

尘肺综合诊断指标的研究

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尘肺诊断主要根据职业史及质量合格的X线胸片,目前存在的主要技术问题是读片差异大,胸片技术质量差,二者间也相互影响。解决的途径除提供标准片以统一诊断基准外,还需在X线技术主要是提高胸片信息量上开展研究。本研究的成果是将来进行“尘肺X线检查的质量保证”项目中不可缺少的技术措施。

自1986年开始,全体专题组人员,并团结了众多专题组以外的、但对此项工作有兴趣、有积极性并有能力的职防工作人员,积极努力、通力合作,按时全面完成了攻关专题研究计划,攻下高电压摄片技术关,积累了丰富资料,得到一套完整的尘肺高电压胸片诊断标准参考片,其质量不仅在形态、技术上全面超过《1986国家标准片》,与ILO标准片相比,也在总体上超过。

一、关于高电压摄片技术

1. 高电压技术简介:

多年来,放射科摄胸片常规作法是用50~70伏管电压,10~20毫安秒的电流量摄片。不仅检查尘肺时如此,医院日常工作也如此。根据老的放射科实践经验,电压超过70千伏,所摄胸片灰黑一片,因电压高了,穿透力强,散射线多,故而许多病理影像在灰黑背景衬托下消失不见,技术术语称为曝光过度,是产生废片的主要原因之一。

高电压技术就是要利用电压高所产生的X线穿透力强的性质,获得更多的影像信息,又要使背景黑化适度,保存信息。

2. 问题的提出:

50年代,美国宾州大学医学院放射科在从事临床病理与X线影像对照的研究时发现,许多例尸检所见明显肺部疾患,主要是肺癌,在死前不久的X线胸片上未曾显现而漏诊。其原因主要是X线质量不好,穿透力不强或穿透无差异不能成像所造成。从此萌发提高X线电压探求新技术的概念,以求解决胸片信息量低的难题。

最初的试验用的是治疗用X线机,电压高达2000千伏。

经过20多年的研究,理论上的进展多,实践的进

展则远不能满意。当然,在实践上也能证明高电压摄片可以提高影像信息丰度,就是不能拿出成熟的技术参数。文献报告的电压在110~350千伏大范围内浮动。更重要的是优片率极不稳定,据我国中华医学会放射学会专家估计,很少有那个单位能将一级片率稳定在20%以上,国外情况也不例外。

高电压摄片技术之所以成为“技术关”要攻,主要是实践问题,有如化学反应式人人皆知,但只有找到特殊参数才能进入工业生产,如侯德榜氯碱法。

3. 高电压胸片的优点:

从物理性能看,电压超过100千伏所产生的X射线为硬射线或高能射线。高能射线在穿透物体时被物体吸收的规律从光电吸收改为康普顿-吴有训吸收,摄片成像的规律也从性质差异对比成像改成密度差异对比成像。电压低时光电吸收,骨骼与软组织含钙不同,对比强烈,可以成像。但同是软组织之间,对比很小,不能成像。因此骨骼下的病理改变完全被骨影遮盖,胸大肌和女性乳房下的其它组织完全与之相重合,不能分辨。这就是普通电压时胸片信息量低的原因。

高电压时,康-吴吸收可使密度差异对比成像,不仅肺组织中与含气丰富的肺泡有差异的实性肿块可以显现成像,而且同在肺组织中的细微但致密的结构也可显现呈像。另一方面,物质性质差异的对比减少,即骨骼影、心脏、发达的肌肉与乳房等的影像不再突出,其遮盖作用大大减轻,与其重叠的病理影像也就显现出来。以上这些优点对尘肺诊断的要求来说是再合适不过了。此外,还有机件耗损小,患者接受辐射量低等优点。

所有这些优点还有待以数量概念加以表达。

4. 高电压技术在尘肺领域的应用:

60年代,德国学者Bohlig应用高电压技术拍摄石棉肺患者胸片,并在这些胸片的基础上总结出第一批不规则阴影影像特征的论文。他所用的技术参数不详,但从UICC标准片看,有一点是可以认定的:即胸片信息量确实有提高,但质量不稳定。

70年代,ILO接受Bohlig的建议,把推荐高电压摄片技术写进“ILO分类”的正式文件中。但仍旧没

有提供成熟的参数。

我国有少数放射科学者作过机上试验,由于设备条件的限制,未能深入研究。至于能否在尘肺领域应用,则一直是少数学者向往的研究项目。

二、高电压摄片技术进展实况

1. 工作方法:

专题组始终坚持理论联系实际与群策群力的作风,依靠机上试验-分析-再试验等反复实践的科学技术方法,分析了千余张胸片的缺陷表现形式,探讨产生缺陷的原因,终于找到了合适的技术参数,攻克了高技术难关,取得了稳定的高质量结果。

2. 技术参数特征与基本经验:

提高X线穿透特性,不是电压越高越好,电压过高,不仅穿透力过度强劲造成部分信息丢失,还会因射线能量过强,发生过多次散射线,干扰影像对比。

经试验选用的电压值,在国内众多的射线机型中使用有通用性。

我们还认为选定适当的技术参数还不够,还有许多辅助但是必需的条件,可归纳成“改善高压滤线条件,重视设备配套,提高基础医疗质量”。

3. 达到的水平:

(1) 技术通用性:现已在6种进口机型、3种国产机型上拍摄到优级高电压片,稳定性强。目前的主要问题是国产机摄片仍在试验阶段。有应用前景,但未解决通用性问题。

(2) 一级片率逐年提高。放射学会拟以一级片30%作为放射科上等级的验收标准,所有参加攻关研究的单位,均能达到此指标,作为专题负责单位的中国预防医学科学院劳卫所,一级片率现已能稳定在60%以上。

(3) 单片示范性强,一张获1989年放射学会一等奖的高电压片,可以显示所有高电压胸片的优点。

(4) 总结出整套的控制指标,肺区光密度值即黑化度,作为评定片质高低的指标有通用性。

(5) 指导性强,除有整套的培训教材外,还有较强的现场施教能力,常有立竿见影的结果。

(6) 国外反映强烈,在三次国际交流中,均引起国际同道的强烈兴趣,此外,哈佛Greene教授来函祝贺,美国放射学会主要负责人Wiot教授曾当面称道。

三、高电压标准参考片

在五年试验中共拍摄胸片数万张,其中尘肺病例

超过2000例,从中反复挑选,最终得到一套37张的标准参考片,是具备有尘肺影像各种形态,各种基准特性的完整系列片。

其基准的确实性,已在全国尘肺诊断组扩大的工作会议上得到认可,一致同意作为基础基准申报,并开始修订《尘肺X线诊断标准》。

37张参考片数据如下表。

四、高电压技术应用的前景

高电压技术应用首先要攻克国产机摄片的难关。

国产机应用问题有一个实验实例可以说明其可行性。

1990年4月,在浙江苍南县平阳矾矿放射科,使用一台北京产125千伏,500毫安X射线机,7天摄片271张,获一级片60.5%的好成绩。原机试验前废片率几乎近于100%。试验中废片率低于1%,实验结束时由原放射科人员独立操作摄片7张,获一级片4张。

但国产机摄高电压胸片,技术问题复杂,上述试验仅说明应用前景良好。下阶段应研究其通用性问题。

五、展 望

1. 尘肺诊断工作的主要问题:

尘肺诊断工作的主要问题是“质量保证”问题。

预计本课题的成果将在“质量保证”诸对策中居中心地位,发挥骨干技术的作用。

2. 尘肺诊断工作质量问题的现状:

(1) 基层胸片废片率高,废片率高到什么程度,现无估计,但实惊人。

(2) 有诊断权的人基本未经技术考核。

(3) 诊断组的结构、成员、活动方式,均无规范。

(4) 各级诊断组之间“责、权、利”界限不明,抢地盘、争收入、检查与诊断脱节等现象普遍存在。上述情况的原因很复杂。

3. 解决“质量保证”问题的途径:

(1) 适当改善装备,根据需要与现实实际相结合的原则设计一个最低要求清单。

(2) 理顺各级诊断组的关系,规定责、权、利的范围,诊断组掌握高电压摄片技术,成员更新程序及考核要有安排。

(3) 高电压摄片技术向深度与广度上发展,以解决废片率高的现实矛盾。

高电压参考片一览表

片号	形态	密集度范围	技术质量	缺陷	诊断	附注	片号	形态	密集度范围	技术质量	缺陷	诊断	附注	片号	形态	密集度范围	技术质量	缺陷	诊断	附注
14330			1		0	卫研供片	9859	r	2 3 3 3 3 3	1		I ⁺	卫研	1129	q	1 1 1 1	2	略黑、位不正	I ⁺ 斑	沈职
9230	p	1 1 1 1 1 1	1		0 ⁺	卫研	79	s	1 1 1 1 1 1	1		0 ⁺	卫研	14177	q	2 2 2 2 1 1	1		I ⁺ <2×1	镇江
3675	p	1 1 1 1 1 1	1		I	卫研	3346	s	1 1 1 1 1 1	1		I	卫研	204	r	2 2 2 2 1 1	2	略黑	II	镇江
9316	p	1 1 1 1 1 1	1		I ⁺	卫研	4595	s	1 1 1 1 1 1	1		I ⁺	沈职	189	q	3 2 1 1 1 1	1		III ⁺	卫研
46923	p	1 1 2 1 2 2	2	略白, 右偏	II	沈职	5909	s	1 1 2 2 2 2	2	划痕、肩胛	II	煤炭	7537	s	2 3 2 3 3 3	1		II心缘	上海
38	p	3 3 3 3 3 3	2	划痕	II ⁺	北京	9016	s	2 2 3 3 3 3	2	位不正、左胛	II ⁺	沈职	9			1		心缘僵直	卫研
63	q	1 1 1 1 1 1	1		I	镇江	38706	t	1 1 1 1 1 1	2	虚、位不正、肩胛	II	北京	38384			1		双侧胸膜斑	北京
1189	q	1 1 1 1 1 1	1		I ⁺	四川	42779	t	1 1 1 1 1 1	2	略白	I ⁺	沈职	7370			1		双侧胸膜斑	上海
—	q	2 2 2 2 2 2	1		II	辽宁	17045	t	2 2 2 2 2 2	2	虚	II	贵州	12			1		膈面胸膜斑	镇江
38838	q	3 2 3 3 3 3	1		II ⁺	北京	32392	t	2 1 3 3 3 3	2	略黑、左虚	II ⁺	贵州	383			1		双侧胸膜斑	四川
1	r	1 1 1 1 1 1	1		I	辽宁	52	u	2 1 2 2 2 2	1			卫研	10			1		膈面胸膜斑钙化	辽宁
102	r	1 1 2 1 1 1	2	虚、略呈阴阳、缺下角、污	I ⁺	四川	141	u	3 3 3 3 3 3	1			卫研							
3145	r	2 2 2 2 1 1	2	缺下角	II	镇江	4610	q	2 1 2 2 2 1	2	略白并灰小聚	II ⁺	鞍钢							

Application of High Kilo-Voltage Technique in Roentgenodiagnosis of Pneumoconioses

Ding Maobo

According the Chinese "Roentgenodiagnostic Criteria of Pneumoconioses 1986", high quality of chest film is the prerequisite to detect pneumoconiosis from dust-exposed workers. However, variation of interpretation of the films between different observers and by the same observer but in different sessions remained high when the conventional radiographs were classified, even the Standard Films of 1986 Criteria were being compared throughout the procedure. In respective study, many factors causing this variation could be considered. The inherent disadvantage of low kV is, perhaps, the most important one. The information conveyed by a film exposed to X-ray with 50-70kV, is reduced due to high contrast of image, superimposed shadows of ribs, heart, pectoral muscles, breasts and hyperadiposis in both sexes. The scope of this study,

(a) To apply high voltage technique to solve the problem of information mentioned above,

(b) To collect a series of reference films using high kilo-voltage technique for the revision of the Standard Films in near future.

During the fifties, Dr. Tuddenham, Director of Radiology, University of Pennsylvania, School of Medicine, and many other experts, found poor perceptibility of the conventional chest films when they compared post-mortum findings with radiographs exposed shortly before death. Large masses found at autopsy but could not be revealed on radiographs.

Since then, efforts had been made by many experts for answering questions such as, how could such large lesions be concealed and what might be done to obviate the

problem. They concluded that lesions might be obscured on conventional radiographs on account of following factors.

(a) Poor matching of overall shadows with the film characteristic curve,

(b) Small peripheral pulmonary lesions might be completely shaded by radio-opacity of overlying ribs, etc,

(c) Superimposed shadows might reduce the perception of any small opacities,

(d) The influence of the background contrast.

Theoretically, All these factors would be very much minimized with the application of high energy radiation which works in accordance with the principle of Compton-Wu Attenuation. Further investigation displayed that high kV chest films could definitely reduce the film contrast, increase penetration, lead to better matching with the film characteristic curve and less obscurity, hence, the quality of information would be greatly improved.

Earlier investigation and trial were not very satisfactory. In order to obtain a reliable guide to guarantee a consistently high output of excellent films and an acceptable fraction of poor films, people had done great effort for over 30 years yet the problem remained to be solved. WHO had called the application of high kV technique since the publication of its well known revised Guideline of Classification 1980 in which no instruction of radiation procedure available and only six films of high kV classified as quality grade 1 included in its more well known Standard Film of 22 pieces. In China, at the beginning of eighties, pneumoconiosis surveys as well as radiological clinics of general hospitals used low kV technique routinely, no much attention paid to

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The somatosensory (SEP), visual (VEP) and brain stem auditory (BAEP) evoked potentials were conducted in 109 healthy adults and the normal limits of the three modalities of evoked potential were obtained by a regression equation with 2.5 times standard deviation of the residual deviation. The results of multimodality of evoked potentials in 180 patients compared with the normal values showed that the changes of long latency components of SEP (N₃₂, N₆₀), the III—V interpeak latency of BAEP and the P₁₀₀ latency of VEP were significantly sensitive parameters in evaluating brain dysfunction and prediction of prognosis. The CT scanning in 100 patients confirmed the selective lesions in bilateral subcortical white matter and globus pallidus which led to brain atrophy at later stage.

The results of an epidemiological study on 223 in patients and analysed by Logistic regression revealed that the risk factors for the development of delayed encephalopathy including elderliness, mental work, previously with hypertension, coma lasting for 2-3 days, long standing dizziness and fatigue after regaining consciousness and mental stimulation during recovery.

The determination of myelin basic protein and IgG in cerebral spinal fluid indicates the possible immunological mechanism of occurrence of delayed encephalopathy.

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the advantage of high kV technique.

During the past 4~5 years, we have finalized our investigation and in our routine work, the radiographs of excellent quality is kept steadily at a rate of 60~70%. We established procedure in detail for exposure which turned out to be practical and useful during training demonstration. A series of 37 chest films showing every category of 1986 Chinese Classification of Pneumoconioses had been collected. These films could be used as the

2. Chronic carbon disulphide poisoning

To detect the neurobehavioral effects of carbon disulphide and other solvents, the WHO neurobehavioral core test batteries (WHO/NCTB) were adapted into Chinese version showing comparable validity and higher applicability. The reaction time equipment has been reproduced in China following the WHO design and supplied to the users in China with much cheaper cost. A computerized neurobehavioral evaluation system in Chinese version (NES-C) has also been developed which is as efficient and applicable as those applied in the English speaking countries.

Evidences obtained by electromyographic studies, ophthalmological examinations and detection of urinary TTCA point out the necessity of revision of the current diagnostic criteria for chronic carbon disulphide poisoning. In addition depletion of prostaglandin F₂ in brain was found in the animal studies.

3. Acrylamide poisoning

The significance of electroneuromyography in early detection of toxic neuropathy in addition to the occupational history and clinical manifestations has led to the establishment of diagnostic criteria for occupational acrylamide poisoning.

Disturbances of calcium hemostasis were explored in the investigation of mechanism of acrylamide neurotoxicity.

bases of establishing a new set of Standard Films. 20 of these films were comparable with the ILO Standard Films 1980, 16 of them had better morphology of opacities as well as technical quality. Another 2 were at the same level. Dr. Greene of MGH Harvard Medical School in Boston, being impressed with the quality of our films, wrote to us extending his heartiest congratulations for the quality of film which he considered being of highest standard one to which he did not often meet in the United States.