AN ELECTROROENTGENOGRAPHIC METHOD OF INVESTIGATION IN DIAGNOSING DISEASES OF THE CARDIOVASCULAR SYSTEM AND RESPIRATORY ORGANS

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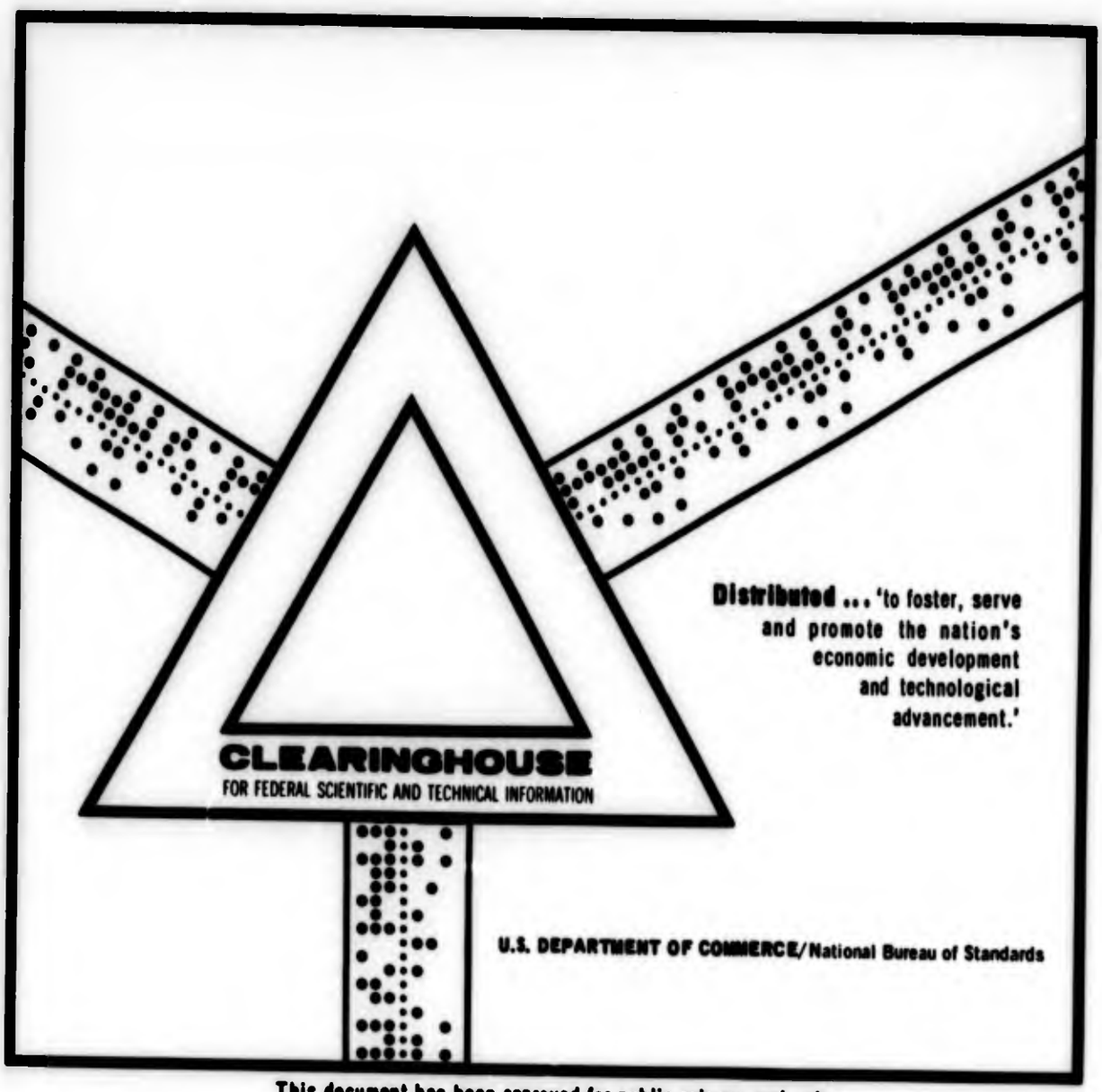

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FOREIGN TECHNOLOGY DIVISION

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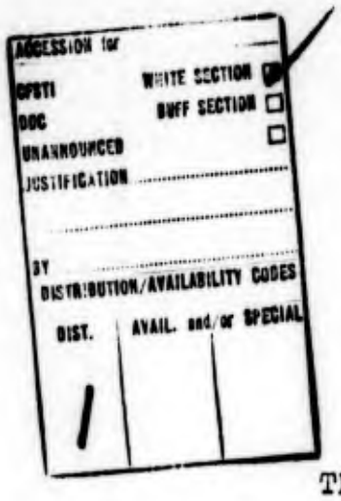

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U. S. BOARD ON GEOGRAPHIC NAMES TRANSLITERATION SYSTEM

Block	Italic	Transliteration
А а	*А а*	A, a
Б б	*Б б*	B, b
В в	*В в*	V, v
Г г	*Г г*	G, g
Д д	*Д д*	D, d
Е е	*Е е*	Ye, ye; E, e*
Ж ж	*Ж ж*	Zh, zh
З з	*З з*	Z, z
И и	*И и*	I, i
Й й	*Й й*	Y, y
К к	*К к*	K, k
Л л	*Л л*	L, l
М м	*М м*	M, m
Н н	*Н н*	N, n
О о	*О о*	O, o
П п	*П п*	P, p
Р р	*Р р*	R, r
С с	*С с*	S, s
Т т	*Т т*	T, t
У у	*У у*	U, u
Ф ф	*Ф ф*	F, f
Х х	*Х х*	Kh, kh
Ц ц	*Ц ц*	Ts, ts
Ч ч	*Ч ч*	Ch, ch
Ш ш	*Ш ш*	Sh, sh
Щ щ	*Щ щ*	Shch, shch
Ъ ъ	*Ъ ъ*	"
Ы ы	*Ы ы*	Y, y
Ь ь	*Ь ь*	'
Э э	*Э э*	E, e
Ю ю	*Ю ю*	Yu, yu
Я я	*Я я*	Ya, ya

* ye initially, after vowels, and after ъ, ь; e elsewhere. When written as ё in Russian, transliterate as yё or ё. The use of diacritical marks is preferred, but such marks may be omitted when expediency dictates.

FOLLOWING ARE THE CORRESPONDING RUSSIAN AND ENGLISH DESIGNATIONS OF THE TRIGONOMETRIC FUNCTIONS

Russian	English
sin	sin
cos	cos
tg	tan
ctg	cot
sec	sec
cosec	csc
sh	sinh
ch	cosh
th	tanh
cth	coth
sch	sech
csch	csch
arc sin	$\sin^{-1}$
arc cos	$\cos^{-1}$
arc tg	$\tan^{-1}$
arc ctg	$\cot^{-1}$
arc sec	$\sec^{-1}$
arc cosec	$\csc^{-1}$
arc sh	$\sinh^{-1}$
arc ch	$\cosh^{-1}$
arc th	$\tanh^{-1}$
arc cth	$\coth^{-1}$
arc sch	sech^{-1}
arc csch	csch^{-1}
rot	curl
lg	log

AN ELECTROROENTGENOGRAPHIC METHOD OF INVESTIGATION IN DIAGNOSING DISEASES OF THE CARDIOVASCULAR SYSTEM AND RESPIRATORY ORGANS

N. R. Paleyev

Chair of hospital therapy (Manager – Prof. V. S. Smolenskiy) Sechchenov Moscow Medical Institute, and the Roentgenologic Division (Manager – Prof. I. Ye. Rabkin) of the Scientific Research Institute of Clinical and Experimental Surgery, (Director – Acadimician B. V. Petrovskiy) Ministry of Public Health, USSR, Moscow.

At present the first steps in the way of the clinical use electroroentgenography have been made of – a method, based on the effect of photoconductivity of semiconductors and the reproduction of a hidden electrostatic image. The first reports on the application of electroroentgenography experimentally for medical purposes (for osteopathic diagnostics) go back to 1954 (Oliphant; Roach and Hilleboe). Pogerzelska-Stronczak (1958, 1963) developed a method of electroroentgenographic investigation for the alveolar appendices and the teeth. During 1960-1965, the advantages of this method in X-ray diagnostics of diseases of the mammary gland (Gould, et al.; Ruzicka, et al.) were disclosed. In 1964-1965, Prof. A. M. Martsinkyavichus used electroroentgenography in the investigation of peripheral vessels. Very satisfying results were also obtained in its application in the diagnostics of stomach diseases (M. B. Shneyderis, et al., 1966, 1967), of the larynx (V. V. Gurauskas, et al.). During 1964-1968 we conducted

an extensive experimental and clinical approbation of the electroroentgenographic method, including its application osteopathic field in the cardiovascular system, in respiratory organs in mammary glands in kidneys.

Interest in electroroentgenography can be explained by its advantages over conventional roentgenography (speed of the examination use of noncombustible material, indifferential to ionizing radiation, the releasing of scarce X-ray film for other purposes, and others). Since each selenium plate sustains no less than 1000 exposures, 1 m^2 of electroroentgenographic plates replaces more than 1000 m^2 of X-ray film - therefore 13-17 kg of silver and 19-33 kg of photographic gelatins are saved.

One of unique features of the electroroentgenographic method is the reading of photograph: the X-ray photographs are examined in transmitted light electroroentgenographs - in reflected light. This feature was not discussed in the literature, but meanwhile it deserves special consideration.

If one were to consider that sight conforms to the basic psychophysiologic law of perceptions - the intensity of a sensation is proportional to the logarithm of irritation - then it is impossible not to agree that the visual sensation increases much more slowly than that which causes its brightness. The ability to comprehend the brightness over a wide range is governed by the adaptational capabilities of the eye. However, the process of adaptation requires time, and within the field of sight of more or less bright spots (however they originated) perception of fine detail by the eye is sharply reduced. S. V. Kravkov convincingly showed in experiments that the differentiation of fields, compared according to brightness, in a large degree, depends on their background. If brightness of the background notable differs from the brightness of the fields, the possibility of visual differentation of hardly perceptible distinctions decreases.

It is understandable that in reading photographs in transmitted light it is difficult to avoid the effect of all these unfavorable factors. In examining the X-ray photograph on a negative viewer sections of the glass not covered by the X-ray photograph will blind the eye, which lowers the perception of fine details. Even with the blacking out of the open sections of the glass of the viewer with shutters, the presence of light spots on the X-ray photograph reduces the adaptability of the eye, and lowers the perception of the X-ray image. If, under the most favorable conditions of observation visual acuity attains 0.08 mm (S. V. Kravkov), then, on the negative viewer one can differentiate detail up to 0.15 mm inclusively, and on the screen of an electro-optical converter with a brightness of 1 apostilb – not less than 0.3 mm (V. V. Dmokhovskiy).

Thus, the reading of X-ray photographs in transmitted light permits at best to distinguish detail of no less than "double visual acuity." This is essentially, since "the problem of the quality of an X-ray image is in essence a problem of the quality of the transmission of fine detail" (V. V. Dmokhovskoy). In this respect the electroroentgenographic method has definite advantages. However, for an objective comparative appraisal of both methods of reading photographs special investigations are necessary.

The method of electroroentgenography we used was described by I. Naynis, et al., and by us (1966, 1967). Investigations were conducted with the help of a ERGA-M, SERP-30 and SERP-M3 selenium plates. Dosimetry showed that in using SERP-M3 selenium plates skin doses are identical to those of conventional roentgenography. These data were obtained during the investigation with the use of a screen during conventional roentgenography and without the screen – during electroroentgenography which does not lower the quality of the electroroentgenograph.

Among the patients we investigated 164 were for different diseases of the lung (including 68 – cancer of the lung), 314 – acquired diseases and 52 – congenital vitium cordis.

The technical features of electroroentgenography lend certain advantages of the method in its use in the diagnostics of cancer of the lung. Among these advantages – the fringe effect, by virtue of the sharpness of the outline of the tumor on the electroroentgenograph, as a rule, considerably exceeds the sharpness of a conventional roentgenographic image. The low overall contrast in combination with the fringe effect over a wide range of conditions, makes it possible to produce qualitative photographs; these define the advantage of electroroentgenography reproducing in the structure of a tumor, image of an opening of the trachea and bronchi, and facilitate the differentiation of a tumorous node and accompanying complications (pneumonia, atelectasis). An increase in the rigidity of the rays during electroroentgenography merely does not lower, but, conversely, increases the photosensitivity of the selenium plates. In this case, owing to the absorption of soft rays by the upper part of the selenium layer there is a need to use screens. Thus, there can be merits in electroroentgenographs and also in those which are superexposed X-ray photographs. This determines the diagnostic value of electroroentgenography during identification, in particular, cancer of the segmentary bronchi which is especially important in connection with the comparatively high nobability of surgery.

Domestic and foreign experience show that the effectiveness of mass fluorographic investigations of the population for lung cancer is inadequate, since a small number of cases of disclosure of the disease during these investigations does not reflect true incidence of the disease. Thus, L. M. Gol'dstein and A. V. Petrov after 5 years of investigating 2,684,634 persons in Leningrad found lung cancer in only 56 of them. In connection with the great speed of producing a readily available photograph during electroroentgenography (less than 2 min after exposure) and with an allocation to the physician that is incomparably larger than that for fluorography, and for diagnostic information, the electroroentgenographic method can occupy a definite place in mass overall inspections of the population.

In the diagnostics of lung diseases we used electroroentgenography in producing direct and lateral photographs, tomographs and pneumomediastographs, X-ray penumopolygraphs.

On electroroentgen pneumatic polygram of patient "M" 50 years old, suffering from planocellular cancer of left third segmental bronchus with prominant endobronchial growth (Fig. 1), the criteria of expiratory emphysema are quite evident: a decrease in the intensity of pulmonary outline, the bronchus is larger than on the right, the distance between the ribs, some reduction of the respiratory excursion of the diaphragm and ribs on the left.

The features of the electroroentgenographic method of investigation noted above also give a favorable account in the X-ray diagnostics of inflammatory diseases of the lungs, cavity formations. In Fig. 2 an electroroentgenograph (a) and an X-ray photograph (b) of a pectoral cell of patient "S" 7 years old, suffering from chronic interstitial pneumonia is presented. On electroroentgenograph one may see considerably more detail of the pulmonary outline in sections of the lowered transparency: it is defined by its cellular structure well outlined in bands.

In the direct (Fig. 3a) and lateral (Fig. 3b) electroroentgraphs of patient "I" suffering from polycystosis of the right lung; the cysts with levels of liquid in them, are clearly visible.

The possibility of reproducing a great amount of detail on electroroentgenographs is an important advantage of the method in using it in the diagnostics of certain forms of heart pathology. As it is known, in the diagnostics of heart defects the appraisal of the state of the lesser pulmonary circulation plays an important role. Electroroentgenography makes it possible especially to study throughly the vascular structure of the pulmonary outline, to establish the type of heart stasis in lungs, to reveal the symptoms of the disturbance of lymph circulation (horizontal lines of Kerla, small quantities of liquid in bone-diaphragmal sinuses). By virtue of what is on

electroroentgenographs, as a rule, one can define the additional arc of the atrium sinistrum (Fig. 4), can open the possibility of indirect exposure of hyperemia of the individual chambers of heart. Detection of pleuropericardial adhersions has important value, but electroroentgenographic investigation is just as important in helping to disclose them.

The effectiveness of the electroroentgenographic method in the diagnostics of inherent heart defects and anomalies of the large vessels have determined the advantages of its use in the studies of the state of the lesser pulmonary circulation. Owing to the successes of heart surgery, the diagnostics of congenital vitium cordis became a real problem not only for the surgeons, but for the therapeutists as well. The problem arose before the practical physician of prognosis and timely direction of the patient regarding an operation, if the ailment involves a defect subject to surgical therapy. At the present time the array of anamnesical, physiological, X-ray and electrocardiographic investigations frequently make it possible to correctly estimate the nature of the anomaly. Only a small part of congenital defects requires the application of complex methods of investigation for identification: angiocardiography, sounding.

Among the persons we investigated were patients with a septal defect, with open ductus arteriosus, aortic coarctation, isolated pulmonary stenosis, tetralogy and triology of the Fallot, and Ebstein's anomaly. The electroroentgenographic method, which makes it possible to obtain not only a detailed pulmonary figure on one photograph, but also a fine image of bone structure, turned out to be very effective in the diagnostics aortic coarctation (Fig. 5).

Electroroentgenography was used in the dynamic observation of patients, undergoing operations with the application of the prosthesis of the valves: mitral – during mitral vitium cordis, tricuspidal – during Ebstein's anomaly and acquired vitium cordis. The feasibility of obtaining a distinct image of the prosthesis of valve, as well as an outline of the lesser pulmonary circulation on one photograph turned out to be the important merit of the method.

Conclusion

1. The first experiment in applying the electroroentgenographic method of investigation to diseases of the respiratory organs and cardiovascular system have indicated its diagnostic value.

2. The method possesses important technical merits and is very economical.

3. It is expedient to use this method extensively in hospital and polyclinical practice.

4. Electroroentgenography can be used as a method of roentgenographic control during surgical operations.

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ABSTRACT

(U) The first experiment in applying the electroroentgenographic method of investigation to diseases of the respiratory organs and cardiovascular system have indicated its diagnost · value. The method possesses important technical merits and i . very economical. It is expedient to use this method extensively in hospital and polyclinical practice. Electroroentgenography can be used as a method of roentgenographic control during surgical operations.