

Phototherapy in dermatology: care, concerns and best practice amidst COVID-19 pandemic

Smitha S Prabhu, MD
Sathish Ballambat Pai, MD*
Manasa Narayan Kayarkatte, MD,
DNB

*Department of Dermatology &
Venereology, Kasturba Medical
College, Manipal Academy of Higher
Education, Udupi, Karnataka, India*

**Corresponding author:
Sathish Ballambat Pai, MD
Department of Dermatology &
Venereology, Kasturba Medical
College, Manipal Academy of Higher
Education, Udupi, Karnataka, India
Tel: +91 9900405072
Email: sb.pai@manipal.edu*

Phototherapy is an essential and useful therapeutic procedure wherein the properties of ultraviolet light are used to cure certain dermatological conditions like psoriasis, vitiligo, and atopic dermatitis. This is usually an office-based procedure dependent on the accurate use of sophisticated phototherapy units. Since the advent of the COVID-19 pandemic, phototherapy practices were shut down as they were considered as non-essential services.

Here, we attempt to analyze how COVID-19 has affected phototherapy and seek to formulate a working guideline for safe phototherapy operations in these taxing circumstances. We used search engines like PubMed, Google Scholar, and Embase to retrieve articles and guidelines regarding phototherapy in dermatology, using the pertinent search terms. There was a paucity of data with only a couple of research letters and guidelines by the British Association of Dermatology and the American Academy of Dermatology, as well as general guidelines issued by the Indian Association of Dermatologists, Venereologists and Leprologists.

After a careful study of various modalities of phototherapy and viral inactivation, we collated a set of guiding instructions toward the appropriate utilization of phototherapy amidst the COVID-19 pandemic.

Phototherapy is a viable option for selected patients even amidst the COVID-19 pandemic. However, local and national guidelines have to be followed while selecting the patient and operating the phototherapy machine with adequate protective measures for both the patient and the healthcare worker. Home phototherapy units and PUVASOL are good options for those patients who are unable to attend the phototherapy center due to various reasons.

Keywords: phototherapy, COVID-19 pandemic, psoriasis, dermatology, practice guidelines

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INTRODUCTION

Phototherapy is a well-practiced, office-based therapeutic procedure in dermatology wherein the properties of ultraviolet light (UVL) are used, alone, or in combination with other medications,

to treat chronic inflammatory and even neoplastic cutaneous conditions.

Properties of ultraviolet light (UVL)

Ultraviolet light is a part of the solar spectrum

and is split into UVA (320-400 nm), UVB (285-320 nm), or UVC (200-285 nm). Only UVA and UVB are utilized in phototherapy. The former is further subdivided as UVA1 (340-400 nm) and UVA2 (320-340 nm), while the latter can be broadband UVB (BB-UVB) comprising the whole spectrum or narrowband UVB (NB-UVB), which is a narrow width of wavelengths between 311-313 nm. The commonly utilized spectra are UVA and NB-UVB. The common dermatological conditions wherein phototherapy is utilized therapeutically are given in Table 1.

The Common types of phototherapy include NBUVB, psoralen with UVA (PUVA), and targeted phototherapy, though some specialized centers also have photodynamic therapy (PDT) and UVA1 chambers¹. Phototherapy involves various systems of administration ranging from large office-based phototherapy chambers that deliver precise wavelengths at precise fluency to smaller units like hand and feet units, home units, and units that utilize the UVA spectrum of natural solar radiation (PUVASOL). Proper administration of phototherapy involves the patient attending the phototherapy clinic at specified intervals and being

exposed to the required dose of UV radiation for a controlled amount of time.

The ongoing COVID-19 pandemic has caused unprecedented turmoil and restriction of movement, either by administrative rules or as personal measures for self-protection. Health providers have been forced to discontinue or put on hold elective procedures in view of curtailing the further spread of the virus. This was done to ensure patient safety and to direct health resources toward dealing with COVID-19 healthcare.

Phototherapy, despite chiefly being an elective procedure, has a huge impact on the treatment of chronic diseases like psoriasis and vitiligo as it reduces the physical and psychosocial distress of patients.

This research was undertaken to assess the impact of COVID-19 on phototherapy procedures and to formulate a learned directive toward the administration of phototherapy in adverse situations like the ongoing COVID-19 pandemic. The keywords of phototherapy, dermatology, UVA, NBUVB, COVID-19, and guidelines were used to search the PubMed, Embase, and Google Scholar search engines. There was a paucity of data with

Table 1. Common dermatological conditions where phototherapy is used

| Dermatological conditions | The choice phototherapy |
|--|--|
| FDA approved | |
| Psoriasis | PUVA, NBUVB, targeted phototherapy for localized forms |
| Vitiligo | NBUVB, PUVA, targeted phototherapy for localized forms |
| Off label indications | |
| Inflammatory & Immunological | |
| Seborrhoeic dermatitis | NBUVB |
| Atopic dermatitis | NBUVB |
| Lichen planus | NBUVB |
| Alopecia areata | PUVA, NBUVB, targeted phototherapy |
| Neoplastic & Clonal | |
| Mycosis fungoides | NBUVB, PUVA, PDT |
| Parapsoriasis | NBUVB, PUVA |
| Pityriasis lichenoides | NBUVB, PUVA |
| Actinic keratosis, Squamous cell carcinoma, Basal cell carcinoma | PDT |
| Photodermatoses | |
| Polymorphous light eruption | |
| Chronic actinic dermatitis | NBUVB |
| Actinic reticuloid | |
| Miscellaneous | |
| Granuloma annulare | |
| Urticaria pigmentosa | NBUVB |
| Morphea | UVA1 |
| Systemic pruritus | NBUVB + PUVA |
| Acne, Rosacea, Leishmaniasis, Verrucae | PDT |

only one research paper, a couple of guidelines, and a few observations.

In this article, we succinctly summarize the various methods of phototherapy and highlight their advantages and drawbacks. Then, we go on to formulate guidelines of our own based on our collective phototherapy experience of more than 30 years.

Types of phototherapy

The various modalities of phototherapy are summarized in Table 2. These include:

Psoralen with UVA (PUVA). UVA is absorbed in the dermis and exerts its apoptotic effect on dermal blood vessel components, dendritic cells, fibroblasts, endothelial cells, and mast cells¹. In PUVA, the topical, bath or oral administration of psoralens (8-methoxy psoralen (8-MOP), 4,5,8-trimethyl psoralen (TMP) or 5-methoxy psoralen (5-MOP)) occurs together with the administration of UVA light either via PUVA chambers or using sunlight (PUVASOL) in an adequate dose depending upon patient and disease characteristics. Oral psoralens are taken 1.5 to 2 hours before the administration of UVA light, whereas topical/bath psoralens are applied in low dilutions twenty minutes beforehand; 0.6 to 0.8 mg/kg of body weight of 8-MOP or 0.3 to 0.6 mg/kg of trimethyl psoralen can be administered with food. Topical psoralen is used at a concentration of 0.5 mg - 5 mg/l of 8-MOP or 0.125-0.5 mg/l of TMP. Typically, 15-20 sessions and 50-100 sessions are needed for the clearance of psoriasis and vitiligo, respectively, with a frequency of twice to thrice per week. The starting dose is 1-2 mJ/cm², which is progressively increased by 0.5 mJ/cm² depending upon the response.

Table 2. Common modalities of phototherapy

| With Photosensitizers [Photochemotherapy] | Without Photosensitizers [Phototherapy] |
|--|--|
| PUVA & its modifications | |
| • Psoralens | NB-UVB |
| • Bath PUVA, PUVASOL, Bathing suit PUVA, Hand & Foot PUVA, Clothes on PUVA, Turban PUVA | UVA1 |
| KUCA | |
| • Khellin | Excimer laser |
| Photodynamic therapy | |
| • ALA | Intense pulsed light |

Abbreviations: ALA, Amino levulinic acid; KUCA, Khellin plus UVA

Ultraviolet B (UVB). UVB exerts its effects by damaging nuclear DNA within the epidermal-dermal junctional cells, leading to apoptosis and cellular death of keratinocytes, immune cells, and fibroblasts¹.

Narrowband UVB (NBUVB). Here, the patient is exposed to NBUVB in specialized chambers. Smaller handheld units are also available. The starting dose is either calculated depending upon the skin type or by determining the minimal erythema dose (MED) via phototesting and using 70% of the MED as the first dose. In progressive sessions, the dose is increased by 20%. Notably, NBUVB is less erythemogenic than PUVA and may be given at more frequent intervals, though there should be a minimum gap of 48 hours between sessions.

Targeted phototherapy. Here, high intensity UV radiation is applied only to clinically diseased skin using a handheld device that delivers high fluence UV light via fiberoptic cables with a narrow aperture. The light can be of any source (e.g., UVA, UVB, or visible light) and is delivered via UV light sources, intense pulse light, or an excimer laser. This needs less frequent patient visits (two per week) and a shorter duration of treatment (maximum of 16 weeks), showing results within 8 to 10 sessions².

UVA1 Phototherapy. Notably, UVA1 is of longer wavelengths (340-400 nm) that penetrate deeper than other waves of the UV spectrum. It induces collagenase/matrix metalloproteinase-1 expression, T-cell apoptosis, and the depletion of Langerhans and mast cells in the dermis, along with the stimulation of endothelial cells for neovascularization. Hence, it is indicated in scleroderma, morphea, extragenital lichen sclerosis atrophicus, graft-versus-host disease, nephrogenic systemic fibrosis, atopic dermatitis, cutaneous T-cell lymphoma, disseminated granuloma annulare, and mastocytosis^{3,4}. The UVA1 machine is quite expensive, making its availability limited.

Photodynamic Therapy (PDT). This is performed only in select centers and was traditionally favored in neoplastic conditions like actinic keratosis, squamous cell carcinoma in situ, superficial basal cell carcinoma, and mycosis fungoides. Modern-day indications encompass various non-neoplastic conditions like acne, rosacea, hidradenitis suppurativa, warts, leishmaniasis, and even photo-rejuvenation of the skin. It is based on the local or

systemic application of a photosensitizer (usually aminolevulinic acid or methyl aminolevulinate) that gets accumulated in pathological tissues. Upon irradiating with the appropriate wavelength, these photosensitizer molecules absorb the light and selectively destruct tissue by free radical generation⁵.

Home Phototherapy. If performed correctly, home phototherapy is a cost-effective and convenient modality. This should be especially explored and utilized in this current COVID-19 pandemic scenario. Home phototherapy units mostly comprise of NBUVB units. Home LED blue light (458 nm) is also an efficacious treatment for psoriasis. Tanning beds, if in vogue in the geographic area where the patient is from, are still cheaper alternatives and usually comprise of UVA light, though some amount of UVB is also emitted. Drawbacks include unsupervised sessions with the possibility of overexposure and inability to progressively increase the fluency, though these can be better controlled than the natural sunlight used in PUVASOL.

On the other hand, PUVASOL involves administering psoralen and exposing to sunlight containing mostly UVA radiation, avoiding the peak time of UVB and infrared radiation (~11:15 AM - 2:30 PM)⁶. In addition to verbal counseling, a step-by-step guide that explains the whole therapy in easily understandable words is advisable. Psoralen tablets should be consumed 1.5-2 hours prior to exposure; initial exposure should be for four minutes, as two minutes of exposure approximately equals to 1 mJ/cm² of UVA, though more exposure may be needed in temperate climates and in winter. Treatment with PUVASOL should be undertaken two to three times per week on non-consecutive days, with adequate eye protection using UV protective glasses like Beta 2 Toric UV glasses. Eye protection should continue for the whole day. Topical sunscreen may be applied to non-involved exposed skin to avoid tanning.

Clothes-on-PUVA is a novel variation of PUVA wherein female patients who are reluctant to expose their body during PUVASOL may wear a lightweight cotton fabric of 30 by 30 threads per cm², wherein the exposure time is calculated to be 3.3 times more to account for the blocking effect of the cloth (e.g., 13 minutes instead of 4 minutes)⁷.

Phototherapy concerns amidst the COVID-19 pandemic

Phototherapy is being practiced by many centers around the world for various indications. Many of these centers have closed down, especially in areas worst affected by the pandemic. However, phototherapy is an essential dermatology service as it enables patients to avoid immunosuppressant drugs and prevents acute flare-ups⁸. The decision to operate phototherapy should be based on the local guidelines, and the public health and government body recommendations; it should be made in consultation with the hospital infection committee for hospital-based centers⁹. The risk-benefit ratio for the patient and the health safety measures of the HCW should be carefully weighed. The risk of spreading COVID-19 via phototherapy units is not known but is thought to be negligible because the germicidal nature of UVL is well known and solar radiation is shown to inactivate the severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2)¹⁰, leading to the assumption that UVA and UVB may limit the replication of the virus. Furthermore, UVC has been used in decontaminating N95 masks and the N95 filters of respirators¹¹. Moreover, psoralen photochemotherapy is known to inactivate certain RNA and DNA viruses¹².

By considering the published guidelines and taking into account a few points that we practice in our highly experienced center (30 years of experience), the modification of phototherapy services in view of COVID-19 social distancing should be based on the following principles^{8,9,13}:

1. Minimizing hospital visits and in-person consultations for patients
 2. Maximizing patient as well as healthcare provider safety
 3. Resident and staff training
 4. Consideration of maintenance and care of phototherapy machines
1. Minimizing patient visits and in-person consultations:
 - The initial consultation to decide upon phototherapy may be undertaken via tele dermatology under the provision of good quality full body photographs by the patient, and confirmation of history and physical condition by a phone-based interview.

- The urgency for phototherapy should be assessed on a case by case basis balancing the risk of acquiring severe COVID-19 infection with the risk of flare up of disease and in consideration of alternative therapeutic options. Patients should be counselled following the risk assessment.
 - Each patient should be evaluated upon a risk-benefit ratio: the risk of having or acquiring severe COVID-19 (e.g., if severe comorbidities are present) versus the urgency for phototherapy based on the severity of the dermatological condition and contraindications for alternative treatments. The patient should be counselled regarding the decision made based upon this assessment.
 - Phototesting procedures like minimal erythema dose (MED) determination before starting NBUVB may be avoided, and all patients should be started on a skin-based fixed dose regimen.
 - The duration between visits can be maximized without compromising the therapeutic efficacy. That is, two visits per week can be held rather than three or four till the COVID-19 crisis resolves. In this context, PUVA may be preferred over NBUVB.
 - Wherever possible, targeted phototherapy is a good option for non-facial regions as it needs less frequent sessions with a shorter treatment course, and improvement starts within 8 to 10 sessions.
 - Consider alternative treatment for patients who have well-controlled or minimal disease, or in whom phototherapy needs not be the first line therapy.
 - Patient travel should be minimized. When needed, patients should be referred to the geographically closest phototherapy center.
 - Wherever possible, facilitate home phototherapy by providing learned advice regarding the purchase of home phototherapy units and PUVASOL, which utilizes solar radiation at the comfort of the patients' home and in isolation. The procedure of PUVASOL may have to be explained and given in print in an easy to understand language to avoid treatment mishap.
2. Maximizing patient and healthcare worker (HCW) safety:
- Schedule patient visits by appointment such that no two patients remain in the same vicinity at one time.
 - Discourage patient bystanders for all adult patients, and only one responsible adult should accompany each child.
 - Appropriate triage and seclusion of patients with overt symptoms suggestive of COVID-19 (fever, cough, upper respiratory infection, respiratory distress, etc.) or for patients coming from containment zones. Testing for COVID-19 to be undertaken based on the prevalent guidelines at that point of time. In hospitals, patients should pass through the triage area; in smaller establishments, there should be a well-designated single point of entry.
 - Patients with a history of family members suffering from COVID-19 should be discouraged from undergoing phototherapy.
 - An added clause about risk of transmission of COVID-19 may be added to the phototherapy consent form.
 - The patient waiting area should have far-spaced seating arrangements. Unnecessary objects like tables, cushions, and magazines should be removed from the area.
 - Compulsory use of protective clothing and masks for all patients and attendees.
 - Patients should continue wearing a mask even during phototherapy, if possible.
 - Compulsory use of hand sanitizers by patients and attendees before entering and after leaving the phototherapy chamber.
 - Patients can carry individual protective goggles and genital shields that have to be sanitized before and after usage and should be stored in individual bags by the patients themselves.
 - All clothing that are removed must be stored within individual bags that are preferably disposable.
 - Healthcare workers/staff must use a facial mask, goggles, face guards, visors, hand gloves, and an apron whenever there is a patient in the phototherapy room. The protective equipment must be changed between patient visits.
 - Staff should sanitize their hands before and after every patient appointment.
 - Avoid delays in phototherapy.
 - In centers offering 'bathtub PUVA therapy' and topical PUVA, these modalities may

be substituted with oral PUVA or NBUVB depending upon disease and patient characteristics.

- In centers using targeted phototherapy, treatment of facial lesions can be avoided.
 - Records, prescriptions, and payment should be made in digital format to minimize contact with paper and fomites.
3. Resident and staff training:
- Videoconferencing facilities may be used for ongoing training of trainees.
 - Only one trainee at a time must be allowed in the phototherapy room after ensuring that personal protection is used in a correct manner. Social distancing should be maintained at all times.
4. Maintenance, care, and sanitization of phototherapy units:
- Avoid turning on the fan of the phototherapy unit.
 - Avoid air-conditioning in the office and waiting area, but maintain good cross ventilation.
 - Replace cushioned furniture with stainless steel furniture to enable easy cleaning.
 - The ideal room temperature should be 25-30 °C.
 - All surfaces that may be touched by patients should be periodically wiped down using a 70% alcohol-based sanitizer, particularly after every patient appointment.
 - Disinfect “high-touch surfaces” of changing areas and phototherapy units before and after every patient visit.
 - The entire phototherapy chamber floor and surfaces should be decontaminated using a freshly prepared sodium hypochlorite solution with 0.5-1% strength at least thrice daily (note that a bleaching effect on the chamber has been noticed with sodium hypochlorite in some instances). For surfaces of electronic items and equipment, a 70% alcohol wipe must be used.

Cleaning and maintenance of phototherapy units

So far, standard guidelines are not yet available. Based on theoretical evidence, we have formulated a few steps to be followed prior to and after each session. The virucidal activity of UV light

may pose an advantage during this pandemic to minimize the related risks. Since the SARS-CoV-2 can persist on inanimate surfaces for up to nine days, the disinfection of high-contact areas should be carried out before and after each patient session. It is observed that 62-71% ethanol, 0.5% hydrogen peroxide, or 0.1% sodium hypochlorite can destroy the virus in one minute¹⁴. Alcohol-based disinfectants can be used without damaging any components of the unit. The commonly used Sterilium® handrubs, based on (i) 45% iso-propanol, (ii) 30% n-propanol and 0.2% mectronium etilsulphate, (iii) 80% ethanol, (iv) 85% ethanol, or (v) 95% ethanol (Sterillium Virugard®) can be utilized as studies show as low as 30 seconds for their viricidal activity¹⁵. Though quaternary ammonium products like benzalkonium are easily available and used widely for disinfecting surfaces, the efficacy remains questionable and it needs a longer contact time, making its use unfavorable for high-contact areas like handles. It may, however, be useful for the foot-stand at the end of the day¹⁶. The following disinfectants are not recommended: peracetic acid (which is corrosive), glutaraldehyde (expensive and associated with skin and eye irritation), and ortho-phthaldehyde (induces protein-graying, including on skin)¹⁷.

Bathtub cleaning

After each use, the bathtub should be washed with copious amounts of clean running water to remove organic debris. Following this, the tub must be scrubbed with detergent (sodium dodecylbenzenesulfonate) or super lime, before being again cleaned with a 1% sodium hypochlorite solution.

CONCLUSION

Phototherapy is an essential modality for the treatment of certain conditions like uncontrolled psoriasis, vitiligo, and atopic dermatitis when topical treatment proves ineffective and systemic medications are contraindicated due to their potential for immunosuppression, particularly in the COVID-19 era. Phototherapy may be administered with the due precautions of social distancing, hygiene, and personal protection for both patients and HCWs in both the clinic and

unit by following local and national guidelines that are in place at a particular point in time. If office-based phototherapy is not possible, various home phototherapy measures may be explored.

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