control groups

Variables	Control	Case	*p*-value
Systolic Blood Pressure (mm Hg)	122.42 (6.10)	123.05(8.71)	0.711
Diastolic Blood Pressure (mm Hg)	79.93 (5.71)	82.55(6.88)	0.067
Fasting Blood Sugar (mg/dL)	88.13(11.60)	94.38(17.15)	0.060
Fasting Insulin (µU/mL)	6.62 (2.10)	10.45(6.53)	0.001
HOMA-IR	1.38 (.52)	2.39(1.54)	<0.05
Total cholesterol (mg/dL)	183.23 (13.39)	188.88(21.91)	0.168
HDL-C (mg/dL)	52.30 (4.84)	52.27(9.11)	0.988
LDL-C (mg/dL)	97.43 (10.73)	104.13(17.97)	0.046
VLDL (mg/dL)	44.15 (65.29)	33.29(10.48)	0.302

Triglycerides (mg/dL)	150.95 (20.26)	160.20(31.11)	0.119
Thyroid Stimulating Hormone (µU/mL)	3.12 (.69)	2.96(1.66)	0.553
Testosterone (pg/ml)	17.61 (3.56)	21.47(31.21)	0.440
Vitamin D (ng/ml)	30.15(18.88)	13.91(7.34)	<0.05

Table 5: Adjusted and unadjusted odds ratio for association of BPA with hair loss

	BPA Levels	
	<1.43 ng/ml (referent)	>1.43ng/ml
Case (n)	14	26
Controls (n)	27	13
Unadjusted odds ratio (95%CI)	1	3.857* (1.526-9.75)
Age-adjusted odds ratio (95%CI)	1	5.957** (2.054-17.28)
Adjusted for Age, metabolic syndrome and Vitamin D deficiency (95%CI)	1	7.314**(2.173-24.62)

*p=0.004, **p=0.001

Table 6: Differences in metabolic syndrome and vitamin D status between groups

	Control	Case	p-value
Metabolic Syndrome Absent	35	25	<0.05
Metabolic Syndrome Present	5	15	
Vitamin D deficiency	25	40	0.010
No Vitamin D deficiency	15	0	