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Use of Xenon Chloride Excimer Laser in the Treatment of Vitiligo

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Abstract
With the help of chemical process the molecule of Xenon Chloride obtained in chemical labs is found to be very important in medical field. The advances in phototherapy over the last decade made it possible to treat the skin disorders like vitiligo with excimer laser. Vitiligo is cosmetically disfiguring disease in which white patches appear on any part of the skin. These patches are due to destruction of melanocytes which produce melanin the chemical that gives color to skin. The main purpose of treatment is to reinitiate melanin formation activity. It is also called as re-pigmentation of skin which is originally de-pigmented. The patients of vitiligo are treated in many countries with a unit as a source of light using XeCl. This therapy is popularly known as phototherapy. The results obtained are satisfactory in many cases. We have also studied the effect of UVB light in the treatment of vitiligo based on the unit manufactured by Daavlin Co. at a clinical lab in consultation with skin specialist.

Keywords: Vitiligo, excimer laser, pigmentation, phototherapy.

Introduction

The excimer lamps based on excitation of molecule like XeCl is used in producing UVB with 308 nm wavelength which has high penetrating power and is found to be useful in accelerating melanin formation activity. The UVB units are available in various shapes and sizes to cover entire body surface or targeting to a small skin area like fingers or toes. The de-pigmented skin showing white patch can be re-pigmented to achieve normal skin color. Primarily Mercury lamps were popular though they were not much ecofriendly. With the inert gases lamps focus was shifted to various application areas. In case of Xenon it is found that Xenon Iodide molecule can give radiation of wavelength 253 nm with photon energy 4.91 eV, Xenon Bromide with 282 nm and 4.41 eV, Xenon Chloride with 308 nm and 4.03 eV. The last in the series Xenon Fluoride with 351 nm and 3.53 eV. Out of these four molecules XeCl is found to be most suitable for radiation that are useful for the treatment of vitiligo patches. We studied the applications of Xenon-halide molecules in the lamps categorized as Excimers.

Materials and Method

One of the most usable ways for practical use is excitation by an electric discharge. Actually it is used more types of discharge for excimer lamp pumping(some of them are glow discharge, pulsed discharge, capacitive discharge, longitudinal and transverse discharges, volume discharge, spark discharge, micro-hollow discharge, etc.). Currently, the excimer lamps with capacitive discharge type of excitation namely dielectric barrier discharge [21] [22] are the most widely spread. Lamps using this discharge type are already commercially available. In this technology electrodes are not in direct contact with the active medium (plasma) that eliminates any interaction between the discharge and the electrodes, Xenon mono chloride (XeCl) is an excimer which is used in excimer lasers emitting near ultraviolet light at 308 nm. It is most commonly used in medicine. At least two gases must be used to generate exciplexes: a halogen donor and a rare gas. [1] However, not all rare gas halide molecules lead to the development of lasers; some may not even exist. Multiple molecules and applications have been developed. [2][3][4][5][6][7][8][9][10]

In a case study by Korean team who compared the clinical efficacy of a short-term intervention of 308-nm excimer laser with that of narrow-band UVB (NBUVB) phototherapy for vitiligo patients to see the early response. Twenty-three symmetrically patterned patches of vitiligo on 8 patients were selected. Vitiligo patches on one side of the body were treated 2 times per week for a maximum of 20 treatments with the excimer laser, and NBUVB phototherapy was used on patches on the other side. Improvement (re-pigmentation) was

assessed on a visual scale via serial photographs taken every five treatments and scored as follows: 0, ≤1% improvement; 1, ≤25% improvement; 2, 26-50% improvement; 3, 51-75% improvement; and 4, ≥75% improvement. At five treatments, the excimer laser-treated patches had an average score of 0.26, compared with 0.04 for patches treated with NBUVB phototherapy. A slightly higher re-pigmentation ($p>0.05$) in the excimer treated area was thus observed. At 10, 15, or 20 treatments, the differences between the average scores were significant: 0.83, 1.17, and 1.39 for the excimer-treated patches, and 0.17, 0.30, and 0.74 for the NBUVB phototherapy-treated areas ($p<0.05$). In conclusion, the 308-nm excimer laser appears to be more effective than NBUVB phototherapy, as it produces more rapid and profound re-pigmentation. They used a 308-nm excimer laser with a self-contained gas system of Xe-Cl (Photomedex®, Carlsbad, CA, U.S.A.). Output is initiated by a foot switch and consists of a train of short pulses with a pulse-width of 30 nanoseconds, delivered through a fiber optic hand piece. It is operated at 3 mJ per pulse with pulse repetition of up to 200 Hz. The laser allows fixed fluences to be delivered, from 100 mJ/cm^2 to a maximum dose of 2,100 mJ/cm^2, in 50 mJ/cm^{2}increments. Additional fluences can be delivered by pressing the foot switch. The NBUVB phototherapy unit (Waldmann Co., Germany) contains a bank of 48 fluorescent tubes (TL-100W/01, Phillips, Eindhoven, The Netherlands) with peak emission at 311 to 312 nm..[12]

In another case study by Goldinger *et al*. tried the combination therapy for two months i.e. 24 treatments (8 weeks), nine patients were evaluated. Eight patients showed evidence of re-pigmentation on both body sides, with no significant difference between the body side treated with calcipotriol and excimer laser and the side treated with excimer laser alone. The mean re-pigmentation rate was 22.4% (1-37%).The addition of calcipotriol ointment to 308-nm xenon chloride excimer laser phototherapy does not significantly enhance its efficacy. Small additive effects must be investigated in a larger trial..[13]

In 2002 Eszter Baltas MD and his team used XeCl and they found that the 308-nm xenon chloride (XeCl) excimer laser was effective in inducing re-pigmentation in one patient with localized vitiligo. The aim of this study was to expand our observation on the therapeutic efficacy and safety of the 308-nm XeCl laser for the treatment of vitiligo..[14]

In 2004 a group from japan studied that the rate of re-pigmentation continued to increase with the number of treatments up to 20 sessions, and then showed plateaus between 20 to 30 sessions. On the other hand, the lesions in acral and joint areas showed the worst responses throughout the treatment sessions. Our findings extend previous observations that the 308-nm excimer laser is an effective treatment option for patients with vitiligo. However, further studies will be needed to determine the optimal dosing and administration method, especially for acral and joint areas..[15]

In India Most studies of vitiligo treatment with phototherapy set a 75% re-pigmentation rate as cosmetically acceptable, and are able to achieve it in 12.5 to 75% of patients after one year of treatment.[18]. By comparison, other studies have found a 43% improvement with narrow band UVB therapy.[19]

Result

The XeCl molecule is found to be very important molecule medically. It is a basic building block for XeCl laser which is used as a source of light for the treatment of skin diseases like vitiligo. It is being used at many places for obtaining the normal color of the skin patch which appears white due to malfunction of melano-genesis activity. The photo-biological interaction which takes place with the help of a molecule obtained from two gases Xenon and Chlorine. Even though no study so far has claimed 100% cure to the disease the results are optimistic and clinically proven. The XeCl molecule is thus found to be a suitable source for lasing action.

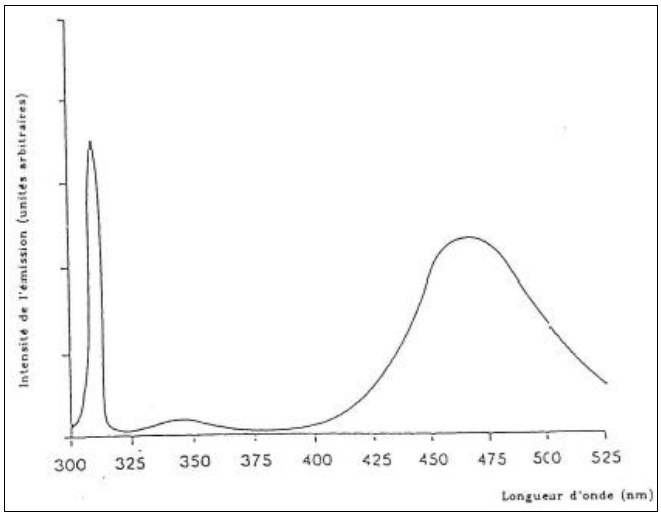

Fig 1: Narrow band absorption by human skin in the wavelength range 308 to 311nm showing the sharp peak at 311nm.

Conclusion

The xenon chloride molecule is found to be useful molecule and its medical importance is undoubtedly proved beyond any explanation. It is also found that a narrow band wavelength in the range of 308 to 311 nm is particularly absorbed by most of the affected legions of the human topical skin i.e. epidermic part of the skin. The excimer laser with the xenon chloride molecules is found many applications in the treatment of Vitiligo, Psoriasis, Pitiriasis versicolour, etc diseases. The scientists are searching more and more applications of xenon chloride molecule worldwide. The proper fluances and exposure time if calculated exactly with the consultation of the dermatologist, would be better for effective treatment of dermatological diseases of an individual patient. We had used nitrogen laser for the treatment of dermatological diseases with slightly higher wavelength but found less suitable for treating skin diseases as compared to excimer laser.

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