

ALLEGED RADIATION RISKS FROM VISUAL DISPLAY TERMINALS

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A number of careful scientific studies have been focussed on the measurement of electromagnetic radiation or fields due to VDTs based on the cathode ray tube technique (CRT), while limited attention has also been given acoustic radiation (see reviews, e g Bergqvist 1984 or Guy 1984). The discussion as to whether work at VDTs can affect human health has been centered on different types of effects such as eye damage or discomforts, neck and shoulder discomfort, adverse reproductive outcomes, skin disorders and different stress reactions. In the present paper a short review is given of some of the alleged radiation hazards from the VDTs, mainly with emphasis on pregnancy outcome.

THE CLUSTER PHENOMENON

The discussions as to whether VDT work may influence pregnancy outcomes among operators originated with the observation that some groups of pregnant women had an unusually high frequency of miscarriages or birth of malformed children. Several investigators have found, however, that the reported number of such clusters is not higher than what is to be expected; although the occurrence of such a cluster is a very unusual event, the number of pregnant VDT workers is so large that also such events should be expected to occur, with a certain (low) frequency. Thus, a plausible explanation of the occurrence of these clusters is that of random distribution of adverse pregnancy outcomes - which will result in a low frequency of clusters due to chance without any VDT-specific causal factors being involved.

THE POSSIBILITY OF TERATOGENIC FACTORS ATTRIBUTABLE TO VDT WORK

A number of alternate explanations for these clusters have been discussed; X-ray radiation, UV-radiation, microwaves, electric fields, magnetic fields, light air ion depletion, PCB emission, stress and worry and sedentary work. Two of these factors are at present appearing in the debate: stress and worry and low frequency pulsed magnetic fields.

Stress and worry: Some recent literature reviews have suggested a relationship between stress/worry and miscarriages /Björseth et al 1985, MacKay 1984/. The possibility warrants further research, but available data, although indicative, appear insufficient to establish such

a link. Furthermore, consistent relationships between 'VDT work' and 'higher stress levels' have not been found. It appears prudent, however, to rectify stressful work situations for pregnant VDT operators (as well as non-pregnant operators). The explicit worry due to the debate concerning pregnancy outcomes remains a factor whose possible influence on pregnancy outcomes have not been tested.

Effects of pulsed magnetic fields on embryos: Based on a series of studies, Delgado and coworkers have suggested that square pulsed, low frequency magnetic fields can disturb the embryonal development in chick embryos /Delgado et al 1982, Ubeda et al 1983/. Later investigations have however revealed serious technical shortcomings in these studies - invalidating at least the 'exposure data' presented. Some other groups have failed to replicate these studies on square pulsed magnetic fields, in chick embryos /Maffeo et al 1984, Hansson-Mild unpublished, Tell-cited by Guy 1984/ or mice embryos /Tribukait et al 1987/. A possible exception is a recent study /Juutilainen & Saali 1986/, where some effects on chick embryos of various forms of magnetic fields were indicated. According to the authors, the result did correlate with the amplitude of the field (i.e. the B levels), but not with the time derivate (dB/dt levels, or current induction).

It has been suggested, that the relevance of these studies to VDT-like situations hinge upon the similarity of the dB/dt-levels. It is then worth noting that the positive study of those cited above, does not indicate that dB/dt is a relevant parameter for the effect. In a review for the WHO Regional Office for Europe, the working group concluded: "Although one or two parameters of the exposure fields employed in these studies are similar to those around VDTs, there are significant differences in numerous other parameters. Any extrapolation of these study results to exposure of VDT operators can only be considered tenuous." /Marriott & Stuchly 1986/.

A few studies have also been performed, where the magnetic fields used were similar in pulse shape and frequencies to those found around VDTs ('saw-tooth pulses'):

In one study by Tribukait et al /1987/, pregnant mice were exposed to various field intensities, the strongest being 15 uT. The foetuses were examined after 18 days (15 days of exposure and 3 days following exposure). In the 15 uT group, 11 (2.9%) of the exposed foetuses showed malformations, compared with 7 (1.4%) among the controls. On the other hand, 2 (0.5%) of the exposed foetuses died after the exposure period, compared to 8 (1.4%) among the controls. Results from this study have been reported twice, both in January (approximately half of the material) and in May 1986. The differences described above were those for the full study. (It was noted, that such differences was only present in the first half of the study, data from the second half of the study showed identical results among the exposed and control groups as to these outcomes.)

Another study by Frölen et al has recently been concluded - with the purpose of

replicating the study of Tribukait et al (above) with saw-tooth pulsed magnetic fields. The study results (here expressed as numbers/100 dams were: Implantations 716 (exposed) and 688 (controls), living foetuses 625 and 644, number of malformations in living foetuses 45 and 45, dead foetuses 15 and 6, resorptions 76 and 38, and number of malformations in dead foetuses 7 and 2, respectively. Thus Frölén et al did not find any increase in the number of malformed living mice foetuses due to magnetic field exposure, and thus the earlier results have not been verified. Instead, a certain increase in the number of foetuses that have started development in the uterus, and a corresponding increase in the number of dead or resorbed foetuses were found.

In an ongoing study on clastogenic effects of pulsed magnetic fields on human amniotic fluid cells (Nordenson and Hansson Mild, 1987), some preliminary results have been released. For both 50 Hz sinusoidal and 20 kHz sawtooth fields experiments, increased frequencies of chromosome aberrations were seen. The authors point out that implications of this to human health is still unclear.

A study has been performed with chick embryos and saw-tooth pulses /Sandström et al 1987/. No significant differences in number of abnormalities were observed between controls and exposed eggs.

Stuchly et al (1987) have recently reported on a study on rats exposed both before and during pregnancy to sawtooth pulsed magnetic fields of similar characteristics. No adverse pregnancy outcomes were found.

EPIDEMIOLOGICAL STUDIES OF PREGNANCY OUTCOMES RELATED TO VDT WORK

Systematic comparisons between VDT operators and non-VDT workers as to pregnancy outcomes have been made in a number of epidemiological studies. Hitherto, about 10 such studies have been conducted. None of these studies have provided evidence for an effect of VDT work on the frequency of miscarriages or serious malformations. In some studies, the frequencies were somewhat increased - which were explainable by confounders and/or random variations. In other studies, the frequencies were somewhat decreased - likewise explainable. These studies were of varied size and quality. Five of them can be considered (according to the authors) as fulfilling some necessary quality criteria. These studies are briefly presented in table 1.

The existence of five large and apparently well conducted studies enables an evaluation not only based on the presence or absence of statistical significance or computed confidence intervals in each study, but that can also consider possible consistent ('nonsignificant') findings across these studies. Concerning miscarriages, there are then results which can be

Table 1. Outcome of five epidemiological studies that compared miscarriage and malformation occurrences for women with and without VDT work during pregnancy.

<u>Study</u>	<u>Number of pregnancies</u>	<u>Did the study find evidence of link between VDT work and:</u>	
		<u>Miscarriage</u>	<u>Malformations</u>
Swedish case-control study /Källén & Ericson 1986/	1 447	No	No?
Swedish Nat'l Insurance study /Westerholm & Ericsson 1987)	4 347	No	No
Finnish case-control study /Kurppa et al 1985/	2 950	Not inv.	No
Montreal study /McDonald et al 1986/			
- previous pregnancies	3 863	No	No
- current pregnancies	3 799	No?	No
Michigan study /Butler & Brix 1986/	817	No	Not inv.

Comments for table 1: No = no significant differences occurred. No? = some differences were noted, but the final evaluation by the authors was that these differences did not appear to constitute evidence for an increased risk due to VDT work. Some further details and the authors own conclusions regarding their studies are presented in the text.

evaluated in different ways in the Montreal study (current pregnancies only) and possibly also in the Michigan study (as discussed above). In contrast, the Montreal study (previous pregnancies), the Swedish Nat'l Insurance study and by and large the Swedish case-control study lack such results. Concerning malformations, results open to interpretations exist in the Swedish case-control study, but are not found in the Montreal study, by and large not in the Swedish Nat'l Insurance study and not in the Finnish case-control study. A consistent pattern of increased risks is thus not present.

REFERENCES

See Bergqvist UOV and Knave BG: VDT work - an occupational health hazard? The IRPA 7 International Non-Ionizing Radiation Workshop 5-8 April 1988, Melbourne, Victoria. Ed. by MH Repacholi.