

## Extrakorporale Photopherese – Prinzipien und klinische Anwendungen

1. Lerner, A. B., Denton, C. R. & Fitzpatrick, T. B. Clinical and experimental studies with 8-methoxypsoralen in vitiligo. *J Invest Dermatol* 20, 299-314, doi:10.1038/jid.1953.36 (1953).
2. Parrish, J. A. Editorial: Photochemotherapy of psoriasis. *Arch Dermatol* 112, 35-36 (1976).
3. Wolff, K. W. et al. Photochemotherapy for psoriasis with orally administered methoxsalen. *Arch Dermatol* 112, 943-950 (1976).
4. Baden, H. P., Parrington, J. M., Delhanty, J. D. & Pathak, M. A. DNA synthesis in normal and xeroderma pigmentosum fibroblasts following treatment with 8-methoxypsoralen and long wave ultraviolet light. *Biochim Biophys Acta* 262, 247-255, doi:10.1016/0005-2787(72)90260-2 (1972).
5. Walter, J. F., Kelsey, W. H., Voorhees, J. J. & Duell, E. A. Psoralen plus black light inhibits epidermal DNA synthesis. *Arch Dermatol* 107, 861-865 (1973).
6. McCullough, J. L. & Weinstein, G. D. Effect of lipid-soluble esters of methotrexate on DNA synthesis in human skin. *J Invest Dermatol* 63, 464-466, doi:10.1111/1523-1747.ep12680390 (1974).
7. Gilchrist, B. A., Parrish, J. A., Tanenbaum, L., Haynes, H. A. & Fitzpatrick, T. B. Oral methoxsalen photochemotherapy of mycosis fungoides. *Cancer* 38, 683-689, doi:10.1002/1097-0142(197608)38:2<683::aid-cnrcr2820380210>3.0.co;2-v (1976).
8. Hodge, L., Warin, A. P., Gange, R. W., Bleehen, S. & Vella Briffa, D. Photochemotherapy in mycosis fungoides. *Br Med J* 2, 1257-1259, doi:10.1136/bmj.2.6097.1257 (1977).
9. Honigsmann, H., Brenner, W., Rauschmeier, W., Konrad, K. & Wolff, K. Photochemotherapy for cutaneous T cell lymphoma. A follow-up study. *J Am Acad Dermatol* 10, 238-245, doi:10.1016/s0190-9622(84)70030-2 (1984).
10. Stern, R. S., Thibodeau, L. A., Kleinerman, R. A., Parrish, J. A. & Fitzpatrick, T. B. Risk of cutaneous carcinoma in patients treated with oral methoxsalen photochemotherapy for psoriasis. *N Engl J Med* 300, 809-813, doi:10.1056/NEJM197904123001501 (1979).
11. Momtaz, K. & Fitzpatrick, T. B. The benefits and risks of long-term PUVA photochemotherapy. *Dermatol Clin* 16, 227-234, doi:10.1016/s0733-8635(05)70005-x (1998).
12. Ben-Nun, A., Wekerle, H. & Cohen, I. R. Vaccination against autoimmune encephalomyelitis with T-lymphocyte line cells reactive against myelin basic protein. *Nature* 292, 60-61, doi:10.1038/292060a0 (1981).
13. Holoshitz, J., Naparstek, Y., Ben-Nun, A. & Cohen, I. R. Lines of T lymphocytes induce or vaccinate against autoimmune arthritis. *Science* 219, 56-58, doi:10.1126/science.6336851 (1983).
14. Edelson, R. et al. Treatment of cutaneous T-cell lymphoma by extracorporeal photochemotherapy. Preliminary results. *N Engl J Med* 316, 297-303, doi:10.1056/NEJM198702053160603 (1987).
15. Pathak, M. A. Molecular aspects of drug photosensitivity with special emphasis on psoralen photosensitization reaction. *J Natl Cancer Inst* 69, 163-170, doi:10.1093/jnci/69.1.163 (1982).
16. Asensi Cantó, P., Sanz Caballer, J., Solves Alcaína, P., de la Rubia Comos, J. & Gómez Seguí, I. Extracorporeal Photopheresis in Graft-versus-Host Disease. *Transplant Cell Ther* 29, 556-566, doi:10.1016/j.jtct.2023.07.001 (2023).
17. Helmberg, W., Sipurzynski, S., Groselje-Strehle, A., Greinix, H. & Schlenke, P. Does Offline Beat Inline Treatment: Investigation into Extracorporeal Photopheresis. *Transfus Med Hemother* 47, 198-204, doi:10.1159/000506750 (2020).
18. Mayer, W. et al. Comparison of procedure times and collection efficiencies using integrated and multistep nonintegrated procedures for extracorporeal photopheresis. *J Clin Apher* 37, 332-339, doi:10.1002/jca.21974 (2022).
19. Brosig, A. et al. Technical comparison of four different extracorporeal photopheresis systems. *Transfusion* 56, 2510-2519, doi:10.1111/trf.13728 (2016).
20. V., A. d. W. M. F. e. AWMF-S2k-Leitlinie (013-072). Extrakorporale Photopherese (ECP). (2021). <[https://register.awmf.org/assets/guidelines/013-072I\\_S2k\\_Extrakorporale-Photopherese-ECP\\_2022-02.pdf](https://register.awmf.org/assets/guidelines/013-072I_S2k_Extrakorporale-Photopherese-ECP_2022-02.pdf)>.
21. Witt, V. Therapeutische Apheresen. *Transfusionsmedizin* 11, 188-202, doi:10.1055/a-1342-1017 (2021).
22. Worel, N., Mansouri Taleghani, B. & Strasser, E. Recommendations for Therapeutic Apheresis by the Section "Preparative and Therapeutic Hemapheresis" of the German Society for Transfusion Medicine and Immunohematology. *Transfus Med Hemother* 46, 394-406, doi:10.1159/000503937 (2019).
23. Hackstein, H. et al. Mini buffy coat photopheresis for children and critically ill patients with extracorporeal photopheresis contraindications. *Transfusion* 49, 2366-2373, doi:10.1111/j.1537-2995.2009.02289.x (2009).

24. Verdu-Amoros, J. et al. Mini photopheresis for refractory chronic graft-versus-host disease in children and adolescents. *Transfusion* 58, 2495-2500, doi:10.1111/trf.14880 (2018).
25. Knobler, R. et al. European dermatology forum - updated guidelines on the use of extracorporeal photopheresis 2020 - part 1. *J Eur Acad Dermatol Venereol* 34, 2693-2716, doi:10.1111/jdv.16890 (2020).
26. Bueno, J. L. et al. A paired trial comparing mononuclear cell collection in two machines for further inactivation through an inline or offline extracorporeal photopheresis procedure. *Transfusion* 59, 340-346, doi:10.1111/trf.14975 (2019).
27. Piccirillo, N. et al. Inline and offline extracorporeal photopheresis: Device performance, cell yields and clinical response. *J Clin Apher* 36, 118-126, doi:10.1002/jca.21851 (2021).
28. Connelly-Smith, L. et al. Guidelines on the Use of Therapeutic Apheresis in Clinical Practice - Evidence-Based Approach from the Writing Committee of the American Society for Apheresis: The Ninth Special Issue. *J Clin Apher* 38, 77-278, doi:10.1002/jca.22043 (2023).
29. Hahnel, V. et al. Apoptosis induction by extracorporeal photopheresis is enhanced by increasing the 8-methoxypsoralen concentration and by replacing plasma with saline. *Transfusion* 61, 2991-2999, doi:10.1111/trf.16634 (2021).
30. Budde, H., Berntsch, U., Riggert, J. & Legler, T. J. In vitro effects of different 8-methoxypsoralen treatment protocols for extracorporeal photopheresis on mononuclear cells. *Cent Eur J Immunol* 42, 1-9, doi:10.5114/cej.2017.67312 (2017).
31. Guyatt, G. et al. Grading strength of recommendations and quality of evidence in clinical guidelines: report from an american college of chest physicians task force. *Chest* 129, 174-181, doi:10.1378/chest.129.1.174 (2006).
32. Guyatt, G. H. et al. GRADE: an emerging consensus on rating quality of evidence and strength of recommendations. *BMJ* 336, 924-926, doi:10.1136/bmj.39489.470347.AD (2008).
33. Blaha, M. et al. Analysis of extracorporeal photopheresis within the frame of the WAA register. *Transfus Apher Sci* 60, 103172, doi:10.1016/j.transci.2021.103172 (2021).
34. Musajo, L., Bordin, F., Caporale, G., Marciani, S. & Rigatti, G. Photoreactions at 3655 Angstrom between pyrimidine bases and skin-photosensitizing furocoumarins. *Photochem Photobiol* 6, 711-719, doi:10.1111/j.1751-1097.1967.tb08736.x (1967).
35. Wolnicka-Glubisz, A. et al. Effect of UVA and 8-methoxypsoralen, 4, 6, 4'-trimethylangelicin or chlorpromazine on apoptosis of lymphocytes and their recognition by monocytes. *J Physiol Pharmacol* 61, 107-114 (2010).
36. Bladon, J. & Taylor, P. C. Extracorporeal photopheresis induces apoptosis in the lymphocytes of cutaneous T-cell lymphoma and graft-versus-host disease patients. *Br J Haematol* 107, 707-711, doi:10.1046/j.1365-2141.1999.01773.x (1999).
37. Gerber, A. et al. Investigation of annexin V binding to lymphocytes after extracorporeal photoimmunotherapy as an early marker of apoptosis. *Dermatology* 201, 111-117, doi:10.1159/000018472 (2000).
38. Hannani, D. et al. Photochemotherapy induces a faster apoptosis of alloreactive activated T cells than of nonalloreactive resting T cells in graft versus host disease. *Transplantation* 90, 1232-1238, doi:10.1097/tp.0b013e3181fa4eb6 (2010).
39. Miracco, C. et al. Extracorporeal photochemotherapy induces apoptosis of infiltrating lymphoid cells in patients with mycosis fungoides in early stages. A quantitative histological study. *Br J Dermatol* 137, 549-557, doi:10.1111/j.1365-2133.1997.tb03785.x (1997).
40. Poon, I. K., Hulett, M. D. & Parish, C. R. Molecular mechanisms of late apoptotic/necrotic cell clearance. *Cell Death Differ* 17, 381-397, doi:10.1038/cdd.2009.195 (2010).
41. Poon, I. K., Lucas, C. D., Rossi, A. G. & Ravichandran, K. S. Apoptotic cell clearance: basic biology and therapeutic potential. *Nat Rev Immunol* 14, 166-180, doi:10.1038/nri3607 (2014).
42. Coppard, C. et al. In vitro PUVA treatment triggers calreticulin exposition and HMGB1 release by dying T lymphocytes in GVHD: New insights in extracorporeal photopheresis. *J Clin Apher* 34, 450-460, doi:10.1002/jca.21698 (2019).
43. Chen, G. Y., Tang, J., Zheng, P. & Liu, Y. CD24 and Siglec-10 selectively repress tissue damage-induced immune responses. *Science* 323, 1722-1725, doi:10.1126/science.1168988 (2009).
44. Fontenot, J. D., Gavin, M. A. & Rudensky, A. Y. Foxp3 programs the development and function of CD4+CD25+ regulatory T cells. *Nat Immunol* 4, 330-336, doi:10.1038/ni904 (2003).
45. Hori, S., Nomura, T. & Sakaguchi, S. Control of regulatory T cell development by the transcription factor Foxp3. *Science* 299, 1057-1061, doi:10.1126/science.1079490 (2003).
46. Bojanic, I. et al. Extracorporeal photopheresis as an immunomodulatory treatment modality for chronic GvHD and the importance of emerging biomarkers. *Front Immunol* 14, 1086006, doi:10.3389/fimmu.2023.1086006 (2023).
47. Cho, A., Jantschitsch, C. & Knobler, R. Extracorporeal Photopheresis-An Overview. *Front Med (Lausanne)* 5, 236, doi:10.3389/fmed.2018.00236 (2018).

48. Berger, C. L., Hanlon, D., Kanada, D., Girardi, M. & Edelson, R. L. Transimmunization, a novel approach for tumor immunotherapy. *Transfus Apher Sci* 26, 205-216, doi:10.1016/s1473-0502(02)00014-9 (2002).
49. Vieyra-Garcia, P. A. & Wolf, P. Extracorporeal Photopheresis: A Case of Immunotherapy Ahead of Its Time. *Transfus Med Hemother* 47, 226-235, doi:10.1159/000508479 (2020).
50. Greinix, H. T., Ayuk, F. & Zeiser, R. Extracorporeal photopheresis in acute and chronic steroid-refractory graft-versus-host disease: an evolving treatment landscape. *Leukemia* 36, 2558-2566, doi:10.1038/s41375-022-01701-2 (2022).
51. Faivre, L. et al. Quality control of extracorporeal photochemotherapy: Proliferation assay using CFSE validated according to ISO 15189:2007 standards. *Cytometry B Clin Cytom* 88, 30-39, doi:10.1002/cyto.b.21188 (2015).
52. Schwab, L., Michel, G., Bein, G. & Hackstein, H. CD71 surface analysis of T cells: a simple alternative for extracorporeal photopheresis quality control. *Vox Sang* 115, 81-93, doi:10.1111/vox.12850 (2020).
53. Rieber, N. et al. Extracorporeal photopheresis increases neutrophilic myeloid-derived suppressor cells in patients with GvHD. *Bone Marrow Transplant* 49, 545-552, doi:10.1038/bmt.2013.236 (2014).