Immunocytocchemical characterization of primary cell culture in canine transmissible venereal tumor

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Immunocytocchemistry with anti-vimentin, anti-lysozyme, anti-alpha 1 antitrypsin, anti-CD3 and anti-CD79α antibodies has been used for characterization of primary cell culture in the transmissible venereal tumor (TVT). Samples for primary cell culture and immunohistocytocchemistry assays were taken from eight dogs with cytological and clinical diagnosis of TVT. To validate the immunocytocchemical results in the primary cell culture of TVT, a chromosome count was performed. For the statistical analysis, the Mann-Whitney test with $p<0.05$ was used. TVT tissues and culture cells showed intense anti-vimentin immunoreactivity, lightly to moderate immunoreactivity for anti-lysozyme, and mild for anti-alpha-antitrypsin. No marking was achieved for CD3 and CD79α. All culture cells showed chromosomes variable number of 56 to 68. This is the first report on the use of immunocytocchemical characterization in cell culture of TVT. Significant statistic difference between immunocytocchemistry in tissue and culture cell was not established, what suggests that the use of this technique may provide greater certainty for the confirmation of tumors in the primary culture. This fact is particularly important because in vitro culture of tumor tissues has been increasingly used to provide quick access to drug efficacy and presents relevant information to identify potential response to anticancer medicine; so it is possible to understand the behavior of the tumor.

INDEX TERMS: Canine transmissible venereal tumor, alpha 1 antitrypsin, cytogenetic, lysozyme, vimentin.

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RESUMO.- [Caracterização imunocitoquímica de culturas primárias de tumor venéreo transmissível canino.] Os anticorpos anti-vimentina, anti- lisozima, anti-alfa 1 antitripsina, anti-CD3 e anti-CD79α foram empregados para a caracterização de culturas primárias de tumor venéreo transmissível canino (TVT). Amostras para cultura primária e imunocitoquímica e imunohistoquímica foram coletadas de oito cães com diagnóstico clínico e citológico de TVT. A contagem de cromossomos foi realizada em células de TVT. Não houve marcação para CD3 e CD79α. Finalmente, todas as culturas apresentaram números de cromossomos que variaram de 56 a 68. Este é o primeiro relato que apresenta...


ACCORDING TO BASSANI-SILVA ET AL. (2007), UPON EXPOSING TVT CELLS TO EXTRACTS OF PROPOLIS IN VITRO, SOME BECAME RESISTANT. LATERWISE, WHEN COMPARING MALIGNANT CELL RESPONSE TO CHEMOTHERAPY, TVT CELLS WERE SIGNIFICANTLY LESS SENSITIVE TO THIS TREATMENT (GASPAR ET AL. 2009, 2010).


THEREBY, A DIRECT CONSEQUENCE OF THE ABOVE MENTIONED IS THE HIGHER NUMBER OF CHEMOTHERAPY APPLICATIONS REQUIRED TO OBTAIN INITIAL REGRESSION (GASPAR ET AL. 2010). THIS RESULTS IN HIGHER COSTS FOR OWNERS AND MORE SIDE EFFECTS, SUCH AS ANOREXIA, MYELOSUPPRESSION AND NEPHROTOXICITY, FOR THE ANIMALS. THEREFORE, FURTHER RESEARCH IS REQUIRED TO CONFIRM THE HYPOTHESIS RELATED TO THIS CONDITION.

PRIMARY CELL CULTURE IS ONE OF THE FASTEST WAYS TO STUDY TVT BEHAVIOR. STUDIES BASED ON EXPERIMENTAL PRIMARY CELL CULTURES ARE CONSISTENT WITH SIMILAR SITUATIONS NEXT TO IN VIVO, WHICH DIFFER FROM THOSE OBSERVED IN IMMORTALIZED CELL LINES REPRESENTED BY UNIFORM CELLS WITH WELL-DEFINED CHARACTERISTICS. (LOUKOPOULOS ET AL. 2004, HASEGAWA ET AL. 2008, JÄHN ET AL. 2010). IN THIS RESPECT, STUDIES ON TVT COULD HELP TO ADVANCE IN THE RESEARCH OF MOLECULAR EVENTS ASSOCIATED WITH INITIATION, PROGRESSION AND CHEMOTHERAPY.

HOWEVER, DESPITE THE EXISTENCE OF STUDIES ON PRIMARY CELL CULTURE OF TVT, THERE ARE STILL NO PUBLISHED STUDIES SHOWING THE CHARACTERIZATION AND THE IDENTIFICATION OF TUMOR CELLS IN VITRO THROUGH IMMUNOLOGICAL TECHNIQUES. FOR THIS REASON, THE PRESENT STUDY AIMS TO ISOLATE AND CHARACTERIZE PRIMARY CELL CULTURE OF TVT BY IMMUNOCITOCHIMISTRY; CONTRIBUTING ESPECIALLY TOWARDS STUDIES RELATED TO TUMORIGENESIS AND CHEMOTHERAPY RESISTANCE OF THESE TUMORS IN IN VIVO MODELS.

MATERIALS AND METHODS

THE STUDY WAS APPROVED BY THE ETHICS COMMITTEE ON ANIMAL EXPERIMENTATION OF THE VETERINARY MEDICINE COLLEGE, SÃO PAULO STATE UNIVERSITY (UNESP), BRAZIL (PROTOCOL 223/2011). EIGHT DOGS WITH CYTOLOGICAL AND CLINICAL DIAGNOSIS OF TVT WERE SELECTED FROM THE HOSPITAL OF VETERINARY MEDICINE, UNESP, REGARDLESS OF BREED, GENDER AND AGE.

CYTOLOGICAL PREPARATIONS OF TUMORS WERE FIXED AND THEN STAINED BY THE GIEMSA TECHNIQUE (MAY GRÜNWALD GIEMSA 2%). A MINIMUM OF 100 CELLS PER SLIDE (2) WERE ANALYZED BY LIGHT MICROSCOPY AT 400-X MAGNIFICATION FOR TUMOR DIAGNOSIS AND CLASSIFICATION, ACCORDING TO THE CHARACTERISTICS OF THE PROMINENT CELL TYPE, NAMELY PLASMOCYTOID, LYMPHOCYT OID, OR MIXED, AS DESCRIBED BY AMARAL ET AL. 2007. ONCE THE DIAGNOSIS OF TVT HAD BEEN CONFIRMED, THE ANIMALS WERE ANESTHETIZED FOR TOTAL CLEANSING OF THE TUMOR SITE AND TWO SAMPLES WERE COLLECTED BY INCISIONAL BIOPSY, OBTAINING FRAGMENTS OF APPROXIMATELY 1CM³. TWO SAMPLES WERE TAKEN FROM EACH DOG, ONE FOR CELL CULTURE AND THE OTHER FOR IMMUNOHISTOCHEMISTRY ASSAYS. SPECIMEN OWNERS WERE INFORMED ABOUT THE STUDY PROCEDURES. ALL SAMPLES WERE TAKEN FROM PATIENTS BEFORE UNDERGOING CHEMOTHERAPY. THE SAMPLES WERE STORED IN SALINE AND PHOSPHATE BUFFERED SOLUTION.
phate solution (PBS) pH 7.4 and formaldehyde (Qiagen®, Venlo, Limburg, Netherlands) until the material was processed.

**Primary cell culture.** Insulations of TVT cultures were made according to the protocol described by Bassani-Silva et al. 2007 and Hsiao et al. 2008. Therefore, aseptic fragments of TVT, placed in saline PBS pH 7.4 (Invitrogen, Life Technology, Waltham, Massachusetts, USA), were transported to the Laboratory for in vitro Fertilization and Cellular Cultures in the Department of Animal Reproduction and Veterinary Radiology FMVZ-Unesp, Botucatu Campus. There, the samples were ground using a stainless steel scalpel. Afterwards, the material was transferred to a trypsin solution (TrypLE Select-Invitrogen-Life Technology, Waltham, Massachusetts, USA) at 37.5°C and kept for 40 minutes with a magnetic homogenizer, after which the solution was passed through a 70 micron filter (70 microns Falcon® cell strainers, Corning, NY). Cells resulting from this process were placed in a falcon tube over a Percoll gradient to 42% (Amersham Pharmacia Biotech, Piscataway, NJ) and subsequently centrifuged (820g, 4°C, 25min). TVT cells located in the air-liquid interphase were collected and the pellet was suspended and conditioned in 25cm² flasks (Sarstedt, Germany) with 5mL of DMEM high glucose culture (Dulbecco’s modified essential medium-Gibco). This material was supplemented with 10% fetal calf serum (FCS) (Gibco Life Technologies, Waltham, Massachusetts, USA) and a combination of 100 U/ml penicillin, 100mg /ml streptomycin (Life Technologies Gibco®, Waltham, Massachusetts, USA) and 3μg/ml amphotericin B (Life Technologies Gibco®, Waltham, Massachusetts, USA). The initial purity was confirmed by Hemacolor (Merck, Whitehouse Station, NJ, USA). The samples were then kept in a CO₂ incubator at 5%, moisture 95% and a temperature of 37.5°C. Cell viability and concentration were assessed by an exclusion test using trypan blue and the cells were suspended in DMEM high glucose culture (Dulbecco’s essential medium modified-Gibco® Life Technologies, Waltham, Massachusetts, USA).

**Immunohistochemistry and immunocytochemistry.** Serial histological sections of 3µm were obtained in positive charged slides (Amitel®), which were deparaffinized in xylene and rehydrated in decreased ethanol concentrations. Tissue sections were exposed to heat in a Pascal chamber (Dako® Cytomation) with citrate buffer solution (pH 6.0) at 125°C for 30s in order to induce them to epitope retrieval (HIER). The slides were rinsed three times with Tris pH7.0. They were then incubated overnight by using anti-lysozyme, anti-Alpha-1-antitrypsin, anti-CD3, anti-CD79α primary antibodies (Table 1). The resulting reaction was visualized with a polymer-based technology HiDef® Detection HRP System (Cell Marque®). The slides were revealed with chromogen 3,3’-diaminobenzidine (DAB). They were then counterstained by using Harris hematoxylin.

![Fig.1.](image-url) TVT positive for vimentin, greater than 90%. Obj.20x, bar: 10µm. (B) Moderate positivity for lysozyme. Obj.40x, bar: 20µm. (C) Moderate positivity for alpha-antitrypsin. Obj.40x, bar: 20µm. (D) Lack of tumor cell positivity for CD3, CD79a (See lymphocyte marking). Obj.40x, bar: 20µm. HiDef® Detection HRP System; Chromogen 3’3 diaminobenzidine (DAB), counterstaining with Harris hematoxylin.

<table>
<thead>
<tr>
<th>Antibody Code</th>
<th>Code</th>
<th>Dilution ratio</th>
<th>Epitope retrieval (HIER)</th>
<th>Manufacturer</th>
<th>Type of antibody</th>
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<tbody>
<tr>
<td>Anti-CD79a A045201-2</td>
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<td>Pascal chamber</td>
<td>Dako, EUA</td>
<td>Monoclonal</td>
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<td>solution</td>
<td>Dako, EUA</td>
<td>Polyclonal</td>
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<tr>
<td>Anti-Alpha-1-Antitrypsin N153330-2</td>
<td>1:300</td>
<td>(pH 6.0)</td>
<td>Dako, EUA</td>
<td>Polyclonal</td>
<td></td>
</tr>
<tr>
<td>Anti-vimentin U7034</td>
<td>1:100</td>
<td></td>
<td>Dako, EUA</td>
<td>Monoclonal</td>
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</tr>
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</table>
Immunocytochemistry. Immunocytochemistry assays were performed on cell culture, first hydrated and permeabilized and then, after blocking the endogenous peroxidase, the immunochemo-
chemical steps were conducted.

Negative controls were prepared by substituting specific pri-
mary antibodies with antibody diluent (Novocastra®). Positive
controls were set with liver for anti-Lysozyme, anti-Alpha-1-ANTI-
trypsin and lymph node for anti-CD3 and anti-CD79α, and heart
for anti-vimentin marking.

To identify and quantify the expression of the reaction rate,
samples were subjected to a semi-quantitative evaluation method
as follows: 1 = <25% labeled cells, 2 = 26-50%, 3 = 51-75%, 4 =
>75%, were considered, respectively, 1 = unmarked, 2 = slightly
marked, 3 = moderate, and finally, 4 = with intense marking. One
hundred cells were counted for each slide (Amaral 2005).

Images were captured with a Carl Zeiss optical microscope,
Lab.A1, Germany, obj.10x and 40x, and processed with AxioVision
4.8 software. In all cases, two veterinary pathologists made the
immunohistochemistry evaluation. For each slide, 10 fields were
read with 400x magnification. Inter-observer variation was resol-
ved by simultaneous dual re-evaluation.

Cytogenetic analysis. To validate the immunochemical re-
sults on primary cell culture of TVT, a chromosome count was
conducted. Colchicine was added at a final concentration of 0.2
Mg/mL after 18 hours of incubation. Following two hours of rein-
cubation, cells were harvested by treatment based on a versene
solution. Cell cultures were then treated with a hypotonic citrate
solution. Air-dried preparations were created and stained with
2% acetic orcein and, finally, examined.

Statistical analysis. The comparison of the immunohistoche-
mistry in tissue and the immunocytochemistry in the cell culture
was done by using the Mann-Whitney test with p<0.05.

RESULTS

The TVT tissues showed intense anti-vimentin immunore-
activity, greater than 90% of the cells. The anti-lysozyme
immunoreactivity was 79% of the total labeled tissue, being
lightly moderate in 29% and 50%. In the case of anti-alpha-
antitrypsin, 55% had mild tissue marking. Finally, no ma-
marking was obtained for CD3 and CD79α (Fig.1A-D, Fig.4)

On the other hand, eight cultures, one from each dog,
were isolated (Fig.2). All showed positive anti-vimentin
marking in 100% of cases, of which 75% of the cells presen-
ted intense immunoreactivity and 25% moderate immunore-
activity. For lysozyme, 87% of the cultures were marked,
with 25% mild and 62% moderate. For alpha-antitrypsin,
75% of the cultures had mild marking.

Finally, all cultures were negative for CD3 and CD79α
(Fig.3A-D, Fig.6). There were no statistical differences be-
tween the immunohistochemical and the immunocytoche-
mical expression (p>0.05).

The cells showed a variable number of chromosomes
between the cultures isolated; 56 to 68. None of them exhi-
bited the same number of somatic cells characteristic of
dogs, as demonstrated in Fig.5.

Fig.2. (A) TVT cells, lymphocytoid standard (round cells, little
cytoplasm and high nucleus:cytoplasm ratio), black arrow.
Standard plasmacytoid (ovoid cells, broad cytoplasm and ec-
centric nuclei) white arrow obj.40x. (B) TVT cell culture, third

Fig.3. (A) TVT cell cultures, CD3 (negative), Obj.20x. (B) Lysozyme (+), obj.20x. (C) Vimentin (+), obj.20x. (D) Alpha antitrypsin (+),
HiDef® Detection HRP System; Chromogen 3'3 diaminobenzidine (DAB), Harris hematoxylin counterstaining, obj.20x, bar: 50µm.
DISCUSSION

The TVT has been subject of several studies over the time. However, further research is still needed to better identification of mechanisms related to its strength and aggressiveness (Montoya et al. 2014).

In vitro culture of tumor tissues is especially an interesting model to identify and evaluate tumor biology because cells retain certain characteristics of tissue in vivo. Moreover, the system provides quick access to drug efficacy and presents relevant information to identify potential response as anticancer medicine in the complex microenvironment of tumor tissue (Van der Kuip et al. 2006, Mitra et al. 2013).

The TVT primary culture provides an opportunity to study mechanisms and extrapolate different elements of information about the tumor in vivo. Thus, in the present study, an antibody panel was used to assist in the identification of primary tumor cultures. In summary, eight primary cultures were set to these purposes.

Once isolated, the entire primary culture must be characterized in TVT. Despite having been isolated several times (Adams et al. 1968, Mohanty & Rajya 1977, Beschomer et al. 1979, Okamoto et al. 1988, Bassinli-Silva et al. 2007), the identification of such tumor cells is based on the establishment of cell karyotype (Oshimura et al. 1973, Mukaratirwa & Gruys 2003). Immunocytochemistry was used in this research to define possibilities of identifying isolated cells from tumor as belonging to itself.

From a clinical point of view, TVT cells have been usually characterized through markers such as vimentin, lysozyme, alpha-antitrypsin (Moore & Rosin 1986, Sandusky et al. 1987, Mozos et al. 1996, Marcha et al. 1997, Pereira et al. 2000, Morris et al. 2002, Mukaratirwa & Gruys, 2003, Araújo et al. 2012, Mascarenhas et al. 2014). For this reason, these antibodies were firstly considered to characterize TVT primary cultures.

At first, the chosen panel showed compatibility to the results reported in the scientific literature (Pereira et al. 2000, Morris et al. 2002, Mukaratirwa & Gruys 2003, Araújo et al. 2012, Mascarenhas et al. 2014). In fact, the phenotypic profile presented by the authors to identify the TVT cells can be considered as an auxiliary method in the definitive diagnosis of the tumor.

When compared primary cultures to immunocytochemical features of TVT, a similar statistical profile of tissues was observed. Moreover, expression of vimentin and alpha-antitrypsin lysozyme enables to identify cells coming from TVT, as described in the literature, since these markers have helped in a high number of cases to establish a differential diagnosis (Mozos et al. 1996, Mukaratirwa & Gruys 2003).

In TVT tissues, the use of such markers excluded other types of round cell tumors, such as lymphomas, melanomas, amelanotic melanomas, poorly differentiated carcinomas, and mastocitomas. However, some authors described similar immunostaining in histiocytomas. In this case, differential diagnosis is based on clinical and histopathological criteria (Mozos et al. 1996, Marchal et al. 1997, Mukaratirwa & Gruys 2003, Araújo et al. 2012).

Finally, analyzed tissues and cells of TVT displayed no immunoreactivity for CD3 and CD79α. Nevertheless, concerning tissues, lymphocyte immunostaining was observed during tumor inflammatory infiltration. Data already observed in other studies also support this issue (Mozos et al. 1996, Marchal et al. 1997, Mukaratirwa & Gruys 2003, Araújo et al. 2012).

In the cultures, marking for these antibodies was not found. This was expected because in cultures “in vitro”, lymphocytes and other inflammatory cells lack adhesion, being deleted during the change of medium.
To validate the immunostaining results in primary cultures, the karyotype of TVT cells was assessed. At the end, in all cases, chromosome number resulted less than 78, which was characterized as TVT cells.

These data corroborate what different authors describe: the chromosome number in TVT cell cultures may present a wide variation between 46 and 67 (Adams et al. 1968, Oshimura et al.1973, Mukaratirwa & Gruys 2003, Murchison et al. 2014). Therefore, the results allowed concluding that isolated cells are from TVT.

Likewise, the authors of this research consider these findings as innovative and unpublished, also highlighting the antibody panel as a useful tool for TVT primary cultures to identify cells as coming from the same tumor. These finding would eventually contribute to veterinary oncology investigation.

CONCLUSIONS

This paper is the first report on the use of immunocytochemistry in cell culture of TVT. This fact is particularly important, because in vitro culture of tumor cells has been increasingly used to provide quick access to drug efficacy, and presents relevant information to identify potential response to anticancer medicine.

It is possible to understand the behavior of the tumor. However, significant statistical difference between immunocytochemistry in tissue and cell culture was not established yet, what suggests that the use of this technique may provide greater certainty in confirmation of the tumor in primary culture.


REFERENCES


