ROENTGEN DERMATITIS AND RADIUM DERMATITIS: A COMPARISON

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It is not the purpose in this short article to discuss the detailed symptomatology of dermatitis caused by radium or that provoked by roentgen rays—the symptomatology of both is well known to practical workers in the field.

Some authors aver that in many respects there is a pronounced difference between injuries caused by radium and those caused by roentgen rays. It has been stated that radium dermatitis is less severe than roentgen dermatitis, that it heals more quickly and that it is not followed by sequelae, or that sequelae are less likely to occur. Also the fact that keratoses, subsequent to roentgen dermatitis, will yield to radium therapy much more readily than to roentgen therapy has been used as evidence in favor of a totally different action on the part of the two agents.

That there is some difference in the reaction and some difference in the action of the two agents cannot be denied, but such broad statements as those made in the foregoing are inaccurate and misleading. They give a false sense of security to the clinician who is entering the field of radium therapy.

A clinical and histopathologic study of radium dermatitis and roentgen dermatitis, together with a knowledge of the literature, necessitates the opinion that there is no essential difference between the reactions caused by the two agents.

There is, however, a difference in some details. Unfiltered radium ("soft" beta rays) will cause a reaction that is limited principally to the epidermis and papillary body. The erythema and edema may be intense and the epidermis totally destroyed. A reaction of this type, when viewed by one whose experience has been limited to roentgen dermatitis, causes profound perturbation. This is a second degree reaction, and if provoked by roentgen rays, several months would be required for complete healing, after which sequelae, such as atrophy, scarring, telangiectasia, keratoses, etc., would be likely to develop. A second degree reaction occasioned by "soft" beta rays heals quickly (in two or three weeks) and is much less likely to have sequelae. The rapidity of repair and completeness of repair is simply a question of the degree and depth of the injury. The injury to the epidermis is of no importance. If the derma has not been injured beyond repair, recovery will be rapid, complete and permanent.

This is the type of reaction provoked by the very "soft" beta rays. These rays, being extremely active ionizers, are rapid in action but they are mostly absorbed by the first few millimeters of tissue. The more penetrating beta rays reach and are absorbed by the deeper tissues, but the dose received by the deeper layers of the derma from the customary exposure with unfiltered applicators, is usually not sufficient to injure the true skin permanently.

The superficial character of reactions occasioned by very "soft" beta rays has been demonstrated not only by histopathologic investigation, but also by the fact that sequelae are uncommon and because not infrequently hair will continue to grow after second degree reactions.

It should be clearly appreciated, however, that if the penetration and the quantity of beta radiation is sufficient to injure the true skin seriously, as happens with lightly screened applicators, and at times with unscreened applicators, then the picture will be in all respects the same as that of roentgen dermatitis.

Experimentally it is possible to obtain superficial reactions with roentgen rays—2-inch spark gap with the glass wall of the tube in contact or very close to the skin—but we have never been able to duplicate with roentgen rays the extremely superficial effect obtained with very "soft" beta rays of radium.

Many clinicians, when desiring to utilize gamma rays, cover the applicator with lead, and then place the lead-covered applicator against the skin or mucosa. As is well known, the heavy elements, when acted on by roentgen rays, gamma rays and beta rays, emit a secondary radiation having definite characteristics. The secondary radiation from lead is very "soft" (slight penetration) and will effect the same type of reaction produced by very "soft" beta rays. It is this reaction that created the idea in the minds of some clinicians that there was a profound difference between the reactions effected by roentgen rays and those provoked by gamma rays of radium. All who have had experience know that "burns" from secondary radiation can be prevented by covering the lead with aluminum, glass, leather or any substance that gives rise to few or no secondary rays.

With the exceptions noted, it is our opinion that there is no material difference between the reactions occasioned by the two agents. Penetrating beta rays and gamma rays effect reactions that are histologically and clinically indistinguishable from roentgen-ray reactions. Unfiltered roentgen rays and lightly screened radium will destroy the skin, subcutaneous tissue and even the underlying muscles. Heavily filtered roentgen rays and radium, in sufficient quantity, will destroy or seriously injure tissue to a much greater depth than will lightly-

filtered radiation. This deep effect is also enhanced by distance from the source. Heavily filtered radiation applied from a distance may even cause necrosis of the subcutaneous tissues and muscles before the skin breaks down.

It will be seen from the foregoing that the detailed symptomatology depends on the conditions under which the exposure is made, but that fundamentally the reaction is the same whether produced by roentgen rays or radium. We have seen all the symptoms and all the sequelae that constitute acute, subacute and chronic roentgen dermatitis (including the so-called roentgen-ray skin) duplicated by radium.

The fact that keratoses, due to previous roentgenization, can be cured with radium more readily than with roentgen rays is not at all mysterious or confusing. Keratoses, regardless of etiology (roentgen rays, radium, sunlight, senility, etc.) are fundamentally the same. Keratoses that appear subsequent to excessive roentgenization develop years after the treatment, and they respond to the same treatment as do keratoses from other causes. The so-called roentgen-ray keratoses may be cured with properly applied roentgen-ray treatment or with adequate applications of gamma rays. We have noted no difference in efficacy in this respect between roentgen rays and gamma rays. Beta rays are the most efficacious of any type of radiation for this purpose, when properly applied. It is possible to obtain an intense beta ray effect to a depth of at least 1 cm., and this is all that is required in the treatment of keratoses. There is reason to believe that beta rays would be more efficacious than roentgen rays or gamma rays in epithelioma, if it were possible to obtain an intense effect to a depth of several centimeters without undue injury to the more superficial tissue. It is also possible that it is the secondary beta radiation evolved in tissue acted on by roentgen rays and gamma rays that produces the therapeutic result. If so, then the penetrating roentgen rays and gamma rays simply provide a source of beta radiation at various depths below the surface.

CONCLUSION

In conclusion, we repeat that there is no essential difference between the reaction provoked by radium and the reaction effected by roentgen rays. What little difference there is, is occasioned by the fact that very "soft" beta radiation produces a more superficial "burn" than do gamma rays or roentgen rays of long wave length, and that the shortest gamma rays effect much deeper destruction with correspondingly less superficial destruction than do the shortest roentgen rays, under the usual working conditions. It is becoming the practice in Germany to use a 12-inch to 14-inch spark gap and a skin-target distance of several

feet when employing roentgen rays in deep therapy. It is possible that radiation of this kind may destroy tissue to as great a depth as very short gamma rays, as the latter are used in practice at the present writing.

What we especially desire to emphasize is that no matter how radium is employed, if the quantity is sufficient, the results may be the same as those of the roentgen rays. We have seen atrophy and telangiectasia follow a single erythema dose administered with an unscreened, flat radium applicator of the varnished type.