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RESEARCH ARTICLE

COMPARISON OF DAVIDSON BODIES WITH BARR BODIES

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ABSTRACT

Objective: To compare the accuracy of gender determination using two different techniques - Davidson bodies identification in blood smear and Barr bodies identification in buccal smear. **Methods:** A blinded study using 30 subjects (15 males and 15 females) was performed. Peripheral blood smear was obtained from each patient and stained with Leishman stain for identification of Davidson bodies. Buccal smears were obtained from each patient and stained with H and E stain for identification of Barr bodies. 100 neutrophils in blood smear and 100 squamous cells in buccal smear were identified and examined for the presence of Davidson bodies and Barr bodies respectively. **Result:** Our results showed that females had 1-2% of Davidson bodies in neutrophils compared to 0% in males. However, such clear cut differentiation was not obtained using Barr bodies. **Conclusion:** Davidson bodies and Barr bodies are independent variables. Davidson bodies in blood smear are highly specific when compared to Barr bodies in buccal smear. Thus morphological gender determination using Davidson bodies in hematopathology is easy, reliable, less time consuming and cost effective.

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INTRODUCTION

The sex of an individual can be determined by numerous ways. Sex chromatin seen as darkly staining mass at the nucleus of all non-dividing cells of genotypically females represents the inactivated X-chromosome. It is also found in polymorpho nuclear leukocytes of normal females as a drumstick-shaped mass attached to one end of the nuclear lobes called Davidson bodies. Davidson and Smith were the first to identify and report the presence of neutrophil drumsticks and nonspecific appendages and their differences in sexes. Demonstration of nuclear sex plays a vital role as far as identity of the individual is concerned. The easily available material for Barr body Buccal mucosal cells which can be obtained by performing simple exfoliative cytology without inflicting trauma on the subject. Moore and Barr (1955) were the first scientists to introduce the buccal smear technique to identify sex. The main aim and objective of the present study is the detection of Davidson body and Barr-body-positive cells under light microscopy, thereby determining the sex, which can be helpful in identification of an individual. The purpose of this study is to validate the Davidson bodies as confirmatory guide towards sex identification comparing with Barr bodies. Hence, it intends to highlight the use of Davidson bodies as a useful parameter for gender identification.

MATERIALS AND METHODS

The present study was conducted in The Department of Oral and Maxillofacial Pathology, KSR Institute of Dental Science and Research, Tiruchengode, Tamilnadu. Thirty individuals were randomly choosen from outpatient department of our institute after informed consent was obtained. Peripheral blood smear were obtained under aseptic precautions and buccal mucosal smears were obtained by scraping with wooden stick from each individuals respectively. Peripheral blood smears were stained with Leishman's stain. 100 well stained neutrophils were blindly studied under 100X magnification. Neutrophils were identified and Drumstick appendages were identified and recorded under oil-immersion objective (Fig 1). Buccal smears were fixed in alcohol and stained using Hematoxylin and Eosin stain. 100 cells were observed in each buccal smear slide.

Out of these 100 cells, the total number of Barr-body-positive cells was counted. Morphological detail of the exfoliative cells was studied with 40X objective (Fig 2). A score of one or more Davidson bodies per 100 neutrophils indicate females. More than three Barr bodies per 100 epithelial cells in buccal smear indicate females. Sensitivity and specificity were determined. Independent T test was done and P values determined. Level of significance was set at 0.05. A P value of less than 0.0001 was considered extremely significant.

RESULTS

Out of 30 individuals, Davidson bodies correctly identified the gender of all individuals. However, Barr bodies correctly identified the gender in only 24 individuals. Davidson body was found to be more specific (100%) compared to Barr body (86.66%) in gender identification. Barr bodies were found to reliably identify females (86.6%) than males (73.3%). Difference in gender identification using two methods was found to be statistically significant using independent T test (P = 0.018). Table 1 shows the correctly identified gender using Davidson body and Barr body.

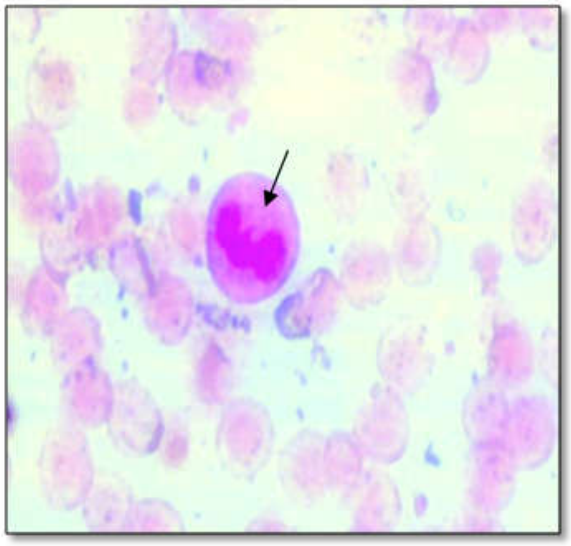

Figure 1. Davidson body - Leishman's stain, 100x (Arrow)

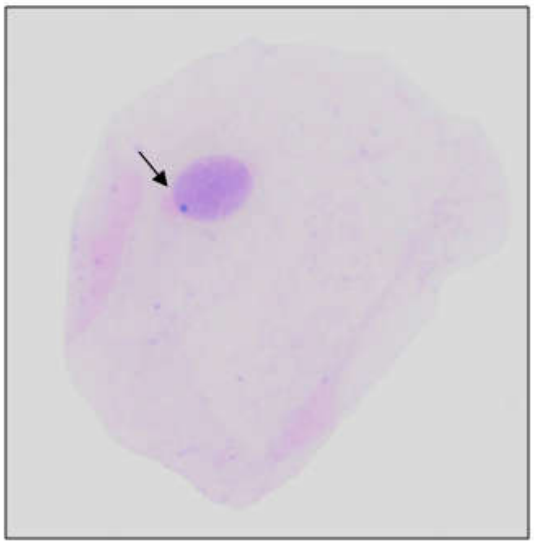

Figure 2. Barr body - H & E stain, 40x (Arrow)

Table 1. Correctly identified individuals using Davison body and Barr body

total - 30	correctly identified		wrongly identfied	
male – 15 female -15	male	female	male	female
davidson body	15	15	0	0
barr body	11	13	4	2

DISCUSSION

The term 'sex chromatin' primarily encompasses two structures: 1) Drumstick of the polymorphonuclear leukocytes in blood smear; 2) Barr body, present in epithelial cells in buccal smear (Chatterjee, 2014). Davidson and Smith demonstrated sexual dimorphism of leukocytes by means of presence or absence of drumsticks. Leukocytic drumsticks are stalked, rounded chromatin appendages, 1.5 microns in diameter, projecting from the neutrophilic nuclei of female subjects only. According to Chatterjee S, 100% of female subjects and 0% of males exhibited Drumstick bodies; We found similar results in our study. It is now accepted that the drumstick is an expression of an X-chromosome in cells and that the drumsticks and Barr bodies are equivalent structures. However, Haque *et al* in their study concluded that neutrophil nuclear drumsticks and mucosal cell Barr are independent variables related to maturation and nuclear configuration factors (Haque *et al*., 1993).

Briggs (1958) stated that drumsticks are never seen in males, which was similar to our study findings. However, many other investigators in their study suggested that the true drumstick appendages can be seen in males also (Mittwoch, 1964; Tupakula *et al*., 2014). According to Mittwoch on an average, less than three per 100 neutrophil shows drumstick appendages. Verma, (2017) in his studies has shown drumsticks in up to 17% of neutrophils in the peripheral smear of healthy women (Procopio-Valle, 1961; Wondergem, 2011; Karni, 2001; Manjulabai *et al*., 1997). In our study on an average, less than two per 100 neutrophil shows drumstick appendages in females. Our findings confirm the observations of Davidson and Smith. We believe that a determination of genetic sex from a peripheral blood film can be made with a high degree of accuracy when compared with Barr bodies. The procedure for obtaining Davidson body is simple, rapid and requires no surgical manipulation. Special equipment and technical assistance for processing and staining histologic sections are unnecessary. Manjulabai *et al*. (1997) did not report any Barr-body-positive cells in men.However, there seems to be a difference in the range and also the mean percent of Barr bodies among male and female in the present study as compared to other studies. Few studies (Aggarwal *et al*., 1996; Nagamori *et al*., 1986; Platt, 1964) reported a higher range and mean values, whereas others (Manjulabai *et al*., 1997; Cardozo, 1972; Mukiibi, 1980) found lower levels compared to the present study. Mittal *et al*. (2009) found that identification of Barr bodies had very high specificity (100%) in gender determination. However, in our study Barr bodies could not reliably identify the gender both in males and females. The criteria to identify the gender using Barr body is ambiguous. Some studies use Barr body less than four as males (Mittal T 2009), whereas others use Barr body less than three as males (Reddy, 2012). This ambiguity could be the reason for unpredictable results using Barr bodies.

Males with Klinefelter's syndrome tend to show one Barr body in each of their cells due to XXY and females with Turner's syndrome don't show any Barr body due to XO; in such cases the results may be wrong in identifying that particular individual where the test would identify the individuals as females for men with Klinefelter's syndrome, and women with Turner's syndrome would test as men (Tucker, 2009). In many forensic cases, sex identification is absolutely essential especially in rape cases where there is possibility of contamination of DNA from both the victim and culprit (Thangaraj *et al*., 2002). Identification of Barr bodies in epithelial cells is comparatively more difficult than identifying the Davidson bodies in neutrophils due to their morphological appearance. To the best of our knowledge, this is the first study to compare the reliability of Davidson bodies with Barr bodies for gender determination.

Conclusion

Based on the findings of our study, we can conclude that Davidson bodies and Barr bodies are independent variables. Davidson bodies in blood smear are highly specific when compared to Barr bodies in buccal smear. Thus morphological gender determination using Davidson bodies in hematopathology is easy, reliable, less time consuming and cost effective.

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