Immunohistochemical and Histological Features of a Spontaneous Leydig Cell Tumour in a Rat

Rafał Ciaputa¹*, Adam Szymerowski², Izabela Janus³, Przemysław Prządka³, Małgorzata Kandefer-Gola¹ and Marcin Nowak¹

¹Department of Pathology, Division of Pathomorphology and Veterinary Forensics, Faculty of Veterinary Medicine, Wrocław University of Environmental and Life Sciences, C.K. Norwida 31, 50-375 Wrocław, Poland
²Student Research Group of Anathomopathologists, Department of Pathology, Division of Pathomorphology and Veterinary Forensics University of Environmental and Life Sciences, Wrocław, Poland
³Department and Clinic of Surgery, University of Environmental and Life Sciences, Poland

*Corresponding author: rafał.ciaputa@upwr.edu.pl

ABSTRACT

Neoplastic testicular lesions are diagnosed increasingly frequently in dogs and humans. In rats, spontaneous testicular tumours, particularly Leydig cell tumours, are very rare. The aim of the study was to carry out a histological and immunohistochemical analysis of a Leydig cell tumour in a rat as well as to present the similarities and differences in the expression of the proteins used to diagnose this type of tumour in dogs and men. Following the histopathological and immunohistochemical analysis (including antibodies against vimentin, calretinin, inhibin-α, β-catenin and E-cadherin), significant similarities were found in the level of expression of the studied cell markers of the rat, dog and male leydigoma. This indicates their usefulness as diagnostic markers of testicular tumours both in humans and animals.

INTRODUCTION

In both humans and dogs, testicular tumours are a group of malignant neoplastic lesions of the male reproductive tract that are diagnosed increasingly frequently. According to the WHO classification, Leydig cell tumours in dogs are some of the more frequent reproductive tract tumours (Ciaputa et al., 2012; Ciaputa et al., 2014; Ciaputa et al., 2015). In rats, spontaneous neoplastic testicular lesions are very rare, although they were reported in various laboratory rats strains (Teerds et al., 1991; Rao et al., 1992; Bonhard and Rinke, 1994).

The Leydig cell tumour derives from a neoplastic proliferation of interstitial cells that are mainly responsible for androgen secretion. Macroscopically, there is a clear demarcation between the tumours and the surrounding testicular interstitium, and the tumours form small, single or multiple soft, yellowish brown foci with areas of haemorrhage. Their histopathological features include the presence of spindle cells which are round, polygonal (Grieco et al., 2008; Ciaputa et al., 2012) or, less frequently, elongated. The cytoplasm of neoplastic Leydig cells may contain vacuoles. The nucleus is small, round and may contain single nucleoli (Peters et al., 2001; Ciaputa et al., 2012).

The aim of the study was to carry out a detailed histological and immunohistochemical analysis of a Leydig cell testicular tumour in a pet rat as well as to compare the similarities and differences in the expression of the proteins used to diagnose this tumour in rats, dogs and humans. Demonstrating a similarity in the expression of the studied proteins in leydigomas in men, dogs and rats may enable the use of rats as models of testicular oncogenesis.

MATERIALS AND METHODS

The study sample was collected intraoperatively from a 1.5 year old male laboratory rat kept at home. The excised tumour was fixed in 7% buffered formalin for 24 hours, then embedded in paraffin blocks and cut into 4µm sections. The sections were stained with hematoxylin and eosin and assessed using the WHO testicular tumour classification (Kennedy et al., 1998). The studied canine testicular tumours were obtained from samples archived by the Department of Pathology, Division of Pathomor-
RESULTS AND DISCUSSION

Macroscopically, the tumour was greyish-yellow and the nuclei were clearly separated from the testicular parenchyma, while small hemorrhagic foci were visible in cross-section. The histological analysis revealed the presence of numerous round or polygonal cells with abundant, vacuolated cytoplasm. The neoplastic cell nuclei were the size of two erythrocytes, or less commonly three, pushed peripherally or squeezed toward the cell membrane. Numerous extravasations and cysts filled with a protein fluid were also found. There were few mitotic figures (i.e. one or two) per high power field (Fig. 1 A,B,C).

The immunohistochemical analysis revealed that the expression of vimentin in the rat (R) was intense ++++. It was also intense (+++) in 70% and moderate in 30% (+++) of the studied dogs (D). In all the studied male samples (M), the expression of vimentin was also intense (+++). The expression of calretinin in the studied rat, as well as in canine and human specimens was intense (+++). In the rat, the expression of inhibin-α was intense (+++). In dogs, this expression was intense in 60% of the canine samples and moderate ++ in 40% of them. In all the studied male samples, the expression of inhibin-α was intense (+++). The expression of β-catenin and E-cadherin in all the studied samples was intense (+++). No Ki-67 expression was observed in the rat samples, while 80% of the canine samples showed intense Ki-67 expression (+++) and 20% of the samples showed moderate expression (+). In men, the Ki-67 expression was intense in all the studied tumours (Fig. 2 A,B,C,D,E).

Tumours of testis are the most frequently diagnosed neoplastic diseases in men. Similar problems are observed in dogs. A study carried out between 2009 and 2011 in Lower Silesia found that 6% of 1743 dogs had testicular tumours, while a study between 2012 and 2013 found that 6.1% of 4174 dogs had testicular tumours (Ciaputa et al., 2012; Ciaputa et al., 2013; Ciaputa et al., 2017). Finding a similarity in the histologic structure of the described spontaneous Leydig-cell tumour in a rat may broaden our understanding of the duration and speed of carcinogenesis. In men and dogs, leydigomas are usually observed in older-aged individuals. They are relatively less common in men than dogs (Ciaputa et al., 2012; Ciaputa et al., 2014; Ciaputa et al., 2015). Studies carried out on various laboratory rats strains also show a high incidence of Leydig-cell tumours in old animals (Teerds et al., 1991; Rao et al., 1992; Bomhard and Rinke, 1994). It seems that the studied rat had the qualities of an aging organism.

We were able to find similarities in the expression of chosen cell markers in the rat, canine and male leydigoma. The presence of the expression of vimentin in the tumours confirmed their mesenchymal origin (Ciaputa et al., 2014). Calretinin was used to show secretory activity. It is thought that a strong expression of calretinin in steroid secreting cells may indicate tumour secretory activity (Ciaputa et al., 2014). Indicating the expression of inhibin-α as a marker of the tumour growth potential, which is an inhibitor of this process, also seems justified (Ciaputa et al., 2014). The study also included an analysis of proteins responsible for intercellular adhesion, such as E-cadherin and β-catenin. The analysis of their expression
Fig. 1 A, B, C: Leydig cell tumour in a rat. Numerous round or polygonal neoplastic Leydig cells with abundant, vacuolised cytoplasm (A, B, C). The cell nuclei are enlarged and localised peripherally (A, B, C). Haemorrhages (A) and cysts filled with a protein fluid (C) can be seen between the neoplastic cells. (H&E, A. 100x, B. 200x and C. 400x).


is very useful in determining the metastatic potential of a tumour (Ciaputa et al., 2014). In combination with the nuclear expression of the Ki-67 proliferative antigen, it is possible to assess the degree of the tumour malignancy (Ciaputa et al., 2014). In this study, we did not find an expression of the Ki-67 protein in the rat sample. However, it is not possible to completely exclude the proliferative potential of the studied tumour, as 1-2 mitotic figures were seen in the high power microscopic field. Nevertheless, we found that this marker was not useful in the assessment of the mitotic index of the rat Leydigoma. Our own studies, which were carried out on a large group of the most common testicular tumours in dogs and men, have shown diagnostic utility of the above described cell markers (Ciaputa et al., 2012; Ciaputa et al., 2014; Ciaputa et al., 2015).

The presence of these proteins in a rat Leydigoma suggests that they are useful as diagnostic markers of testicular tumours in humans and animals.

There is ongoing research into animal cancer models. Rats, which are often used in in vivo studies, could be used in studies on oncogenesis or cancer treatment of these types of tumours if there is confirmation of the histologic and immunohistochemical similarities between the rat and human testicular tumours. In addition, the diagnosis of the same type of testicular tumour in the rat, dog and human is interesting.

The rat is increasingly treated as a domestic pet rather than a laboratory, therefore reports describing spontaneous tumours in domestic rats are in our opinion valuable even with a small number of cases. Due to increasingly improving pet rat owner care, rats are able to live longer, which may lead to the development of numerous age-related diseases, including neoplastic lesions. To date, these have been rarely diagnosed due to the short life expectancy of this species.

Authors contribution: RC, AS, IJ, MK-G, MN: executed the experiment and analyze results, photographic recording, preparing and elaboration the manuscript PP: clinical diagnosis, surgical procedure.

REFERENCES


