

造影剤投与と3T-MR像と腫瘍組織像との相関性及び今後のプロトコール  
平成28年11月6日 (13:00~)  
第4回研究会  
(於幹岡大学工学部イノベーション共同研究センター)

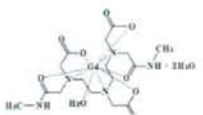
- (I) 0.05 mmol/kg.bw.-Gd-DTPA-AS2-2Glc(OH) / PC3 の計測検証。  
(II) 0.05 mmol/kg.bw.- Gadodiamide hydrate (オムニスキャン) / DU-145 の計測検証。  
(III) 0.05 mmol/kg.bw.-Gd-DTPA(EDA) / DU-145 の計測検証。  
(IV) 実験腫瘍モデルマウス(PC-3, DU 145/BALB-c-nu/nu; 30g; 腫瘍サイズ=直径1.5cm)にIV投与/0.05mg/g/bw.ネブナル麻酔下/30分間の T1, T2 計測。  
(V) 3T-MRIにて投与前後のMR画像の取得後、組織像と画像の比較検討。

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ナノサイズシュガーボールデンドリマー型MRI造影剤(血管)



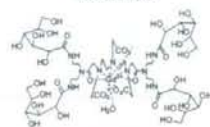
Gadodiamide hydrate (オムニスキャン)  
M.W.: 645.72



Gd-DTPA(EDA)  
M.W.: 649.75

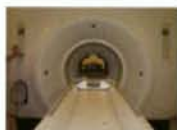


Asymmetric Gd-DTPA-D2-2Glu(OH)  
M.W.: 1118.22



Gd-DTPA-D1-Glc(OH)  
M.W.: 1450.47

3T-MRI  
Sigma VH/i 3.0T  
GE横河メディカルシステム  
2005年4月  
日本国内では最高の磁場強度  
を搭載した高画質の頭部専用  
MR装置



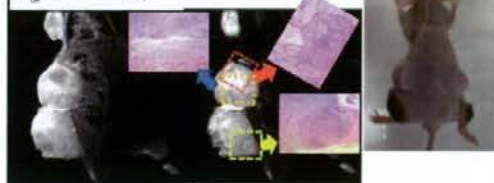
PC-3/BALBc鼠



PC-3/BALBc鼠



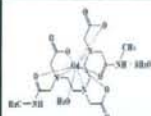
Gd-DTPA-D1-Glc(OH)投与後のT1  
とT2画像(ヒト前立腺癌:PC-3)



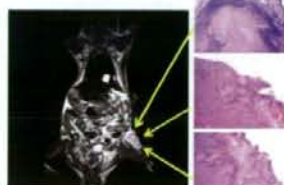
T1投与後 (30 min)  
TR= 600 msec  
TE= 14 msec

T2投与後 (30 min)  
TR= 4850 msec  
TE= 90.664 msec  
Gd-DTPA-D1-Glc(OH)  
(0.05mmol/kg.bw.-i.v.)

オムニスキャン投与前後のT2画像  
(ヒト前立腺癌DU-145)



T1投与前  
TR= 4850 msec  
TE= 90.664 msec



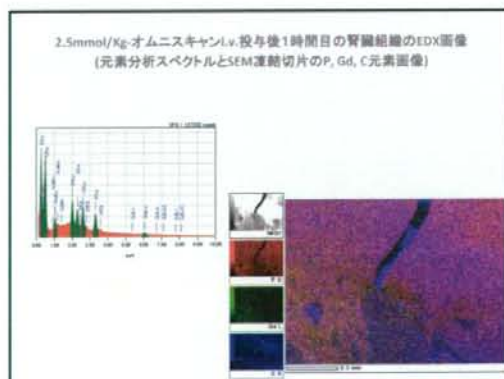
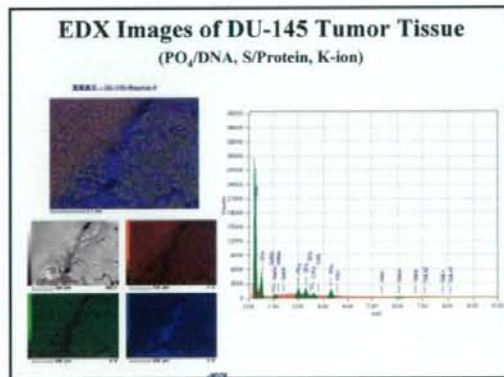
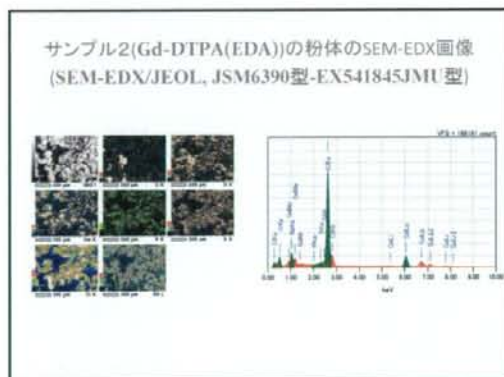
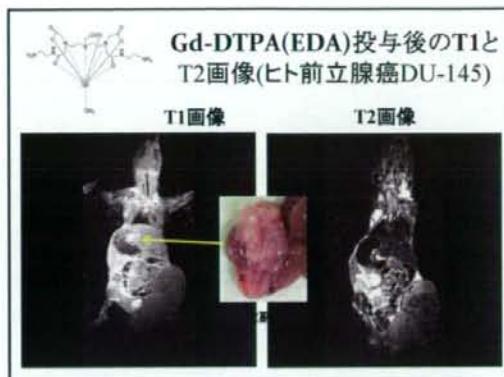
T2投与後(30 min)  
TR= 4850 msec  
TE= 90.664 msec  
Gadodiamide hydrate (オムニスキャン)  
(0.05mmol/kg.bw.-i.v.)

Gd-DTPA(EDA)投与前後の  
T1画像(ヒト前立腺癌DU-145)



投与前

投与後(30分以内)



2008年度 第4回研究会 2008.11.6  
 静岡大学工学部物質工学科 准教授 戸田三津夫  
 特別：新規MRI造影剤の調整-Gd錯体の構造解析

1.はじめに

- Gd<sup>III</sup>錯体の超分子化学的考察

2.懸案の青島サンプル問題について

- 好成績サンプル合成の再現性
- その原因説明
- 好成績サンプルの正体
- さらに高性能な造影剤の合成？

Gd<sup>III</sup>錯体の構造例

Figure 13 Structure of [Gd(NCS)<sub>2</sub>(OH)<sub>2</sub>(dhsoa-30-crown-18)]

Comprehensive Supramolecular Chemistry, 1, 331, Pergamon 1996.  
 original paper: Polyhedron, 10, 1889 (1991)

Gd<sup>III</sup>錯体の錯形成安定度定数

complex	log K <sub>st</sub>
Gd-dota	25.8
Gd-dpba	22.5
Gd-BOTPA	22.6
Gd-DO3A	21.1
Gd-DO3MA	25.3
Gd-HP-DO3A	23.8
Gd-(1)	25.9
Gd-(2)	26.4
Gd-N,P,Me,Cl	19.8
Gd-edta	17.3

—只錯体にするよ1000倍とれたよ！  
 Comprehensive Supramolecular Chemistry, 10, 515, Pergamon 1996

Gd<sup>III</sup>錯体の酸触媒解離反応

complex	k <sub>obs</sub> × 10 <sup>4</sup> (s <sup>-1</sup> )
Gd-dota	0.84 × 10 <sup>-4</sup>
Gd-HP-DO3A	3.1 × 10 <sup>-2</sup>
Gd-DO3A	2.4
Gd-dpba	1.1
Gd-(4)	1.3 × 10 <sup>-4</sup>
Gd-(3)	10.4 × 10 <sup>-4</sup>
Gd-DO3MA	0.162

—只錯体にするよ100倍とれたよ！  
 Comprehensive Supramolecular Chemistry, 10, 517, Pergamon 1996

その他のGd<sup>III</sup>錯体

修飾カリックスアレーンが、Gd<sup>3+</sup>, Y<sup>3+</sup>, Sc<sup>3+</sup>と弱い錯体を生成することが報告されている

Eu錯体に関する知見

Ev picrateのジクロロメタン層への抽出率  
 log β<sub>st</sub> 25°Cでの錯体の安定度定数

compound	Ev	log β <sub>st</sub>
A	13	4.8
B	14	4.1
C	5	3.7

A: R = -CH<sub>2</sub>CH<sub>2</sub>  
 B: R = -CH<sub>2</sub>CH<sub>2</sub>CH<sub>2</sub>  
 C: R = -CH<sub>2</sub>CH<sub>2</sub>CH<sub>2</sub>CH<sub>2</sub>

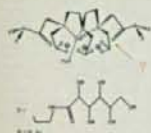
Comprehensive Supramolecular Chemistry, 1, 583, Pergamon 1996

ランタノイド (原子番号57-71) の精製法について

2価、3価、4価金属で、精製が困難  
 レアメタルとされるが、クラーク数がそこそこでも金より高価な場合がある

容易に分離可能

### 青島サンプルの問題



予定構造

性能評価の成績が  
明らかに異なる

再産性の問題  
合成ルートの問題  
スペクトルデータが異なる

有効物質が異なる (構造の問題)  
有効物質の含有率が異なる (組成の問題)

今のところ確認がない

### 検証法

IR 少なくとも、同一かどうかはわかる (過去のサンプルとの比較も)

HPLC 配座の違う結体や一次構造の違う結体等が同種類あるかわかる

XRD 結晶が得られれば、何らかの情報が取れる?

NMR Gd以外のランタノイド結体で配位子の構造を解析

電気泳動

反応の見直し エステル、アミド、イミンなどの生成はないか?

## 2-5 第5回研究会（2009年1月6日）

議題： 現在の創製の進捗状況と今後のスケジュール

### 第1部 研究会&進捗報告

- ・ 12/23 の岡崎実験報告と今後について
  - ・ ・ 静岡大学 山下 光司
- ・ 現在の創製状況
  - ・ ・ 静岡大学 Bitragunta Siva Kumar
  - ・ ・ 静岡大学 Uma Ravi Shankar
  - ・ ・ 静岡大学 青木 峻
- ・ 報告書分担、作成の注意、経費のお願い
  - ・ ・ 静岡大学 山下 光司



### 厚生労働科研費 2008年度第5回研究会

2009年1月6日(火)  
静岡大学浜松キャンパス  
総合研究棟10階会議室  
山下光司

### A sample



### AA sample



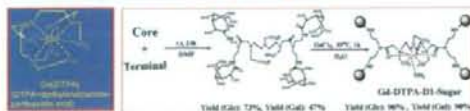
### Wiemer教授招聘

• 11月20日～12月1日 (医療機器センター)

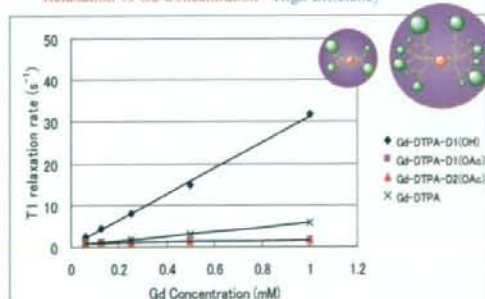
11月22日～23日: 複素環化学討論会  
11月26日: 静岡大学静岡キャンパス 遺伝子実験施設にて講演  
浜松医科大学にて講演  
11月28日: 静岡大学浜松キャンパスにて講演  
創造科学技術大学院 大学院特別講義

### Target Molecules (#1)

Aoshima Sample/Aoki Sample  
緩和速度  $\sim 40$  ( $M^{-1} \cdot s^{-1}$ )  
構造決定、類似サンプルの再現実験  
単一成分(?)で優れたMRI造影剤  
LC/MSIにて成分と構造解析  
(コニカミノルタTC三浦さんに委託)



### Relaxation vs Gd Concentration—High Efficiency



## 血管造影の結果

### *in-vivo* MR Angiography (MRA)

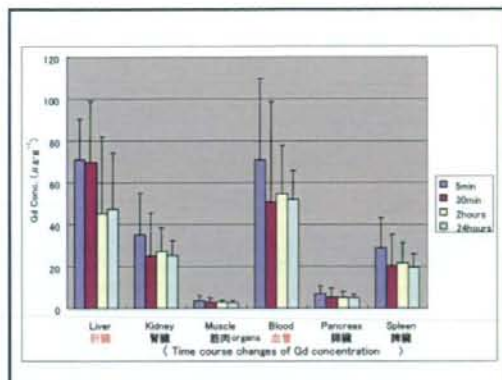
Gd-DTPA



DEN-OH



MRA 結論: DTPA-D1Glu(OH)は血中への停滞性を有する。  
Blood Pool MR Angiographyへの応用が可能

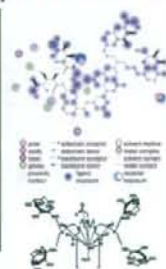
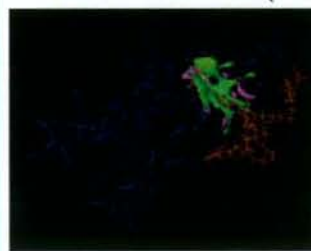


## 今後のサンプル調製予定 (安全性評価/in vivo評価用)

- ① 加水分解
  - ② m/z 955 (1-Sugara?)  
m/z 723 (No-Sugar?)
- 青島サンプルの別途合成

・ 昨年度と同じ評価は行わない。

## Docking Simulation of DTPA-C6-D-4Glc(OH) and Albumin

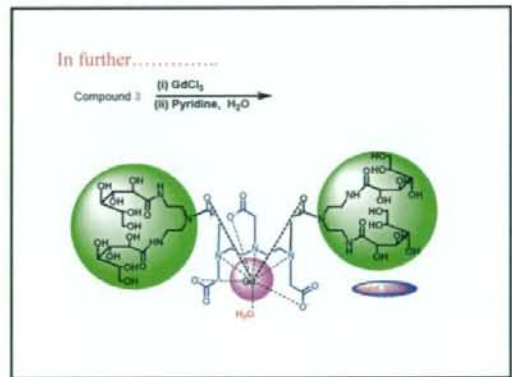
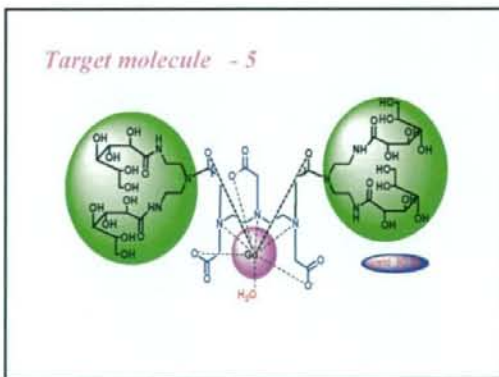
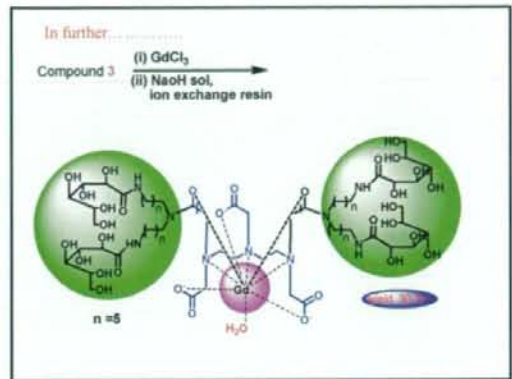
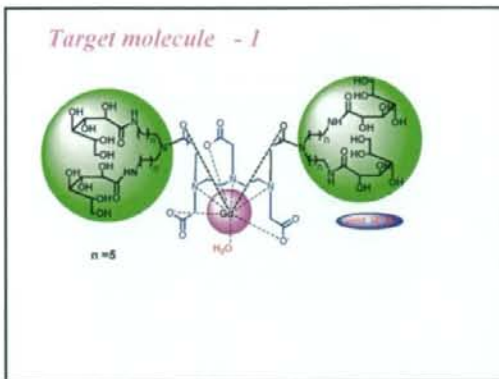


S: -7.027 [kcal/mol]

## 経費、報告書分担について (お願い)

・ 経費: 各研究分担者の先生方の経費を使っ  
てください。(敬称略)

- |                |                    |             |
|----------------|--------------------|-------------|
| (静岡大学)         | (浜松医大)             | (理科大学)      |
| ・ 山下 光司        | ・ 飯原 晴海(分子<br>認識)  | ・ 三好 憲雄     |
| ・ 木村 元彦(安全性評価) | ・ 間寛白 崇寛(分子<br>認識) | (東京慈恵会医科大学) |
| ・ 田中 康隆(構造解析)  | ・ 竹原 康雄            | ・ 岡野 孝      |
| ・ 戸田 三津夫(錯形成)  | (一括計上)             | (沼津高専)      |
| (一括計上)         | ・ 藤江 三千男(分子<br>認識) | ・ 柳川 達夫     |
| (浜松工業技術支援セ)    |                    |             |
| ・ 本間 慎行        |                    |             |
| (一括計上)         |                    |             |

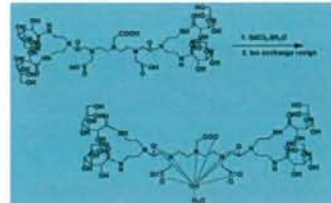




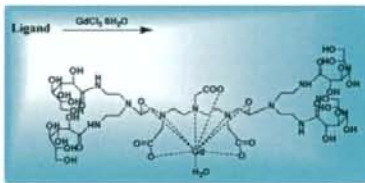
**Design and Synthesis of New Asymmetric Gd-DTPA-Sugar**

Bitragunta Siva Kumar

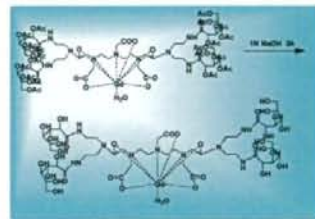
Preparation of Complex



Final Complex

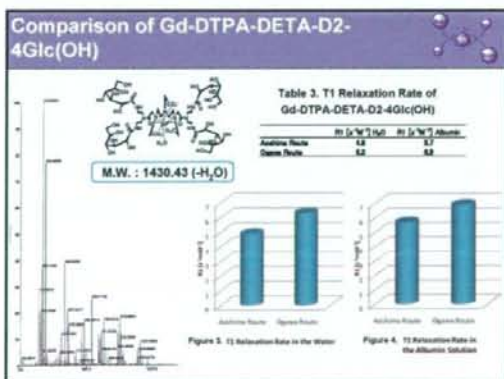
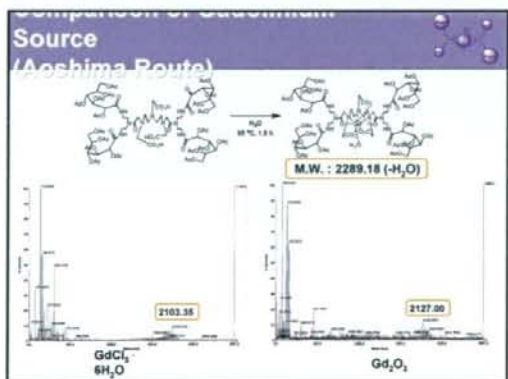
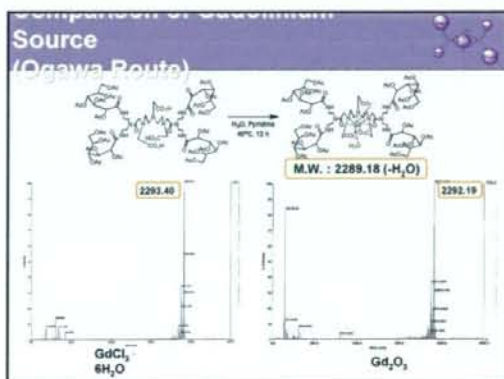
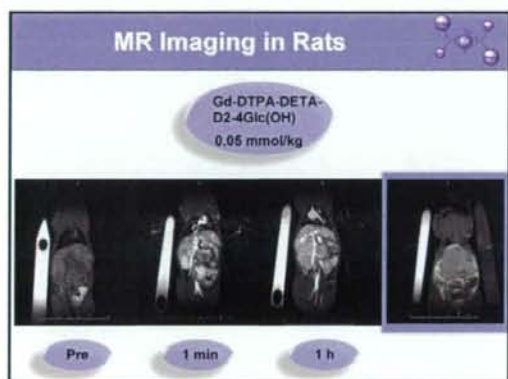
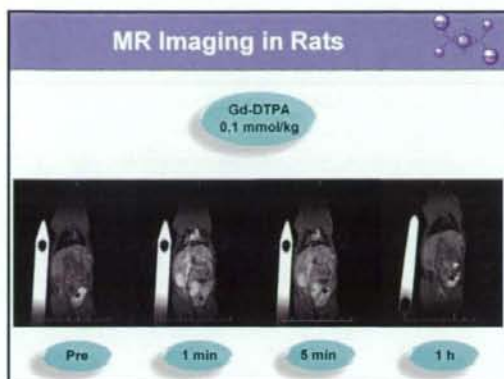
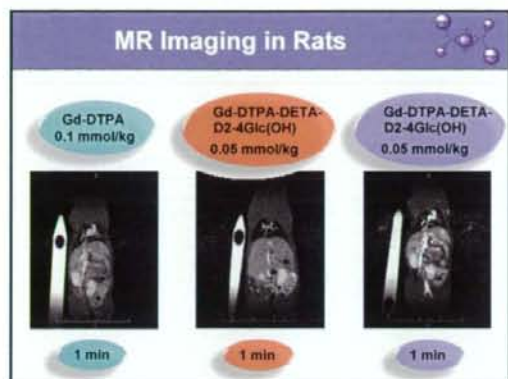


Pathway III



Relaxivity

1.661 in water (pure)



## データ集3 研究者業績

山下光司

### (1) 著書

1. Yamashita, Mitsuji, "Preparation, Structure, and Biological Property of Phosphorus Heterocycles with a C-P ring System", in Top Heterocyclic Chemistry Series Vol. 8 (Bioactive Heterocycles II), ed. by Shoji Eguchi, Springer, Germany, 2007, published on line.
2. Yamashita, M. "Product class 7: N,P- and P,P-acetals." Science of Synthesis, Volume Date 2006, 30, 649-679, Houben-Weyl, Georg Thieme Verlag, Stuttgart (2007).
3. Yamashita, M. "Product class 2: O,P- and S,P-acetals." Science of Synthesis, Volume Date 2006, 30, 83-109, Houben-Weyl, Georg Thieme Verlag, Stuttgart (2007).
4. M. Yamashita, O/P and S/P Acetals & N/P and P/P Acetals, Science of Synthesis, Houben-Weyl, Georg Thieme Verlag, Stuttgart, 2006

### (2) 原著論文

1. Satoki Nakamura, Daisuke Yokota, Isao Hirano, Takaaki Ono, Michio Fujie, Kiyoshi Shibata, Kazuyuki Shigeno, Kaori Shinjo, Kazunori Ohnishi, Mitsuji Yamashita, Taishi Niimi, Takuya Suyama, Kasthuraiah Maddali, Junko Yamashita, and Yukiko Iguchi, "Development and pharmacologic characterization of TMPP/DMPP with antileukemic activity: inhibition of cell cycle progression through FoxM1", Cancer Research, in press (2008)
2. Satoru Ito, Mitsuji Yamashita, Taishi Niimi, Michio Fujie, Valluru Krishna Reddy, Hirano Totsuka, Buchammagari Haritha, Maddali Kasthuraiah, Satoki Nakamura, Kazuhide Asai, Takuya Suyama, Junko Yamashita, Yukiko Iguchi, Gang Yu, and Tatsuo Oshikawa, "Preparation and characterization of phospholanes and phospho sugars as novel anti-cancer agents", Heterocyclic Communications, in press (2008)
3. Martin, Kral; Akihisa, Ogino; Kazuo, Narushima; Norihiro, Inagaki; Mitsuji, Yamashita; and Masaaki, Nagatsu. Low-Temperature Nitrogen Introduction onto Polyurethane Surface Using Surface-Wave Excited N<sub>2</sub>/H<sub>2</sub> Plasma. Japanese Journal of Applied Physics Vol.46, No.11, (2007), pp7470-7474.
4. Yu, Gang; Yamashita, Mitsuji; Aoshima, Kengo; Kobayashi, Masatsugu; Kato, Tatsunori; Kamikage, Nao; Takahashi, Masaki; Takayanagi, Hisao; Oshikawa, Tatsuo; Laurent, Sofie; Burtea, Carmen; Vander Elst, L.; Muller, Robert N.; Takehara, Yasuo; Sakahara, Harumi. Studies on preparation and characterization of novel MRI contrast agents for targeting organs and blood vessels. Heterocyclic Communications (2007), 13(2-3), 101-108.
5. Yu, G.; Yamashita, M.; Aoshima, K.; Takahashi, M.; Oshikawa, T.; Takayanagi, H.; Laurent, S.; Burtea, C.; Vander Elst, L.; Muller, R. N. A glycosylated complex of gadolinium, a new potential contrast agent for magnetic resonance angiography? Bioorganic & Medicinal Chemistry Letters (2007), 17(8), 2246-2249.
6. Satoru Ito, Mitsuji Yamashita, Taishi Niimi, Michio Fujie, Valluru Krishna Reddy, Hirano Totsuka, Buchammagari Haritha, Maddali Kasthuraiah Reddy, Satoki Nakamura, Kazuhide Asai, Takuya Suyama, Junko Yamashita, Yukiko Iguchi, Gang Yu, and Tatsuo Oshikawa, "Preparation and Characterization of Phospholanes and Phospho Sugars as Novel Anti-cancer Agents". Heterocyclic Commun. (in press).
7. Takahashi, Masaki; Morimoto, Hironao; Miyake, Kentaro; Yamashita, Mitsuji; Kawai,

- Hideki; Sei, Yoshihisa; Yamaguchi, Kentaro. Evaluation of energy transfer in perylene-cored anthracene dendrimers. *Chemical Communications (Cambridge, United Kingdom)* (2006), (29), 3084-3086.
8. Takahashi, Masaki; Morimoto, Hironao; Suzuki, Yousuke; Yamashita, Mitsuji; Kawai, Hideki; Sei, Yoshihisa; Yamaguchi, Kentaro. Construction of divergent anthracene arrays within dendritic frameworks. *Tetrahedron* (2006), 62(13), 3065-3074.
  9. Takahashi, Masaki; Suzuki, Yousuke; Ichihashi, Yasunori; Yamashita, Mitsuji; Kawai, Hideki. 1,3,8,10-Tetrahydro-2,9-diazadibenzo[cd,lm]perylene. Synthesis of reduced perylene bisimide analogues. *Tetrahedron Letters* (2006), Volume Date 2007, 48(3), 357-359.
  10. Ogino, Akihisa; Kral, Martin; Narushima, Kazuo; Yamashita, Mitsuji; Nagatsu, Masaaki. Surface amination of biopolymer using surface-wave excited ammonia plasma. *Japanese Journal of Applied Physics, Part 1: Regular Papers, Brief Communications & Review Papers* (2006), 45(10B), 8494-8497.
  11. Reddy, Valluru Krishna; Haritha, Buchammagari; Yamashita, Mitsuji. Highly diastereoselective epoxidation of  $\alpha, \beta$ -unsaturated carbonyl compounds using sodium peroxide. *Letters in Organic Chemistry* (2005), 2(2), 128-131.
  12. 竹原康雄, 村松克晃, 阪原晴海, 山下光司, 定藤規弘, 中井敏晴, 岡田知久 「dendrimer DTPA-D1Glu(OH)を用いた造影MR Angiography (blood pool agentとしての可能性)」日本磁気共鳴医学会雑誌, 24, S249, 2004.
  13. 村松克晃, 竹原康雄, 阪原晴海, 山下光司, 西川 哲, 定藤規弘 「新しいデンドリマー型造影剤dendrimers DTPA-D1Glu(OH)を用いた富血性肝細胞癌の造影能向上に関する実験的研究」日本医学放射線学会雑誌 (0048-0428) 65巻 臨増 Page S353-S354 (2005.02).

### (3) 国際会議発表

1. Kazuhide Asai, Mitsuji Yamashita, Satoru Ito, Michio Fujie, Satoki Nakamura, Takuya Suyama, Yukiko Iguchi, Junko Yamashita, "SYNTHESIS AND ANTI CANCER BIOACTIVITY EVALUATION OF SOME NOVEL PHOSHA SUGAR DERIVATIVES" 11th Bratislava Symposium on Sacharides (11BSS), 21-26 September, 2008, Smolenice Castle, Slovakia
2. Mitsuji Yamashita, Takashi Aoki, Satoru Ito, Keisuke Ogawa, Nobuhisa Ozaki, Michio Fujie, Gang Yu, Kengo Aoshima, Masaki Sugiyama, Nao Kamikage, Junko Yamashita, Yasuo Takehara, Harumi Sakahara, Hisao Takayanagi, Tatsuo Oshikawa, Sofie Laurent, Carmen Burtea, L. Vander Elst, Robert N. Muller, "Research on Cancer Finding and Chemotherapy at the Early Stage --- Syntheses and Evaluations of Novel Sugar-Ball-Dendrimer MRI Contrast Agents and Phospha Sugars by Sugar Modification", 11th Bratislava Symposium on Sacharides (11BSS), 21-26 September, 2008, Smolenice Castle, Slovakia
3. Honami Kashihira, Mitsuji Yamashita, Yugo Kosaka, Masataka Inuzuka, Hiroshi Nakagomi, Soichiro Abe, "Preparation and Evaluation of Super-hydrophilic Medical Coating Materials Bearing Phosphate Groups" Inter-Academia 2008, 15-18 September, 2008, Pecs, Hungary
4. Yuya Otake, Mitsuji Yamashita, Takeshi Takahashi, Satoru Ito, Keita Kiyofuji, Hidetomo Mikami, Tomokazu Ogawa, Minako Fukumoto, "Preparation and Evaluation of Biocompatible Medical Materials Lubricative Medical Materials Modified by PVP



- (Poly-VinylPrrolidone)” Inter-Academia 2008, 15-18 September, 2008, Pecs, Hungary
5. Mitsuji Yamashita, Michio Fujie, Kazuhide Asai, Takuya Suyama, Junko Yamashita, Satoru Ito, Valluru Krishna Reddy, Hirono Totsuka, Junko Yamashita, Keisuke Ogawa, Nobuhisa Ozaki, Satoki Nakamura, Takashi Aoki, Nobuhisa Ozaki, Gang Yu, Kengo Aoshima, Masatsugu Kobayashi, Tatsunori Kato, Nao Kamikage, Yasuo Takehara, Harumi Sakahara, Hisao Takayanagi, Tatsuo Oshikawa, Sofie Laurent, Carmen Burtea, L. Vander Elst, Robert N. Muller. “Research on Novel Materials for Cancer Finding and Chemotherapy at the Early Stage --- Novel MRI Contrast Agents with Sugar Ball Dendrimer Structures and Novel Ant-tumor Agents with Phospha Sugar or Phosphorus Heterocyclic Structures and Their Evaluation” , Inter-Academia 2008, 15-18 September, 2008, Pecs, Hungary
  6. Junko Yamashita, Mitsuji Yamashita, Michio Fujie, Taishi Niimi, Kazuhide Asai, Takuya Suyama, Hirono Totsuka, Valluru Krihna Reddy, Satoru Ito, Satoki Nakamura, “Medical Materials for Ultra Earlier Finding and Curing Cancers; Syntheses and Evaluation of Anhydro- and Deoxybromo-phospha Sugars or Epoxy- and Bromo-Phospholanes for Leukemia Cells” 24th international Carbohydrate Symposium(ICS2008), 27. July~1. August, 2008, Oslo, Norway
  7. Mitsuji Yamashita, Takashi Aoki, Keisuke Ogawa, Nobuhisa Ozaki, Michio Fujie, Krishna Reddy Valluru, Gang Yu, Kengo Aoshima, Masatsugu Kobayashi, Tatsunori Kato, Nao Kamikage, Junko Yamashita, Yasuo Takehara, Harumi Sakahara, Hisao Takayanagi, Tatsuo Oshikawa, Sofie Laurent, Carmen Burtea, L. Vander Elst, Robert N. Muller, “Studies on Novel MRI Contrast Agents Having a Sugar-Ball-Dendrimer Flame Work for R & D of Imaging Specific Organs, Blood Vessels, and Tumors” , 24th international Carbohydrate Symposium(ICS2008), 27. July~1. August, 2008, Oslo, Norway
  8. Mitsuji Yamashita, Takashi Aoki, Keisuke Ogawa, Nobuhisa Ozaki, Michio Fujie, Junko Yamashita, Kengo Aoshima, Nao Kamikage, Gang Yu, Tatsuo Oshikawa, Yasuo Takehara, Harumi Sakahara, Sophie Laurent, Carmen Burtea, L. Vander Elst, Robert N. Muller “Construction of DDS of Gd-DTPA Complex with Sugar Ball Dendrimer for Drawing Blood Vessels and Tumors by MRI” , ICOM2008, 13-18 July, 2008, Rennes, France
  9. Mitsuji Yamashita, Michio Fujie, Taishi Niimi, Takuya Suyama, Kazuhide Asai, Satoru Ito, Valluru Krishna Reddy, Hirono Totsuka, Junko Yamashita, Keisuke Ogawa, Nobuhisa Ozaki, Satoki Nakamura, “RESEARCH ON CANCER FINDING AND CHEMOTHERAPY AT THE EARLY STAGE --- EPOXIDATION AND BROMINATION OF 2-PHOSPHOLENES FOR PREPARATION OF PHOSPHA SUGARS AND THEIR BIOLOGICAL ACTIVITY” , XV International Conference on Chemistry of Phosphorus Compounds (ICCP-XV), 25-31 June, 2008, Saint-Petersburg, Russia
  10. M. Yamashita, T. Niimi, M. Fujie, V. Krishna Reddy, H. Totsuka, B. Haritha, M. Kasthuraiah Reddy, S. Nakamura, K. Asai, T. Suyama, G. Yu, M. Takahashi, and T. Oshikawa. “Highly stereoselective and stereospecific epoxidation of 2-phospholenes and N-glycosides of phospha sugars and their bioassays” , 17<sup>th</sup> International Conference on Phosphorus Chemistry, 43, Apr. 15-19, 2007, Xiamen, China.
  11. M. Yamashita, T. Iimi, M. Kasthuraiah, T. Suyama, K. Asai, M. Fujie, S. Nakamura, and T. Oshikawa, “Preparation of 2,3-bromides and 2,3-epoxides of phospholanes as analogues of phospha sugars and their important biological activities” , 21<sup>st</sup> International Congress for Heterocyclic Chemistry, 40, Jul. 15-20, 2007, Sydney, Australia.
  12. M. Yamashita, T. Niimi, M. Fujie, V. Krishna Reddy, H. Totsuka, B. Haritha, M.



- Kasthuraiah, S. Nakamura, K. Asai, T. Suyama, and T. Oshikawa, "Highly stereoselective and stereospecific epoxidation of 2-phospholenes to prepare bioactive phospho sugars and their N-Glycosides", 14<sup>th</sup> European Carbohydrate Symposium, 332, Sept. 2-7, 2007, Luebeck, Germany.
13. K. Ogawa, N. Ozaki, M. Fujie, M. Yamashita, G. Yu, K. Aoshima, M. Kobayashi, T. Kato, N. Kamikage, T. Aoki, H. Takayanagi, T. Oshikawa, Y. Takehara, H. Sakahara, S. Laurent, C. Burtea, L. Vander Elst, Robert N. Muller, "Studies on novel contrast agents for specific organs, blood vessels, and tumors", 14<sup>th</sup> European Carbohydrate Symposium, 159, Sept. 2-7, 2007, Luebeck, Germany.
  14. N. Ozaki, M. Yamashita, G. Yu, S. Ito, M. Fujie, K. Ogawa, T. Aoki, S. Mizuno, M. Sugiyama, K. Aoshima, M. Kobayashi, N. Kamikage, Y. Takehara, H. Sakahara, "Synthesis and evaluation of novel Gd-DTPA-Sugar compounds as MRI contrast agents", 5<sup>th</sup> Inter-academia 2007, Sept. 26-27, Hamamatsu, Japan.
  15. H. Kashihiro, Y. Kosaka, H. Nakagomi, S. Abe, and M. Yamashita, "Preparation and evaluation of super-hydrophilic coating materials bearing phosphate groups", 5<sup>th</sup> Inter-academia 2007, Sept. 26-27, Hamamatsu, Japan.
  16. Y. Otake, M. Yamashita, S. Ito, K. Kiyofuji, H. Mikami, T. Ogawa, M. Tsurumaki, and M. Fukumoto, "Biocompatible medical materials: Preparation of lubricative medical materials modified by PVP (Poly-Vinyl Pyrrolidone)", 5<sup>th</sup> Inter-academia 2007, Sept. 26-27, Hamamatsu, Japan.
  17. M. Yamashita, M. Fujie, J. Yamashita, K. Ogawa, K. Aoshima, N. Ozaki, T. Aoki, Y. Takehara, H. Sakahara, and S. Nakamura, "Research on Novel Sugar Dendritic MRI Contrast Agents for Cancer and Phospho Sugar Anti-cancer Material", 4<sup>th</sup> Tumor Progression & Therapeutic Resistance Conference, Oct. 4-5, in Philadelphia, PA. U.S.A.
  18. G. Yu, M. Yamashita, N. Kamikage, M. Takahashi, Y. Takehara, H. Sakahara, "A Nobel Series of Complexes as Contrast Agent for MRI", 23<sup>rd</sup> International Carbohydrate Symposium, 2006.7 (Whistler, Canada)
  19. M. Yamashita, H. Buchammagari, R. V. Krishna, T. Niimi, H. Totsuka, M. Takahashi, "Novel Synthesis of Phospho Sugar Derivatives and the Related Compounds", 23<sup>rd</sup> International Carbohydrate Symposium, 2006.7 (Whistler, Canada, 2006.7)
  20. M. Yamashita, et. al., "Some Recent Approaches towards Innovation of Cancer Therapy - Improvement of QOL of Patients and Novel Materials for Early Stage Findings and Medical Treatments for Tumors by Collaboration of Medical Sciences and Engineering", Inter-academia 2006 (Iasi, Romania, 2006.9)
  21. M. Yamashita, K. R. Reddy, H. Totsuka, H. Buchammagari, T. Niimi, M. Takahashi, T. Oshikawa, Highly Stereoselective and Stereospecific Epoxidation of 2-Phospholenes with Sodium Peroxide or Hydrogen Peroxide and Preparation of N-Glycosides of Phospho Sugars, 20<sup>th</sup> International Congress of Heterocyclic Chemistry, 285 (2005).
  22. M. Yamashita, K. Aoshima, M. Kobayashi, T. Kato, N. Kamikage, M. Takahashi, H. Takayanagi, T. Oshikawa, S. Laurent, C. Burtea, L. V. Studies on Novel MRI Contrast Agents for Targeting Organs and Blood Vessels, 13<sup>th</sup> European Carbohydrate Symposium, 120 (2005).
  23. M. Yamashita, Y. Hara, K. Aoshima, M. Kobayashi, T. Kato, N. Kamikage, M. Takahashi, H. Takayanagi, T. Oshikawa, Y. Takehara, H. Sakahara, Inter-academia 2005, 339-346

- (2005).
24. Mitsuji Yamashita, Yusuke Hara, Kengo Aoshima, Gang Yu, Masatsugu Kobayashi, Tatsunori Kato, Nao Kamikage, Masaki Takahashi, Hisao Takayanagi, Tatsuo Oshikawa, Yasuo Takehara, Harumi Sakahara, "Research and Development of Novel Sugar Dendritic MRI Contrast Agents for Imaging Blood Vessels and Tumors", Inter-Academia Proceedings, 339-346, Wuppertal, Germany (2005).
  25. Masaki Takahashi, Hironao Morimoto, Kentaro Miyake, Mitsuji Yamashita, Hideki Kawai, "Mechanistic Investigation of Fluorescence Resonance Energy Transfer Processes within Anthracene-Perylene Dendrimer Systems", Pacificchem 2005, Honolulu, USA (2005).
  26. Masaki Takahashi, Yousuke Suzuki, Mitsuji Yamashita, Hideki Kawai, "Synthesis and Photoluminescence Study of Amphiphilic Anthracene-Perylene Conjugates", Pacificchem 2005, Honolulu, USA (2005).
  27. Maddali K. Reddy, Taishi Niimi, Masaki Takahashi, Mitsuji Yamashita, "Novel Synthesis of Pentofuranose Analogs of Phospho Sugar Derivatives", Pacificchem 2005, Honolulu, USA (2005).
  28. Mitsuji Yamashita, Satoru Ito, Ryuta Miura, Hironori Mitarashi, Hidetomo Mikami, Masaki Takahashi, Tatsunori Kato, "Hemocompatible Surface Prepared by the Heparinization of Polyurethane for Medical Materials", Pacificchem 2005, Honolulu, USA, (2005)
  29. Gang Yu, Mitsuji Yamashita, Nao Kamikage, Masashi Takahashi, Yasuo Takehara, Harumi Sakahara, "Synthesis of Gadolinium Chelates of Novel DTPA Amido Esters for MRI", Pacificchem 2005, Honolulu, USA, (2005).
  30. K. Muramatsu, Y. Takehara, H. Sakahara, M. Yamashita, T. Nishikawa, N. Sadato, "Tumor Enhancement Characteristics of New Intravascular Contrast Agent Dendrimers DTPA-DiGlu(OH). Experimental Study with Hypervascular Hepatocellular Carcinoma of Rats". International Society for Magnetic Resonance in Medicine 13<sup>th</sup> Scientific Meeting, Miami Beach, Florida, USA, 7-13 May 2005.

#### (4) 知的財産

1. 山下光司、他「親水性多孔質粒状基材およびその製造方法、該親水性多孔質粒状基材を有する親水性コート剤」、特願 2008-235423、2008, 9, 12
2. 山下光司、他「ガドリニウム化合物及びMRI造影剤」特願 2008-136139 (2008)
3. Miura, Norio; Yamashita, Mitsuji. "Preparation of monosaccharide- and oligosaccharide-containing gadolinium compounds and contrast medium for MRI". PCT Int. Appl. (2008), 121pp. CODEN: PIXXD2 WO 2008044443 A1 20080417 CAN 148:485896 AN 2008:473521
4. Yamashita, Mitsuji; Fujie, Michio; Nakamura, Satoki. "Phospholane oxide derivatives and antitumor agents containing them." Jpn. Kokai Tokkyo Koho (2008), 23pp. CODEN: JKXXAF JP 2008195692 A 20080828 CAN 149:299788 AN 2008:1039680
5. Yamashita, Mitsuji; Takahashi, Masaki; Sakahara, Harumi; Takehara, Yasuo; Yu, Gang; Kato, Tatsunori; Kamikage, Nao. Gadolinium-DTPA derivative complexes as contrast medium specific to hypervascular tumors. PCT Int. Appl. (2006),
6. Yamashita, Mitsuji; Takahashi, Masaki; Kosaka, Yugo. Hydrophilization of bases, and coating agents and medical devices containing hydrophilized bases. Jpn.

Kokai Tokkyo Koho (2005).

7. Yamashita, Mitsuji; Takahashi, Masaki; Kosaka, Yugo. Hydrophilic substrates, their manufacture, and use for medical equipment. Jpn. Kokai Tokkyo Koho (2005).
8. Yamashita, Mitsuji; Valluru, Krishna Reddy. Preparation of epoxides via oxidation by metal peroxides. Jpn. Kokai Tokkyo Koho (2005).

## 阪原晴海

### (1) 著書

1. 阪原晴海: 前立腺がんの病期診断, 画像診断-2 (骨シンチグラフィ). 吉田修 監修, 大園誠一郎, 荒井陽一 編, インフォームドコンセントのための図説シリーズ, 前立腺がん. 大阪, 東京, 医薬ジャーナル社, 2008. pp34-39.
2. 竹原康雄, 阪原晴海, 大園誠一郎: 腎がんの検査, 画像診断. 吉田修, 大園誠一郎 編, インフォームドコンセントのための図説シリーズ, 腎がん. 大阪, 東京, 医薬ジャーナル社, 2007. pp36-45.
3. 阪原晴海, 監修: 静岡県核医学談話会 50 回記念、核医学検査ピットフォール集. 静岡県核医学談話会, 日本メジフィジックス株式会社, 2006.
4. 南山堂医学大辞典改訂 19 版. 東京, 南山堂, 2006.
5. 阪原晴海: 副腎など甲状腺以外の内分泌核医学. 吉田祥二, 中尾宣夫, 楢林 勇編, 画像鑑別診断クイックリファレンス 4, 泌尿器・生殖器・後腹膜・副腎. 京都, 金芳堂, 2005, pp95-104.
6. 阪原晴海: 画像検査. 香川靖雄, 近藤和雄, 石田 均, 門脇 孝編, 健康・栄養科学シリーズ, 人体の構造と機能及び疾病の成り立ち・総論. 東京, 南江堂, 2005, pp265-274.

### (2) 原著論文

1. Matoh F, Satoh H, Shiraki K, Saitoh T, Urushida T, Katoh H, Takehara Y, Sakahara H, Hayashi H: Usefulness of delayed enhancement magnetic resonance imaging to differentiate dilated phase of hypertrophic cardiomyopathy and dilated cardiomyopathy. J Card Fail 13 (5): 372-379, 2007
2. Isoda H, Inagawa S, Ito T, Takeda H, Takehara Y, Nozaki A, Sakahara H : Contrast-enhanced three-dimensional MR angiography with an elliptical centric view for the evaluation of intracranial aneurysms. Eur Radiol 17 (5): 1221-1225, 2007.
3. Yamashita S, Masui T, Katayama M, Sato K, Yoshizawa N, Seo H, Sakahara H: T2-weighted MRI of rectosigmoid carcinoma: comparison of respiratory-triggered fast spin-echo, breathhold fast-recovery fast spin-echo, and breathhold single-shot fast spin-echo sequences. J Magn Reson Imaging 25 (3): 511-516, 2007.
4. Yamashita S, Isoda H, Hirano M, Takeda H, Inagawa S, Takehara Y, Alley MT, Markl M, Pelc NJ, Sakahara H: Visualization of hemodynamics in intracranial arteries using time-resolved three-dimensional phase-contrast MRI. J Magn Reson Imaging 25 (3): 473-478, 2007.
5. Masui T, Katayama M, Kobayashi S, Nozaki A, Sugimura M, Ikeda M, Sakahara H: Magnetic resonance cholangiopancreatography: comparison of respiratory-triggered three-dimensional fast-recovery fast spin-echo with parallel imaging technique and breath-hold half-Fourier two-dimensional single-shot fast spin-echo technique. Radiat Med 24 (3): 202-209, 2006.
6. Isoda H, Hirano M, Takeda H, Kosugi T, Alley MT, Markl M, Pelc NJ, Sakahara H: Visualization of hemodynamics in a silicon aneurysm model using time-resolved, 3D,



- phase-contrast MRI. AJNR Am J Neuroradiol 27 (5): 1119-1122, 2006.
7. Kohgo H, Isoda H, Takeda H, Inagawa S, Sugiyama K, Yamashita S, Sakahara H: Visualization of spinal cord motion associated with the cardiac pulse by tagged magnetic resonance imaging with particle image velocimetry software. J Comput Assist Tomogr 30 (1): 111-115, 2006.
  8. Isoda H, Imai M, Inagawa S, Miura K, Sakahara H: Magnetic resonance imaging findings of angiosarcoma of the scalp. J Comput Assist Tomogr 29 (6): 858-862, 2005.
  9. Masui T, Katayama M, Kobayashi S, Sakahara H: Intravenous injection of high and medium concentrations of computed tomography contrast media and related heat sensation, local pain, and adverse reactions. J Comput Assist Tomogr 29 (5): 704-708, 2005.
  10. Saga T, Shimatsu A, Koizumi K, Ichikawa T, Yamamoto K, Noguchi S, Doi R, Ishibashi M, Machinami R, Nakamura K, Sakahara H, Endo K: Morphological imaging in the localization of neuroendocrine gastroenteropancreatic tumors found by somatostatin receptor scintigraphy. Acta Radiol 46 (3):227-232, 2005.

### (3) 国際会議発表

1. Tsuchimochi M, Hayama K, Oda T, Togashi M, Sakahara H: Evaluation of the efficacy of a small CdTe gamma-camera for sentinel lymph node biopsy. J Nucl Med 49 (6): 956-962, 2008.
2. Matoh F, Satoh H, Shiraki K, Odagiri K, Saitoh T, Urushida T, Katoh H, Takehara Y, Sakahara H, Hayashi H: The usefulness of delayed enhancement magnetic resonance imaging for diagnosis and evaluation of cardiac function in patients with cardiac sarcoidosis. J Cardiol 51 (3):179-188, 2008
3. Katayama M, Masui T, Sato K, Sugiyama M, Seo H, Nozaki A, Hirano M, Sakahara H: Preoperative assessment for pelvic adhesion: value of multi-phase and multi-slice kinematic FIESTA imaging. 92nd Scientific Assembly and Annual Meeting of the Radiological Society of North America, November, 2006, Chicago, USA.
4. Isoda H, Ohkura Y, Seo T, Kosugi T, Takeda H, Hirano M, Yamashita S, Inagawa S, Takehara Y, Nozaki A, Nagasawa K, Alley M, Markl M, Pelc N, Sakahara H: Preliminary study of in vivo hemodynamic analysis of intracranial aneurysms with the use of time-resolved three-dimensional phase-contrast MRI and in-house software. 18th Annual International Magnetic Resonance Angiography Workshop. September 13-15, 2006. Basel, Switzerland
5. Takahashi M, Takehara Y, Ichijo K, Tooyama N, Sakahara H, Nozaki A: Non-Breath-Hold Diffusion Weighted Imaging for the Body: Signal Characteristics, Artifacts and Lesion Conspicuity. 14th Scientific Meeting and Exhibition of International Society for Magnetic Resonance in Medicine: May 6-12, 2006, Seattle, Washington, USA
6. Isoda H, Yamashita S, Takeda H, Ohkura Y, Kosugi T, Takehara Y, Inagawa S, Hirano M, Alley MT, Markl M, Pelc NJ, Sakahara H. Preliminary study of wall shear stress of an intracranial aneurysmal model based on the data of Time-Resolved Three-Dimensional Phase-Contrast MRI. 14th scientific meeting and exhibition of International Society for Magnetic Resonance in Medicine. May 6-12, 2006, Seattle, Washington, USA.
7. Takehara Y, Isoda H, Yamashita S, Takeda H, Ohkura Y, Kosugi T, Hirano M, Alley MT, Markl M, Pelc NJ, Sakahara H. Assessment of the wall shear stress (WSS) of the

- abdominal aortic aneurysm using time-resolved three-dimensional phase-contrast MRI (4D-Flow) and a new WSS mapping application (Flowa). 14th scientific meeting and exhibition of International Society for Magnetic Resonance in Medicine. May 6-12, 2006, Seattle, Washington, USA.
8. Yamashita S, Isoda H, Takeda H, Okura Y, Kosugi T, Inagawa S, Takehara Y, Hirano M, Nozaki A, Alley MT, Pelc NJ, Sakahara H. Analysis of wall shear stress of intracranial arteries using time-resolved three-dimensional phase-contrast MR Imaging: preliminary report. 44th Annual Meeting of American Society of Neuroradiology. Apr 29-May 5, 2006, San Diego, USA.
  9. Isoda H, Yamashita S, Takeda H, Ohkura Y, Kosugi T, Takehara Y, Inagawa S, Hirano M, Alley MT, Markl M, Pelc NJ, Sakahara H. Preliminary study of wall shear stress of an intracranial aneurysmal model based on the data of Time-Resolved Three-Dimensional Phase-Contrast MRI. 44th Annual Meeting of American Society of Neuroradiology. Apr 29-May 5, 2006, San Diego, USA.
  10. Isoda H, Nishino K, Kosugi T, Inagawa S, Sakahara H. Visualization of hemodynamics in silicon intracranial aneurysm models with the use of stereoscopic particle image velocimetry. 44th Annual Meeting of American Society of Neuroradiology. Apr 29-May 5, 2006, San Diego, USA.
  11. Takehara Y, Isoda H, Hirano M, Alley M, Markl M, Pelc N, Sakahara H, et al: In-vivo hemodynamic analysis of splanchnic arteries affected by aortic dissection using time-resolved 3D phase-contrast MR imaging. 91th Scientific Assembly and Annual Meeting of the Radiological Society of North America, November 27-December 2, 2005, Chicago, USA
  12. Masui T, Katayama M, Sato K, Yoshizawa N, Koide M, Sasaki K, Sakahara H, et al: 16 Multidetector-row CT of the congenital heart diseases with and without surgical procedure in the children. 91th Scientific Assembly and Annual Meeting of the Radiological Society of North America, November 27-December 2, 2005, Chicago, USA.
  13. Takehara Y, Takahashi M, Ichijo K, Tooyama N, Amano T, Nozaki A, Sakahara H, et al: Improved localization and staging of bladder cancer with use of non-breath-hold diffusion-weighted imaging. 91th Scientific Assembly and Annual Meeting of the Radiological Society of North America, November 27-December 2, 2005, Chicago, USA.
  14. Inagawa S, Nishio A, Isoda H, Kosugi T, Sakahara H: In vitro simulation system for endovascular intervention in neuroradiology. 8<sup>th</sup> Congress of World Federation of Interventional and Therapeutic Neuroradiology. October 19-22, 2005 Venece, Italy
  15. Inagawa S, Isoda H, Yamashita S, Hirano M, Takeda H, Takehara Y, Nozaki A, Nagasawa K, Alley MT, Markl M, Pelc NJ, Sakahara H: In vivo visualization of hemodynamics in intracranial arteries using: time-resolved three-dimensional phase-contrast MRI. 8<sup>th</sup> Congress of World Federation of Interventional and Therapeutic Neuroradiology. October 19-22, 2005 Venece, Italy
  16. Inagawa S, Isoda H, Hirano M, Takeda H, Yamashita S, Kosugi T, Takehara Y, Nozaki A, Nagasawa K, Alley MT, Markl M, Pelc NJ, Sakahara H: Visualization of hemodynamics in a silicon aneurysm model using time-resolved three-dimensional phase-contrast MRI. 8<sup>th</sup> Congress of World Federation of Interventional and Therapeutic Neuroradiology. October 19-22, 2005 Venece, Italy
  17. Sakahara H, Yamashita S: SPECT/CT in <sup>131</sup>I imaging. 5th Hamamatsu-Kyungpook Joint



- Medical Symposium, September 23, 2005, Daegu, Republic of Korea.
18. Isoda H, Hirano M, Takeda H, Yamashita S, Inagawa S, Kosugi T, Takehara Y, Nozaki A, Nagasawa K, Alley M, Markl M, Pelc N, Sakahara H. Visualization of hemodynamics in intracranial arteries and aneurysms using time-resolved 3D phase-contrast MRI. 17th Annual International Magnetic Resonance Angiography Workshop. September 21-23, 2005. Beijing, China
  19. Yamashita S, Isoda H, Hirano M, Takeda H, Inagawa S, Takehara Y, Nozaki A, Nagasawa K, Alley M, Markl M, Pelc N, Sakahara H. Visualization of hemodynamics in intracranial arteries using time-resolved three-dimensional phase-contrast MRI. 43rd Annual Meeting of American Society of Neuroradiology. May 23-27, 2005. Toronto, Canada
  20. Isoda H, Hirano M, Takeda H, Yamashita S, Inagawa S, Kosugi T, Takehara Y, Nozaki A, Nagasawa K, Alley M, Michael M. Pelc N, Sakahara H. Visualization of hemodynamics in the field of neuroradiology using time-resolved three-dimensional phase-contrast MRI. 43rd Annual Meeting of American Society of Neuroradiology. May 23-27, 2005. Toronto, Canada
  21. Isoda H, Hirano M, Takeda H, Yamashita S, Inagawa S, Kosugi T, Takehara Y, Nozaki A, Nagasawa K, Alley M, Markl M, Pelc N, Sakahara H. Visualization of hemodynamics in a silicon aneurysm model using time-resolved three-dimensional phase-contrast MRI. 43rd Annual Meeting of American Society of Neuroradiology. May 23-27, 2005. Toronto, Canada
  22. Yamashita S, Isoda H, Hirano M, Takeda H, Inagawa S, Takehara Y, Nozaki A, Nagasawa K, Alley Ma, Markl M, Pelc N, Sakahara H. Visualization of hemodynamics in intracranial arteries using time-resolved three-dimensional phase-contrast MRI. 13rd scientific meeting and exhibition of International Society for Magnetic Resonance in Medicine. May 7-13, 2005. Miami Beach, Florida, USA
  23. Isoda H, Hirano M, Takeda H, Yamashita S, Inagawa S, Kosugi T, Takehara Y, Nozaki A, Nagasawa K, Alley M, Markl M, Pelc N, Sakahara H. Visualization of hemodynamics in a silicon aneurysm model using time-resolved three-dimensional phase-contrast MRI. 13rd scientific meeting and exhibition of International Society for Magnetic Resonance in Medicine. May 7-13, 2005. Miami Beach, Florida, USA
  24. Muramatsu K, Takehara Y, Sakahara H, Yamashita M, Nishikawa T, Sadato N: Tumor enhancement characteristics of new intravascular contrast agent dendrimers DTPA-D1Glu(OH). Experimental study with hypervascular hepatocellular carcinoma of rats. 13rd scientific meeting and exhibition of International Society for Magnetic Resonance in Medicine. May 7-13, 2005. Miami Beach, Florida, USA

#### (4) 国内学会発表

1. 分子イメージングによる腫瘍診断の現状. 日本放射線技術学会第42回中部部会学術大会. 2007.11.10 (浜松)
2. RI測定的基础. 初心者のための核医学講習会. 第7回日本核医学会春季大会. 2007.5.18-20 (倉敷)
3. 阪原晴海: RI測定的基础. 初心者のための核医学講習会. 第6回日本核医学会春季大会. 2006.5.26-28 (さいたま)
4. 阪原晴海: 腫瘍核医学の将来展望. 第46回日本歯科放射線学会総会教育講演. 2005.5.14 (新潟)

## (5) 知的財産

1. 発明の名称：ガドリニウム化合物及びMRI用造影剤  
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2. 発明の名称：ガドリニウム錯体の製造方法  
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3. 発明の名称：凍結治療装置  
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出願番号：特願 2007-286595 (2009.11.2)
4. 国際出願  
発明の名称：ジエチレントリアミン五酢酸誘導体、ガドリニウム-ジエチレントリアミン五酢酸誘導体の錯体及びMRI造影剤並びに富血性腫瘍特異性造影剤  
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国際出願日：2006年3月7日  
国際出願番号：PCT/JP2006/304409  
国際公開番号：WO 2006/095745 A1  
国際公開日：2006年9月14日
5. 発明の名称：富血性腫瘍得意性造影剤  
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出願人：国立大学法人静岡大学，国立大学法人浜松医科大学  
出願番号：特願 2005-062340 (2005.3.7)
6. 発明の名称：流れ場可視化装置，液体流路モデルの製造方法及び血流シミュレーション方法  
発明者：阪原晴海，磯田治夫，稲川正一，磯貝聡，西野耕一，武田伸一郎，小杉隆司  
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出願番号：特願 2003-202537 (2003.7.28)  
公開番号：特開 2005-040299 (2005.2.17)
7. 発明の名称：新規な dendrimer および造影剤  
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出願番号：特願 2003-99222 (2003.4.2)  
公開番号：特開 2004-307356 (2004.11.4)

## 間賀田泰寛

### (1) 著書

1. Ishida Y, Kawai K, Magata Y, Ebihara K, Takeda R, Abe H, Yoshimoto M, Hashiguchi H, Odagiri K, Matsuo H, Nishimori T Differential Expression of Fos and Zif268 in the