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Recent Development of Laser Photo-Chemotherapy (LPC) for Bone Tumors

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Mini Review

Photodynamic therapies (PDT) have become increasingly popular in the adjuvant treatment of different tumor entities [1]. Chemotherapeutic agents, such as cisplatin may be used in combination with laser-induced thermal therapy (LITT) in an improvement to PDT, known as laser photo chemotherapy (LPC) [1,2]. Based on recent reports on the application of laser photo chemotherapy (LPC) on malignant bone cells under chemotherapeutic conditions with cisplatin or zolendronic acid, the authors feel compelled to describe in this mini-review some relevant aspects of such combined therapy as a potential therapeutic strategy for osteosarcoma [3].

Chemotherapy is regularly used for treating Ewing sarcoma and osteosarcoma, but it isn't often used for other bone cancers, like chordomas and chondrosarcomas, because they aren't very sensitive to chemo [4]. However, it can be useful for some special types of chondrosarcoma, like the dedifferentiated and mesenchymal lineag [3,4]. Anti-cancer agents are sometimes used for bone cancer that has spread through the bloodstream to the lungs and/or other organs [5]. The drugs mainly used for this condition include: Doxorubicin (Adriamycin®), Cisplatin, Carboplatin, Etoposide (VP-16), Ifosfamide (Ifex®), Cyclophosphamide (Cytoxan®), Methotrexate and Vincristine (Oncovin®) [3,5]. In this regard, a number of investigators have shown that some of the above anti-cancer agents are likely candidates for light and or heat activation in cancer cells, as laser photo chemotherapy (LPC) has been consistently used for treatment of retinoblastoma since 1996 [3,6-8].

The propensity for survivors of heritable retinoblastoma to develop second primary osteosarcomas at substantially greater frequency than either the general population or survivors of nonheritable retinoblastoma is well known [9,10]. There is some molecular genetic evidence that the development of these two disparate tumor types involves specific somatic loss of constitutional heterozygosity for the region of human chromosome 13 that includes the RB1 locus [11]. In regards to chemotherapy a number of investigators have shown that anthracyclines and cis-platinum are likely candidates for light or heat activation in cancer cells [1,2,12]. In this sense, Heyman et al. [3] have recently reported a significant decrease of cell bioviability and histomorphological alterations suggestive of higher apoptical activity in osteosarcoma cell lines (Saos-2) treated by cisplatin and zolendronic acid followed by diode laser irradiation, when compared with non-irradiated cells. Therefore, LPC outcomes for retinoblastoma may suggest that a conceptual approach towards osteosarcoma treatment may be possible based on recent clinical studies on combined therapy [12,13-18].

Photo chemotherapy with lasers is an alternative therapy which consists of using a monochromatic light delivered via external irradiation or via interstitial fiber optics to enhance the ``killing`` threshold in tumors containing light and/or heat-sensitive anticancer agents [12]. The development of photoactivatable pro-drugs of platinum-based antitumor agents is aimed at increasing the selectivity and thereby lowering toxicity of this important class of antitumor drugs [19-21]. Hence, laser photo chemotherapy explores three distinct mechanisms of antitumor action: direct anti-cancer effect

i. Additionally: thermal

ii. Light sensitizer

iii. Effects [1,2,22].

These drugs may be injected intravenously at concentrations lower than normal chemotherapeutic levels, or at higher intratumor doses reducing systemic toxicity while enhancing local tumoricidal effects by laser photoactivation in situ [2,23,24]. Anthracyclines have also been identified that have greater photosensitization potential than daunomyucin [25]. With all the supporting evidence of translational and clinical protocols laser photo chemotherapy has established itself as an alternative treatment for retinoblastoma [18,26,27]. Most of

these studies were conducted in children where there has been a few standardized clinical protocols, in particular for unilateral retinoblastoma [27,28]. One of these studies by Ventura et al. [29] was sophisticated enough to direct intra-arterial chemotherapy for combined laser photo activation in an advanced unilateral case in an 8-year old girl with no other options for treatment [29].

In sum, bone tumors are rare neoplasm that causes significant morbidity and mortality that despite important medical advances in the past 20 years produced few significant changes in function or survival for patients affected with these diseases. Based on the successful establishment as an alternative treatment for retinoblastoma LPC may become an alternative option for this devastating disease.

References

1. Paiva MB, Palumbo MN, Greggio B, Sercarz JA (2011) Laser Photo Chemotherapy: An alternative treatment for cancer. In: Ozdemir O (Eds.), Current Cancer Treatment-Novel and Beyond Conventional Approaches. pp. 175-198.
2. Saxton RE, Paiva MB, Lufkin RB, Castro DJ (1995) Laser photochemotherapy: a less invasive approach for treatment of cancer. Semin Surg Oncol 11 (4): 283-289.
3. Heymann PG, Ziebart T, Kämmerer PW, Mandic R, Saydali A, et al. (2016) The enhancing effect of a laser photochemotherapy with cisplatin or zolendronic acid in primary human osteoblasts and osteosarcoma cells in vitro. J Oral Pathol Med 45(10): 803-809.
4. Benjamin RS, Wagner MJ, Livingston JA, Ravi V, Patel SR (2015) Chemotherapy for bone sarcomas in adults: the MD Anderson experience. Am Soc Clin Oncol Educ Book 2015: 656-660.
5. https://www.cancer.org/cancer/bone-cancer/treating/chemotherapy.html
6. Gallie BL, Budning A, DeBoer G, Thiessen JJ, Koren G, et al. (1996) Chemotherapy with focal therapy can cure intraocular retinoblastoma without radiotherapy. Arch Ophthalmol 114(11): 1321-1328.
7. Murphree AL, Villablanca JG, Deegan WF 3rd, Sato JK, Malogolowkin M, et al. (1996) Chemotherapy plus local treatment in the management of intraocular retinoblastoma. Arch Ophthalmol 114(11): 1348-1356.
8. Lueder GT, Goyal R (1996) Visual function after laser hyperthermia and chemotherapy for macular retinoblastoma. Am J Ophthalmol 121(5): 582-584.
9. Hansen MF, Koufos A, Gallie BL, Phillips RA, Fodstad O, et al. (1985) Osteosarcoma and retinoblastoma: a shared chromosomal mechanism revealing recessive predisposition. Proc Natl Acad Sci USA 82(18): 6216-6220.
10. Cook R, Zoumpoulidou G, Luczynski MT, Rieger S, Moquet J, et al. (2015) Direct involvement of retinoblastoma family proteins in DNA repair by non-homologous end-joining. Cell Rep 10(12): 2006-2018.
11. Dommering CJ, Marees T, van der Hout AH, Imhof SM, Meijers-Heijboer H, et al. (2012) RB1 mutations and second primary malignancies after hereditary retinoblastoma. Fam Cancer 11(2): 225-233.
12. Paiva MB, Joo JJ, Abrahão M, Ribeiro JC, Cervantes O, et al. (2011) Update on photo chemotherapy: An alternative for cancer treatment. Anticancer Agents Med Chem 11(8): 772-779.
13. Peterson EC, Elhammady MS, Quintero-Wolfe S, Murray TG, Aziz-Sultan MA (2011) Selective ophthalmic artery infusion of chemotherapy for intraocular retinoblastoma: initial experience with 17 tumors. J Neurosurg 114(6): 1603-1608.
14. Mallipatna A, Sutherland J, Gallie B, Chan H, Héon E (2009) Management and outcome of unilateral retinoblastoma. Photochem Photobiol 13(6): 546-560.
15. Leng T, Cebulla CM, Schefler AC, Murray TG (2010) Focal periocular carboplatin chemotherapy avoids systemic chemotherapy for unilateral, progressive retinoblastoma. Retina 30(4): 66-68.
16. Kunkele A, Jurklies C, Wieland R, Lohmann D, Bornfeld N, et al. (2013) Chemoreduction improves eye retention in patients with retinoblastoma: A report from the German Retinoblastoma Referenced Centre. Br J Ophtalmol 97(10): 1277-1283.
17. Houston SK, Wykoff CC, Berrocal AM, Hess DJ, Murray TG (2013) Lasers for the treatment of intraocular tumors. Lasers Med Sci 28(3): 1025-1034.
18. Lumbroso-Le Rouic L, Aerts I, Hajage D, Lévy-Gabriel C, Savignoni A, et al. (2016) Conservative treatment of retinoblastoma: A prospective phase II randomized trial of noadjuvant chemotherapy followed by local treatments and chemothermotherapy. Eye (Lond) 30(1): 46-52.
19. Bednarski P, Mackay FS, Sadler PJ (2007) Photoactivatable platinum complexes. Anticancer Agents Med Chem 7(1): 75-93.
20. Farrer N, Woods J, Munk V, Mackay F, Sadler P (2010) Photocytotoxic Transdiamine inplatinum(IV) diazido complexes more potent than their cis isomers. Chem Res Toxicol 23(2): 413-421.
21. Mackay F, Woods J, Heringová P, Kaspárková J, Pizarro A, et al. (2007) A potent cytotoxic photoactivated platinum complex. Photochem Photobiol 104(52): 20743-20748.
22. Eshraghi, AA, Castro DJ, Paiva MB, Graeber IP, Jongewaard N, et al. (1997) Laser chemotherapy of human carcinoma cells with three new anticancer drugs. J Clin Laser Med Surg 15(1): 15-21.
23. Nahabedian MY, Cohen RA, Contino MF, Terem TM, Wright WH, et al. (1988) Combination cytotoxic chemotherapy with cisplatin or doxorubicin and photodynamic therapy in murine tumors. J Natl Cancer Inst 80(10): 739-743.
24. Palumbo MN, Cervantes O, Eugênio C, Hortense FTP, Ribeiro JC, et al. (2017) Intratumor cisplatin nephrotoxicity in combined laser-induced thermal therapy for cancer treatment. Lasers Surg Med 49(8): 756-762.
25. Diwu Z, Lown JW (1994) Phototherapeutic potential of alternative photosensitizers to porphyrins. Pharmacol Ther 63(1): 1-35.
26. Engin K (1996) Clinical experience with hyperthermia. Control Clin Trials 17(4): 316-342.
27. Peterson EC, Elhammady MS, Quintero-Wolfe S, Murray TG, Aziz-Sultan MA (2011) Selective ophthalmic artery infusion of chemotherapy for advanced intraocular retinoblastoma: initial experience with 17 tumors. J Neurosurg 114(6): 1603-1608.
28. Leng T, Cebulla CM, Schefler AC, Murray TG (2010) Focal periocular carboplatin chemotherapy avoids systemic chemotherapy for unilateral, progressive retinoblastoma. Retina 30(4): 66-68.
29. Ventura CV, Berrocal AM, Thomson J, Ehlies FJ, Latiff A, Murray TG (2017) Giant retinal tear after intra-arterial chemotherapy for advanced unilateral retinoblastoma. Int J Retin Vitr 14(3): 30.
30. Yousef YA, Nazzal RM, Khalil MB, Deebajah R, Mehyar M, et al. (2017) Management outcome(s) in eyes with retinoblastoma previously inadequately treated with systemic chemotherapy alone without focal therapy. Oman J Ophthalmol 10(2): 70-75.

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