MR :   [1]

                    [1, 2]   [1, 3]   ·   ·   ·

            :   MR
                                       ,   .
            :   4
            (Passager   ,   , Wallstent, Memotherm   )
                                          1.5T   MR   efGRE (enhanced fast
gradient recalled echo) 3D MR   .
                                          3   .

            .
            :   Passager   ,
        , Wallstent, Memotherm   .
            ,   ,
                    .
            : Passager   MR
                                                                                              .

                    ,   ,
                                                        .

                                    (percuta-
neous transluminal angioplasty)   ,
                                                                (11-13).
            (metallic stent)   , Dotter   (magnetic resonance imaging,   MRI
            (coil-spring)   )
    (1),   (Nitinol)   , Palmaz   ,   (14),   (mag-
Wallstent, Memotherm   , Gianturco-Rösch   netic susceptibility artifact)
                                        (2-5).   (15, 16).
                                                                                        ,   ,   ,
            (duplex sonography)
            (6-8).   MRI
            ,   ,   (17-19),
                                    (9, 10),   MRI   (9, 10,
2-3%   (11,   19, 20).
12).   MRI   (9, 10,
                                                                          MR   (contrast enhanced MR angiog-
[1]
[2]
[3]
raphy)   .

MR

           , (imaging parameter)
               .

                                      Walls-
tent(Schneider, minneapolis, MN, U.S.A.), Passager
(Boston scientific vascular, Natick, MA, U.S.A.), Memo-
therm (Bard-Angiomed, Karlsruhe, Ger-many),
(home made wire mesh braid stent)
   4   . Wallstent
0.12mm   (-   -
       -   ) 24
    ,
       . Passager   0.27mm
     Zig-Zag
          Passager   graft   graft
         . Memotherm
              0.15mm   .
    0.22mm   ,
                .

           (vascular phantom)
(Fig. 1).   1.72mMol copper sulfate
            ,
         (hemodialysis pump)
    .   1cm
  0.4mMol   500ml/min
           MR   .
  MR   1.5 T   MR (Signa Advantage, GEMS,
Milwaukee, Wisconsin, U.S.A.)   ,
efGRE(enhanced fast gradient recalled echo) 3D MR
              .   (in-
version time), 26msec; TR, 6.2msec; TE, 1.1msec;
  (flip angle), 20 ;   (field of view), 40cm;
(slab thickness), 30mm; (partitions), 16;   (matrix
number), 256× 192;   (acquisition number), 1
       27   .
     Memotherm   , (20cm,
30cm, 40cm);   , (5 , 20 , 50);   , (256× 128, 256
× 192, 256× 256);   (bandwidth), (15kHz, 31.3kHz,
62.5kHz)   efGRE 3D MR
          MR
    .

        ,   ,
         3

                 :   MR
                      .
                          ,
        1/3   +, 1/3-2/3 ++, 2/3
+++   .   1/3
+, 1/3-2/3 ++, 2/3   +++   .

   4   .
   Memotherm
    ,
         .

Passager   ,
            .
             2/3
Passa-ger   . Wallstent
     1/2   ,   1/2
   . Memotherm
           .   Passager   ,   ,
Wallstent, Memo-therm
  (Table 1) (Fig. 2).
                    (Fig
3),   ,   (Fig 4)
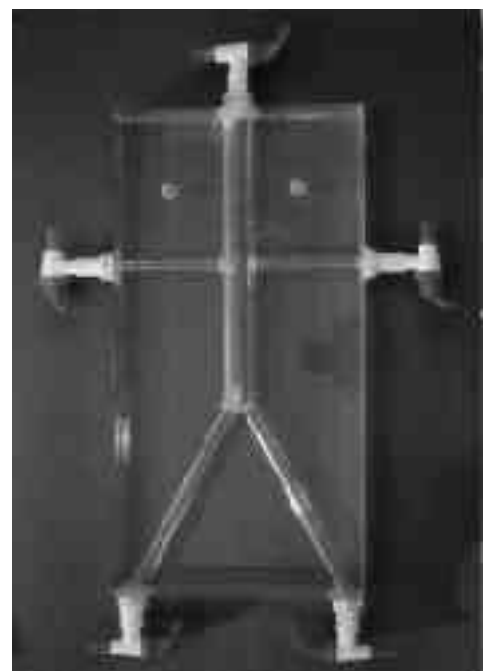
Fig. 1. **Photography of abdominal aorta shaped acrylic phantom.**

.

(Fig 5).

Table 1. Comparison of Four Types of Metallic Stents

	Passager stent	Nitinol stent	Wallstent	Memotherm stent
Width of high SI	+++	+++	++	+
Length of high SI	+++	+++	++	+
Rank	1	2	3	4

+ less than 1/3 to normal
++ 1/3-2/3 to normal
+++ more than 2/3 to normal
SI : signal intensity

,

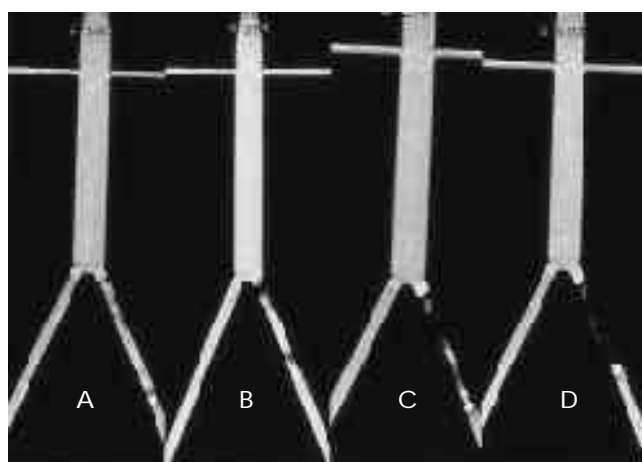(6-8).

MR

(14),

(15, 16).

.

,

Fig. 2. MR angiography images of abdominal aorta shaped phantom filled with Passager stent (A), Nitinol stent (B), Wallstent (C), and Memotherm stent (D). The width and length of high signal intensity with Passager stent and Nitinol stent are lager than with Wallstent and Memotherm stent.

Fig. 4. Effect of flip angle on MR angiography images in Memotherm stent. A-C, MR images at flip angle of 5 ° (A), 20° (B), and 50° (C). The larger the flip angle, the larger the width and length high signal intensity in the metallic stent.

Fig. 3. Effect of field of view on MR angiography images in Memotherm stent. A-C, MR images at field of view of 20cm (A), 30cm (B), and 40cm (C). The larger the field of view, the larger the width and length of high signal intensity in the metallic stent.
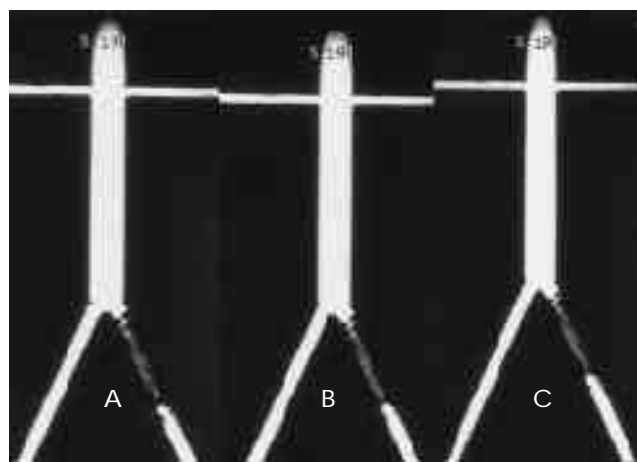

Fig. 5. Effect of bandwidth on MR angiography images in Memotherm stent. A-C, MR images at bandwidth of 15kHz (A), 31.5kHz (B), 62.5kHz (C). There is no difference of degree of high signal intensity according to the bandwidths.

: MR

(21).

Ernst   TR   T 1

, ,   (gradient strength),   ,

(voxel size),   5 , 20 , 50

(21-24).   Ernst   - -

(ferromagnetic)   ,   ,   .

,   (21),

,

(9, 10, 17-19).   (9)

Gianturco-Rösch   - -

,   .

Wallstent

Memotherm   T 1-   Passager

T 2-   .

MR   3D MR

(10).

,   .

(22),

.   ,   ,

(22, 25).

MR   ,

(gradient-recalled echo)   .

3D MR   .   3D MR

,   T 1-

(26, 27).   3D

MR   (time-of-flight)

(flow and saturation)   (26).

MR

.   Passager

,   Passager

.

Wallstent   Memotherm

.   Wallstent

,

.

,

,

.

(21, 22)

(,   )

,

- -

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Contrast Enhanced MR Angiography after Metallic Stent Placement : Experimental Study[1]

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Purpose : The purpose of this study was to evaluate the efficacy of contrast-enhanced MR angiography for follow-up examinations after metallic stent placement and to examine the effects of change of imaging parameters used for contrast-enhanced MR angiography.

Materials and Methods : After four metallic stents (Passager, Ninitol, Wallstent, and Memotherm) were placed in an abdominal aorta shaped vascular phantom, efGRE (enhanced fast gradient recalled echo) 3-D MR angiography was performed, using a 1.5T unit. The four metallic stents were graded 1-3 according to the width and length of their high signal intensity. Variations in the degree of high signal intensity were evaluated according to imaging parameters.

Results : The width and length of high signal intensity with the Passager stent and Nitinol stent were greater than with the Wallstent and Memotherm. The larger the field of view, the smaller the matrix number, the larger the flip angle, the greater the width and length of high signal intensity in the metallic stent.

Conclusion : Contrast-enhanced MR angiography may be a useful follow-up procedure after the placement of Passager and Ninitol metallic stents. The signal intensity of stent lumen varies according to imaging parameters, and the selection of optimal parameters is therefore important.

Index words : Metallic devices
  Phantoms
  Magnetic resonance (MR), angiography

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