

‘2000

¹⁶⁶Ho-coated balloon 가
Development of radioactive ¹⁶⁶Ho-coated balloon
and its dose estimation

150

¹⁶⁶Ho coating

가 . Monte Carlo

Abstract

The use of balloon with radioisotope is a promising method to prevent restenosis after transluminal coronary arterial angioplasty or stent implantation. In this study, we have developed a new radioactive coated balloon, which is prepared by coating the surface of existing balloon with ¹⁶⁶Ho instead of being filled with beta sources which emit high energy beta-particles for the purpose of the delivery of sufficient radiation to the vessel wall. To estimate the safety of ¹⁶⁶Ho-coated balloon, leaching test and radiation resistance test of the balloon were performed. The absorbed dose distributions around the ¹⁶⁶Ho-coated balloon were estimated by means of Monte Carlo simulation and the initial activities for optimal therapeutic regimen were determined on the basis of this results.

1.

95%
vascular remodeling
40%
extracellular matrix
, matrix
(1-6)
 ^{166}Ho
stent
 ^{166}Ho - Stent
 $\text{Ho}(\text{NO}_3)_3$
가 (13,14)
 ^{166}Ho 100%
DTPA
 ^{166}Ho - DTPA가
가
가 PTCA
(7)
 ^{166}Ho coating
mCi, 10- 100 mCi
가 (7)
EGS4 code system
 ^{166}Ho coated balloon
 ^{166}Ho
 ^{166}Ho balloon

2.

- Dose calibrator : Capintec 15R, BIODEx Atomlab 200
- Holmium nitrate pentahydrate, 99.9 % Aldrich
- Tetrahydrofuran (THF) : Merck

- Dimethylformamide (DMF) : Merck
- Polyurethane ()
- Alpha PTCA balloon catheter (amg GmbH)
- Coating device of radioactive balloon

3.

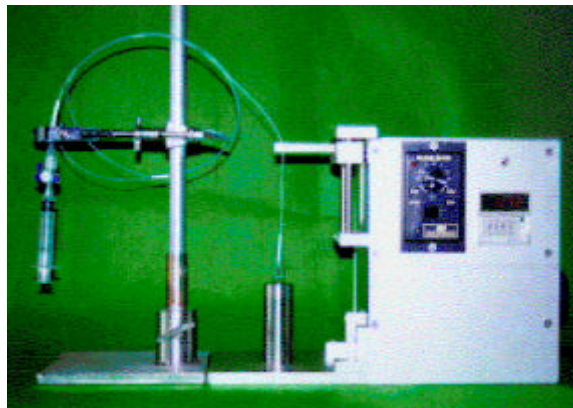
1) ¹⁶⁶Ho coated balloon

¹⁶⁵Ho(NO₃)₃ (: 1.25 × 10¹³ n/cm² · sec,
 power : 20MW) ¹⁶⁶Ho(NO₃)₃ (100 mCi/ml) 10
 ml vial IR Lamp . THF : DMF (10 : 1)
 polyurethane 700 mg 1 ml vial
 2-3 . 0.35 ml pyrex ampoule
 balloon coating (. 1)

¹⁶⁶Ho

¹⁶⁶Ho-coated balloon .

THF가



1. ¹⁶⁶Ho-coated balloon

2) 가

2-1)

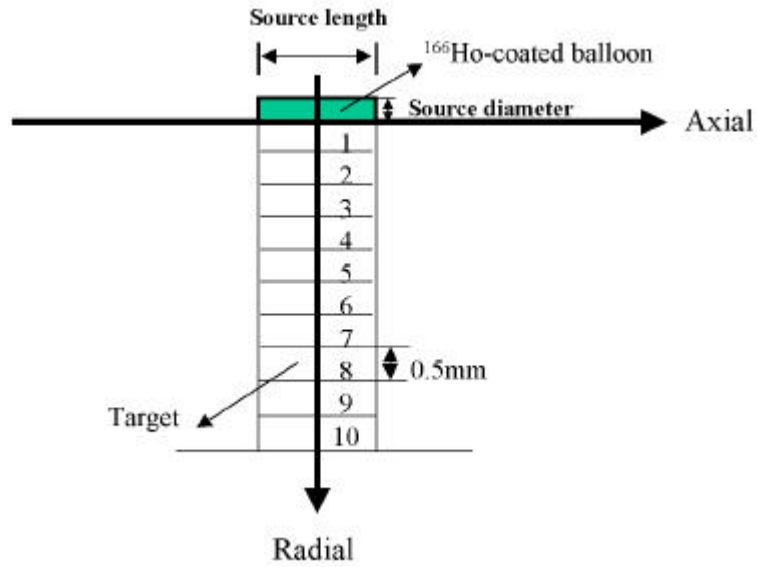
¹⁶⁶Ho balloon (1, 5, 1)
37
1 20%
NaBH₄ Na₂CO₃

2-2) (Radiation resistance test of balloon)

¹⁶⁶Ho 가 가 37
GBq(1 Ci) ¹⁶⁶Ho(NO₃)₃ 가 10 atm.
inflation 10 mm
vial EGS4
code system 1.17MGy

3)

coated balloon catheter
¹⁶⁶Ho - EGS4 code system^(8,9)
2 2.4mm, 25mm 0.5 mm 10
가
Soft tissue⁽¹⁰⁾
¹⁶⁶Ho 2.4mm, 25mm
balloon wire 1 mm, 20 mm



2.

4.

balloon
balloon (3).
10 - 20 μm
 ^{166}Ho matrix
 ^{166}Ho matrix
matrix ^{166}Ho
matrix $^{165}\text{Ho}(\text{NO}_3)_3 \cdot 5\text{H}_2\text{O}$

Balloon $\text{Ho}(\text{NO}_3)_3$
 ^{166}Ho -coated balloon 37 1
20% 가
 ^{166}Ho balloon NaBH_4 Na_2CO_3
 ^{166}Ho -coated balloon Ho 0.5%
 ^{166}Ho 가 (1 Ci)

EGS4 code system 2.4mm 가 25mm
 ^{166}Ho -coated balloon β
1 2 20 Gy 0.5 mm target depth
0.5 mm 23.05 cGy/s
per GBq (0.853 cGy/s per mCi, uncertainty : 0.90%) 20 Gy

180

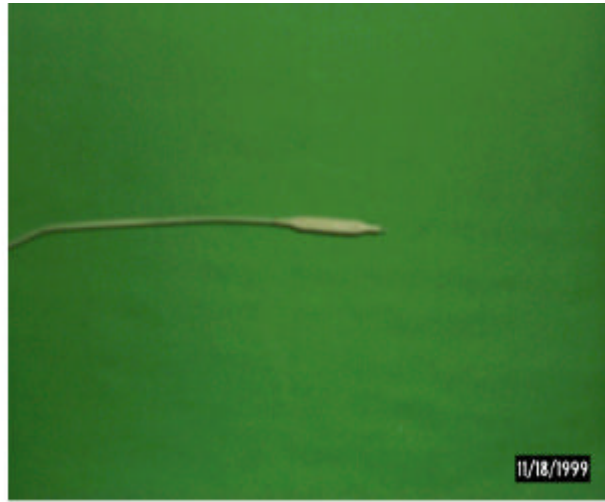
13.04 mCi .

¹⁶⁶Ho

12.51 cGy/s per GBq (0.463 cGy/s per

mCi, uncertainty : 1.32%)

¹⁶⁶Ho-coated balloon



5.

¹⁶⁶Ho balloon NaBH₄ Na₂CO₃ 10mCi
¹⁶⁶Ho-coated balloon (1 , 5 , 1)
 40 μCi, 40 μCi 50 μCi 0.5%

(liquid-filled balloon)

⁹⁰Y, ³²P ¹⁸⁸Re

¹⁶⁶Ho
 가 . ¹⁶⁶Ho-coated balloon balloon

가

6.

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1. ¹⁶⁶Ho-coated balloon

Target Depth (mm)	Absorbed Dose Rate due to β -particles	
	cGy/s per GBq	cGy/s per mCi
0.0 - 0.5	23.05	0.853
0.5 - 1.0	9.61	0.356
1.0 - 1.5	5.29	0.196
1.5 - 2.0	3.07	0.114
2.0 - 2.5	1.8	0.067
2.5 - 3.0	1.04	0.038
3.0 - 3.5	0.59	0.022
3.5 - 4.0	0.32	0.012
4.0 - 4.5	0.16	0.006
4.5 - 5.0	0.08	0.003

2. ¹⁶⁶Ho-coated balloon

20 Gy

(sec)	*	*	(sec)	*	*
	(mCi)	(mCi/cm ²)		(mCi)	(mCi/cm ²)
60	39.10	20.75	160	14.67	7.78
70	33.51	17.78	170	13.80	7.32
80	29.33	15.56	180	13.04	6.92
90	26.07	13.83	190	12.35	6.55
100	23.46	12.45	200	11.74	6.22
110	21.33	11.32	210	11.18	5.93
120	19.55	10.37	220	10.67	5.66
130	18.05	9.57	230	10.21	5.41
140	16.76	8.89	240	9.78	5.19
150	15.64	8.30	250	9.39	4.98

* 0.5 mm target depth