and b) one cannot measures absolute CBF values. These difficulties can be overcome by Xe-133. It, on the other hand, does not allow high image resolution.

The lecture ends by emphasizing the value of CBF tomography in the clinical routine: it gives direct information of an important functional parameter—the blood flow through the tissue—that cannot be imaged by the essentially structure-related CT or MR scanning techniques.

III

Immunoscintigraphy (IS)

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IS belongs to the most important features of progress in nuclear medicine. Although preliminary attempts date back nearly 40 years ago the actual breakthrough was achieved by introducing radioactively labeled monoclonal antibodies (RAMAK) applied especially as "radioimmunococktails" (RIC) of a mixture of [131]J-Anti-CEA** and [131]J-Anti-CA-19-9** as first proposed by CHATAL et al in France and further promoted by our group in Federal Republic of Germany.[1-4]

The following aspects are reviewed:

1. History based on the discoveries of EHRLICH, EDELMAN and PORTER, JERNE, MILSTEIN and KÖHLER, all honored by the NOBEL-PRICE.

2. Radioactive Antibodies (RAB)

We used the above mentioned [131]J-cocktail. The spectrum of previous and present RAB's is presented with detailed specifications on our RIC (Tables 1 and 2).

Some of our own experimental data are shown in Fig. 1.

3. Techniques

Planar (double radionuclide-double compound-isocontour-technique) and tomographic (SPECT) methods:

   A. *SKELETAL IMAGING/URINARY BLADDER*
      Tc-99m-HMDP 150–300 MBq i.v. RECORDING TIME: 5 MINUTES
   B. *LIVER/SPLEEN/BONE MARROW*
      Tc-99m-NANOCOLLOIDE 37–300 MBq i.v. RECORDING TIME: 3–5 MINUTES
   C. *KIDNEY/URETER/URINARY BLADDER*
      Tc-99m-DTPA 74–285 MBq i.v. RECORDING TIME: 3–5 MINUTES

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Table 1 Immunoscintigraphy (II)
—Colorectal carcinoma—

Polyclonal Antibodies	1965	I-131-anti-CEA	Gold Freedman
	1974 to 1980		Goldenberg et al, Hoff et al, Mach et al
Monoclonal Antibodies EXPERIMENTAL	1979	anti-CEA 19–9	Mach et al Koprowski et al
	1982	Inhibition of tumor by MAB (nude mice)	Herlyn et al
	1982	In-111-anti-CEA-MAB I-131-anti-CEA-MAB	Halpern et al
Monoclonal Antibodies CLINICAL	1982	I-131-anti-CEA/19–9 "Radioimmunococktail" I-131-17-1 A	Chatal et al

Table 2 Immunoscintigraphy (I)

|				
1.	HEART	Infarction	I-131-Anticardiac-Myosin F (ab′)-Fragments	Khaw 1978
2.	THYROID	C-cell Carcinoma	I-131-Anti Calcitonin I-125-Anti Thyroglobulin	Gautvik 1982 Wenisch 1983
3.	LYMPH-NODES	Cutaneous T-Cell Lymphoma	In-111 T 101	Carrasquillo/ Larson 1985
4.	PROSTATE	Carcinoma	In-111 antiprostatic acid phosphatase	Halpern 1985
5.	LYMPHOCYTES	B Cell Lymphoma	I-125/I-131 anti B1	Atkins 1985
6.	THROMBOCYTES	Thrombi	Tc-99m IgG 2a	Som 1985
7.	MELANOMA		I-131-, I-123-, Tc-99m-, Pd-109-, In-111-MAB	Larson 1983 Burragi 1984 Fawwaz 1984 Rainsburg 1983
8.	BREAST	Carcinoma	In-111-DTPA-MAB	Rainsburg/ Ehrenfeldt 1983
9.	OVARIAN	Carcinoma	I-123-HMFG2	Thompson 1984 Granowska 1984
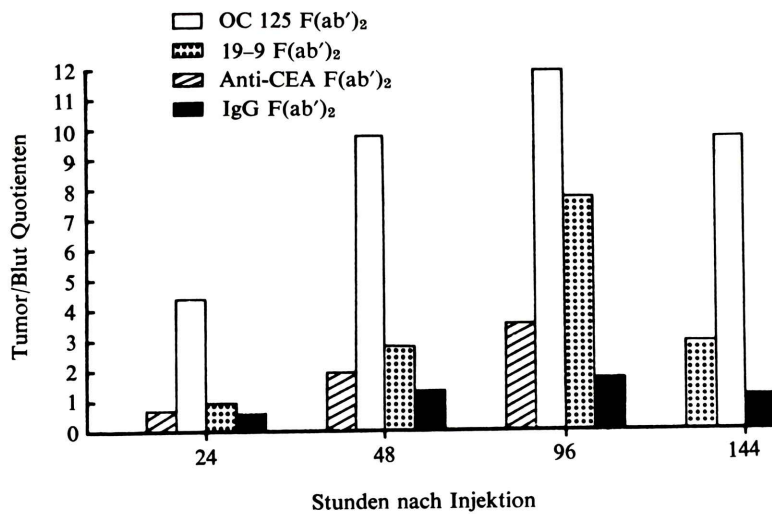
Fig. 1 Tumor-to-blood ratios for several monoclonal antibodies (ordinate) 24 to 144 hours after injection in nude mices. (SENEKOWITSCH et al, 1985).
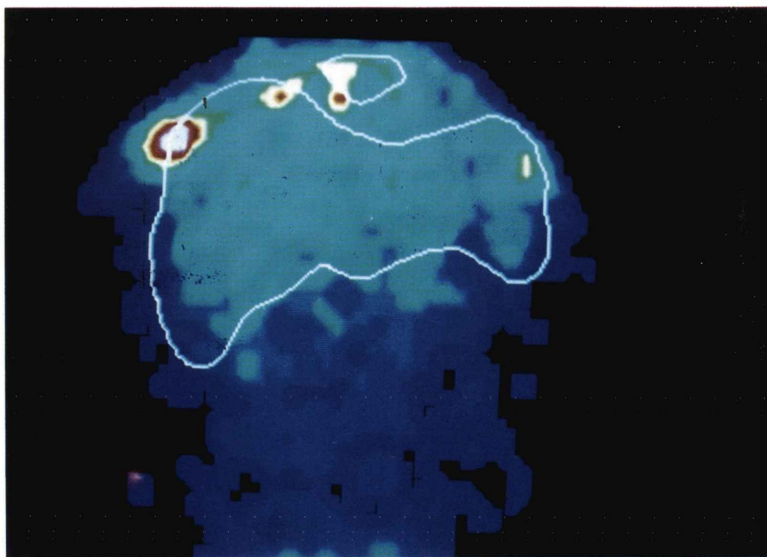

Fig. 2 Immunoscintigram with "radioimmunococktail" 3 days after injection: solitary metastasis of liver in a patient with colorectal carcinoma.

D. STOMACH

Tc-99m-PERTECHNETATE 74–100 MBq i.v. or 37 MBq PER OS. RECORDING TIME: 5 MINUTES

4. Clinical Results

Between Dec. 1984 and 1986 about 300 patients were examined in our hospital.

4.1 Prospective Studies

Group A (n=100) patients with colorectal carcinoma, other gastro-intestinal tumors, breast cancer.

Group B (n=55) before and after implantation of Infusaid® pumps resp ... Infuse-a-ports for regional chemotherapy of liver metastases. More than 95% of all patients had a recurrence of or metastases subsequent to a primary tumor, the largest group being represented by colorectal and gynecological cancer (n=120).

Histologically most of the tumors were adenocarcinomas. Sensitivity, Specificity, positive and negative predictive value (PPV, NPV) (%) were

for pelvic tumors:	83, 85, 88, 93
liver metastases:	93, 85, 93, 85
peritoneal/abdominal:	90, 98, 94, 95
lung tumors:	83, 94, 77, 96

4.2 Retrospective Studies (n=133)

In a selected number of patients Se, Spe, PPV, NPV (%) were also determined in dependance on tumor site

for pelvic tumors:	86, 94, 86, 94
liver metastases:	73, 86, 94, 50
peritoneal/abdominal:	85, 82, 79, 88
lung tumors:	67, 96, 80, 91

4.3 IS and Tumor Markers (TM) (n=97)

Positive IS and elevated TM were detected in 78%, positive IS and normal TM in 8%, negative IS and elevated TM in 5%, negative IS and normal TM in 6%.

4.4 Clinical Indications

Although IS is still considered to persist in a pre-clinical trial phase we are well advised to approach clinical indications in which IS is competing or complementing CT and US. At present we persue a priority list, which will be confirmed by clinical case presentations:

4.4.1 Local recurrence of primary tumor vs. scar vs. corpus alienum (after surgery). Prognostication of recurrence was possible in singular cases up to 7 months before CT and in 10% of our patients IS was the only oncologic investigation to precisely diagnose recurrence or extrahepatic metastases.

4.4.2 Detection or exclusion of solitary liver metastases (Fig. 2).

4.4.3 Detection of extrahepatic metastases in CT/US confirmed liver metastases to plan intra-arterial chemotherapy.

4.4.4 Control of the expansion of resected tumors.

4.4.5 Ovarian cancer.

5. *Problems and Outlook*

Factors interfering with tumor localization of antibody radionuclide conjugates are discussed according to LARSON (s. Year Book Nucl. Med. 1985, p. 22).

Finally our preliminary experiences using ^{111}In-MAB and OC-125* are presented.

6. *Conclusion*

The impact of IS on clinical oncology is remarkable. It may be expected for the 90ties, that nuclear oncology will extend in a way comparable to nuclear cardiology.

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