

Video-Phone in Pathology. Interactive DNA and immunohistochemical measurements between european countries.

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SUMMARY

Presence of video-phones providing real time, real color will shortly be introduced as a part of the everyday work routine in hospitals. They can connect almost anywhere in the world and give the opportunity to do measurements in distant receptors.

In this paper we aim to present a short experience in distant DNA and immunohistochemical quantification by image analysis through a RGB/8 bits/color/pixel video-phone of 512x512 pixel images.

Twenty five histological cases for DNA and nuclear hormone receptors were received and quantified during a fifteen day period from distant broadcasters in Zurich (Switzerland) and Taunusstein (Germany) .

This experience, the first in the world, showed that no major differences were found between the original and the transmitted images. Initial differences were due to a change in brightness and contrast induced when recording the images. Comparable quantifications, of the images received through the videophone were achieved by gain and offset corrections.

INTRODUCTION

High resolution RGB Videophone will become important in pathology laboratories in the near future (1). Slides for consultation will not have to be sent by post, because, real color - real time images can be discussed by phone, similarly to the way in which facsimile machines have finally substituted much of the written information.

The cost of the system is low and it is shortly amortized due to its utility . It is comfortable to monitor, quantify or evaluate patients in distant areas; particularly in isolated regions, or when direct communication is difficult, as in the islands, specifically in the Canary Islands (Spain).

In the present paper we summarized the experience to the point of interactive and immunohistochemical

quantification from images transmitted by remote broadcasters. The testing, was prior to the official opening of the Sanitary Videophone network (1st November 1990); and was included in the annual Image Analysis courses of the University of La Laguna. The transmissions were done between the islands of Tenerife and Fuerteventura with Switzerland and Germany.

MATERIAL AND METHODS

The Telemaster VP-2000 system which transmits RGB images of 512x512 pixels of 8bits/pixel/color , has been tested for a month. During the 3 to 6 hours daily transmissions, we tested 25 cases for DNA and immunohistochemical hormone-receptor quantification of estrogen and progesterone. One week was required to make the necessary corrections, using the rest of the time to evaluate test cases.

This series belongs to the CAAC breast cancer project specimen bank and to a project of the National

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Figure 1. Image transmitted at 9600 bauds in 1 minute from Zurich. Demonstration picture from Telemaster.

Health Service, to evaluate prognostic factors in breast carcinoma .

Cytologies were taken by FNA (fine needle aspiration) from surgical specimens. They were stained with progressive haematoxylin for DNA quantification (2). Immunohistochemical staining of estrogen and progesterone was done on frozen material with the Abbot kit. Quantification was done by means of the Texcan group software from the University of La Laguna, with an added option to introduce videophone images (3-5). Comparisons between the original and transmitted images were evaluated by ploidy and entropy (5-6) of the DNA histograms on exactly the same cells on the immunohistochemical cases the immunoscore and the percentage of positive area was chosen (4-5).

RESULTS

Time required for the transmission-reception of an image varies according to the conditions of transmission through the regular phone-lines . Videophone selects the speed automatically and images were completed in 1 minute at 9600 bauds or 5 to 7 minutes at 2400 bauds. Errors are automatically tested and corrected . The final result is a real color image of high quality.

The transmitted images needed for quantification

were : a background , and 2 to 3 microscopic images. These were taken at 400 or 200x through and analog or a CCD composite video-camara (direct RGB input is also available).

Care was taken that the initial images get the maximum contrast to obtain a more accurate quantification . A narrow band-pass filter (+- 10 nm) at the maximum absorbances of the dye were used. In this case 560 nm for the hematoxylin and the DAB (Diamino Benzidine) .

A slight compression of the image takes place when an interactive image is memorized into the 512x512 pixels of 300 video lines . This does not affect subsequent quantifications providing that special care is taken during cell segmentation. From each case we obtained a total number of 100 problem cells and a 25 control cells for DNA. For immunohistochemistry, an area statistically significant of 10E3 microns is required.

The background reception from the other broadcaster is a «sine-quanon » condition since we work with optical density images operated pixel by pixel with the background. This allows us to correct any optical error not easily detected except using look-up tables (FIG 2).

The present Videophone introduces an RGB or composite Video signal. Our black and white CCD 1 chip composite Sony camera has an offset of 110 for a black of 0 and a Gain of 0 for a white at 250; Videophone on the contrary has a Gain and Offset of 0 and 125 respectively ,

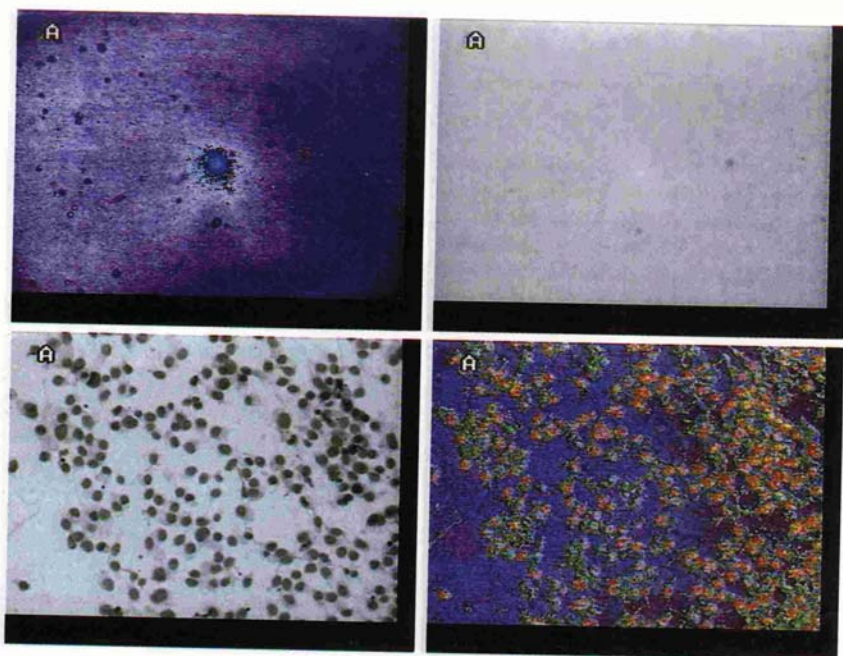


Figure 2. Notice the illumination errors by means of look-up tables.

producing an absolute black and white of 161. For that reason the use of the videophone gain and offset is required to store the images into the computer.

Images are digitized at the frame grabber (Matrox board PIP-1024). They will be processed in the usual form by the software of the Texcan group in 15 to 20 minutes.

The statistical comparisons between original and transmitted images includes the Entropy (range from 2.09 to 3.53) which CV was $2.25 \pm 1.35\%$ and Ploidy (2.2 to 4.1) having a CV of $1.29 \pm 2.8\%$, 75% of the cases having coincidental ploidy (see FIG 3).

In the estrogen and progesterone receptor quantification, we tested highly positive cases with positive area from 100 to 90% and scores from 200 to 350. The CV of the immunoscore was $3.1\% \pm 3.3\%$ and the CV of the positive area was zero when the area is 100% positive; in lower values CV was around $2.2 \pm 3.2\%$.

DISCUSSION

We have shown that the videophone is a crucial instrument. In almost real-time it allows us to receive a real color image from anywhere in the world through the usual phone lines. The technical quality of the high resolution

images (8 bits/pixel/color) allow us to diagnose, make medical exchange and consultations as well as to store or take pictures of high quality etc... Its usefulness has been proved in the recent Gulf-war in which the most important newspapers received the images through videophones. Finally we can talk simultaneously with the broadcaster and transform the Video-phone into an extremely useful system for medical consultations important for communications between isolated regions with their main hospitals and the specialized ones.

We also showed that its application is not limited to the transmission of images (1). RGB images that contains 256 grey level per pixel, can be used to quantify with the same accuracy as in the original ones.

The experience presented here is the first in the world to our knowledge. It shows how DNA and immunohistochemical receptors could be quantified in a distant hospital and produce similar results as if done in the hospital of origin.

Any patient whether belonging to small or main Center Hospital will have exactly the same advantages. Particularly those neoplastic cases that required supplementary studies in order to detect high risk patients that would need a more aggressive treatment (6). There is

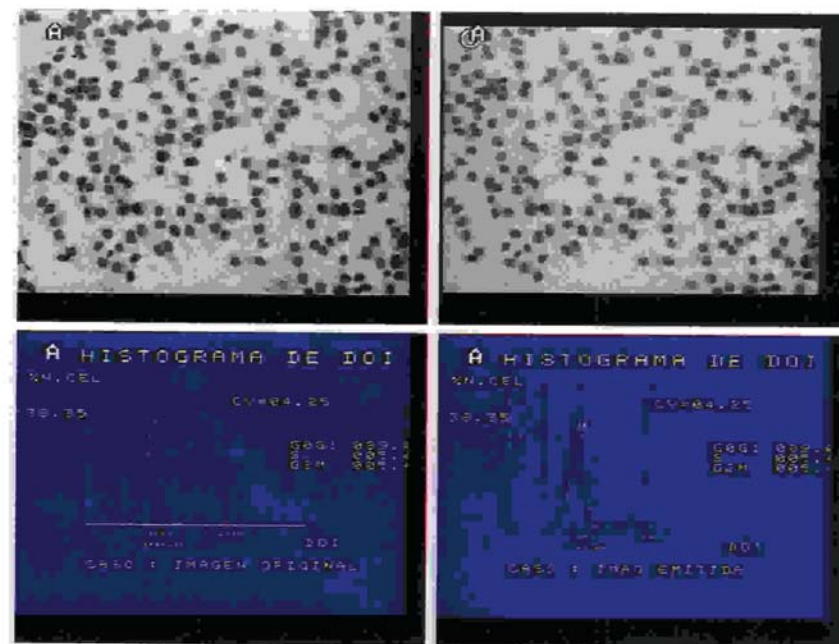


Figure 3. DNA histograms from the original (A-B) and transmitted image (C-D). Notice the compression of the transmitted image compared to the original.

no necessity to have quantification facilities at the same hospital. Images could be sent to a center already equipped with a computer-Videophone interface and accurately measured in a short period of time.

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