APPLICATION OF GLASS CLASSIFICATION OF INFRAINGUINAL ENDOVASCULAR THERAPY IN PATIENTS CHRONIC LIMB-THREATENING ISCHEMIA

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ABSTRACT

- ***Introduction***The Global Vascular Guideline (GVG) proposes a new Global Anatomic Staging System (GLASS), which involves defining a preferred target artery path (TAP) and then estimating limb-based patency (LBP), resulting in three stages of complexity for intervention.

- ***Objective***: Describe clinical characteristics, arterial lesions and endovascular interventions according to 3 grades of GLASS. Evaluation the possibility of technical success in the intervention of the inferior femoral artery, the ability to preserve the limb according to the GLASS classification.

- ***Subjective, methods***: All Patients - CLTI at the Department of Thoracic and Vascular Surgery, University Medical Center. Ho Chi Minh City from June 2020 to June 2022. This is retrospective study describes a series of cases.

- ***Results***: The study sample with 92 lower limbs was surveyed on 92 patients. In which, lesions of GLASS class I, II and III accounted for 34.8%, 42.4% and 22.8%, respectively. The rate of technically successful intervention in the group that gradually decreased according to the complexity of the lesion was 93.75%, 84.62% and 61.9%, respectively.

- ***Conclusions***: In patients with chronic limb-threatening ischemia of the higher GLASS grade, the lower the rate of technical success, preserving the limb; while, the intervention time and complication rate are higher.

Introduction

- PAD - CLTI

- CLTI is a clinical syndrome defined by the presence of peripheral artery disease (PAD) in combination with rest pain, gangrene, or a lower limb ulceration >2 weeks duration.
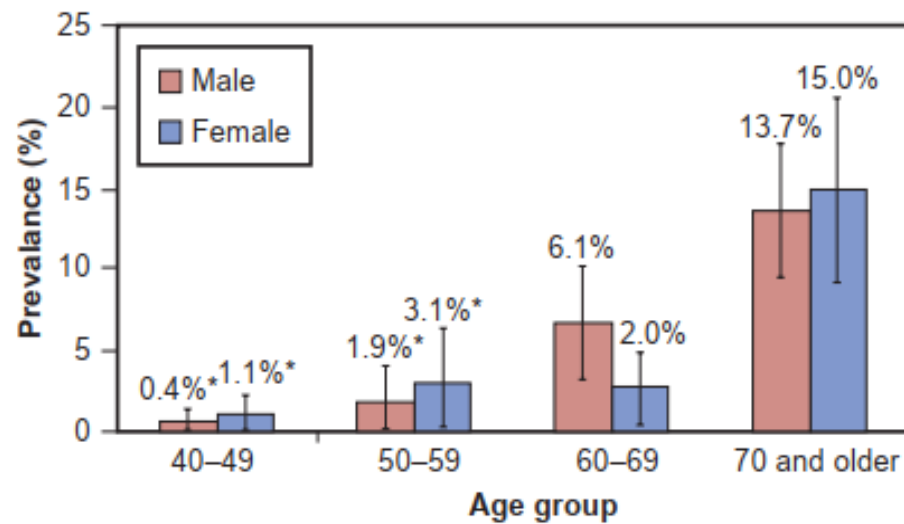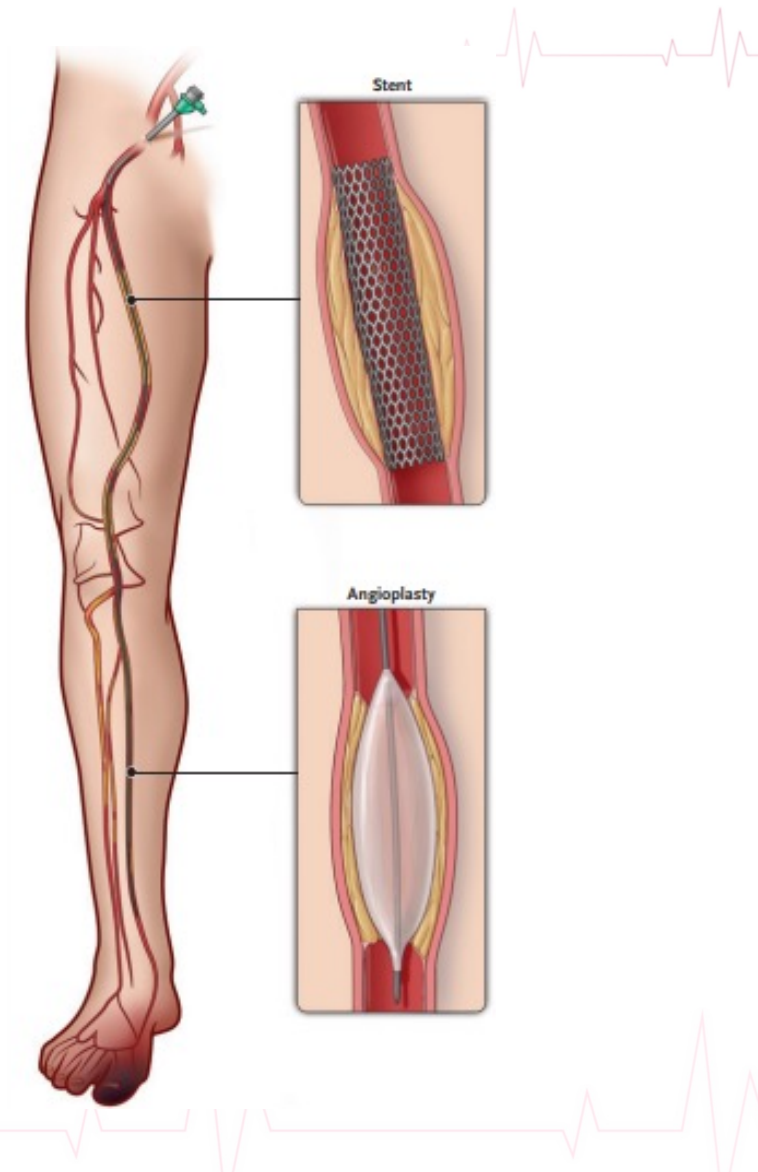
# Introduction

GLASS 2019

PLAN:

1. Patient risks
2. Limb status – Wifi
3. Anatomical Pattern – GLASS

GLASS

Michael S. Conte, Andrew W. Bradbury, Philippe Kolh et al Global vascular guidelines on the management of chronic limb-threatening ischemia 2019.

The 2019 GVG recommended prioritizing research that could provide better evidence to validate the GLASS, particularly for endovascular strategies in different stages of infrainguinal disease.
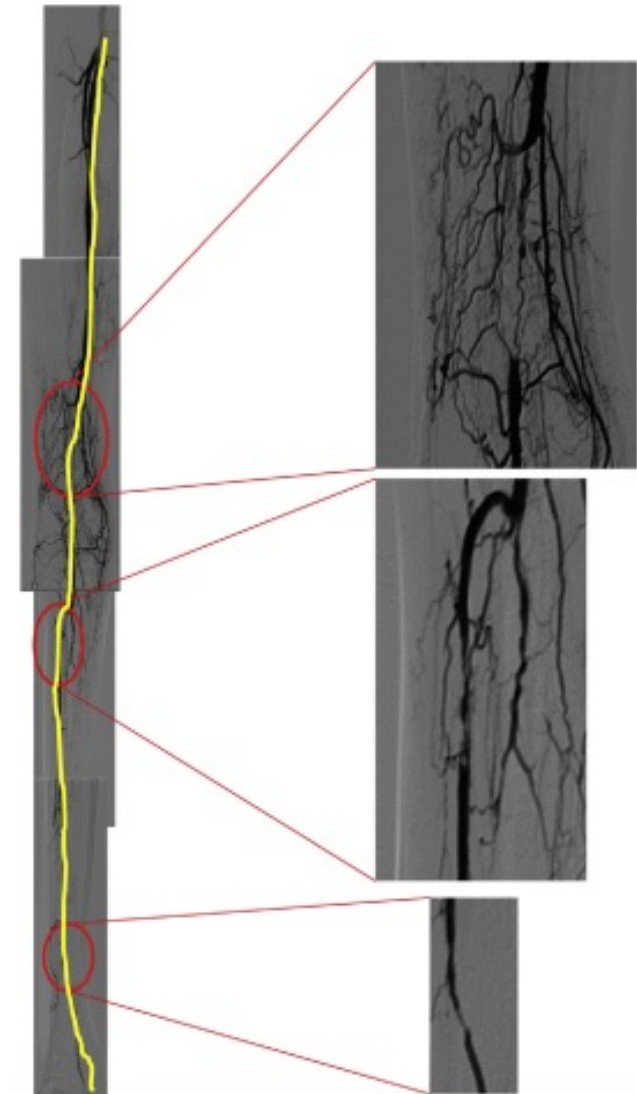
Infra-malleolar/Pedal descriptor	
P0	Target artery crosses ankle into foot, with intact pedal arch
P1	Target artery crosses ankle into foot; absent or severely diseased pedal arch
P2	No target artery crossing ankle into foot
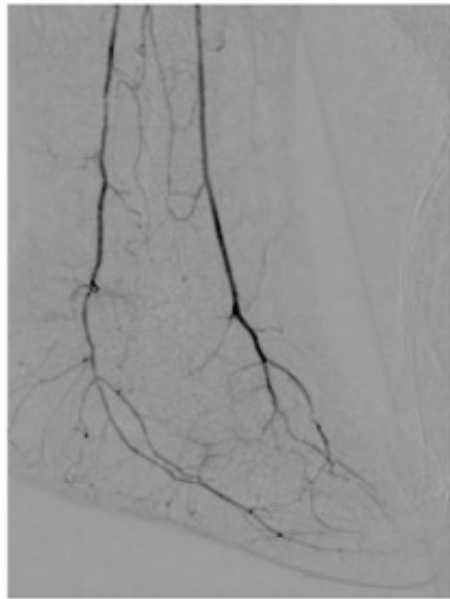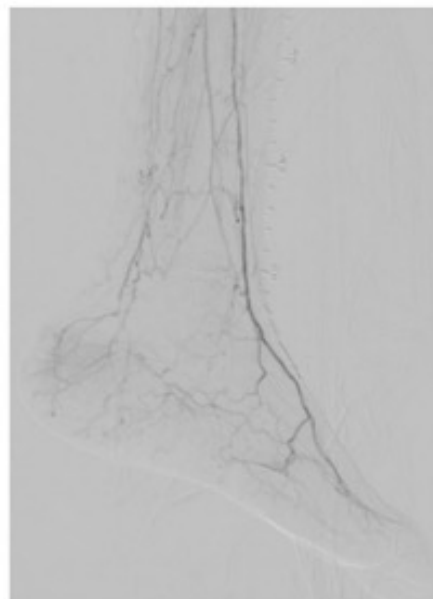
P0 **P1** **P2**

GLASS

Table 1. **(A)** Original/Composite Femoropopliteal (FP) disease grading in GLASS. **(B)** Original/Composite Infrapopliteal (IP) disease grading in GLASS.

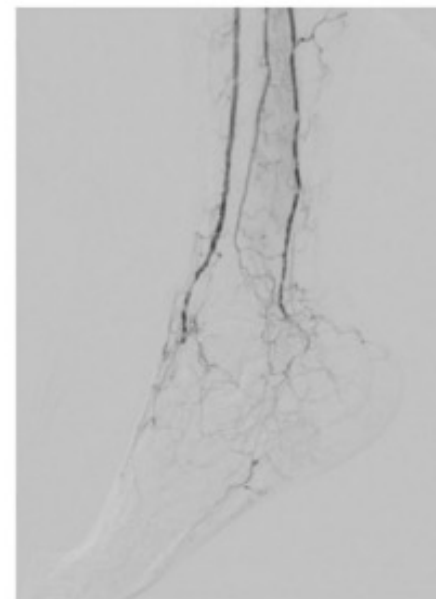| (A)	
Femoro-Popliteal (FP) Grading	
0	Mild or no significant (<50%) disease
1	Total length SFA disease <1/3 (<10 cm); may include single focal CTO (<5 cm) as long as not flush occlusion; popliteal artery with mild or no significant disease
2	Total length SFA disease 1/3–2/3 (10–20 cm); may include CTO totaling <1/3 (10 cm) but not flush occlusion; focal popliteal artery stenosis <2 cm, not involving trifurcation
3	Total length SFA disease >2/3 (>20 cm) length; may include any flush occlusion <20 cm or non-flush CTO 10–20 cm long; short popliteal stenosis 2–5 cm, not involving trifurcation
4	Total length SFA occlusion >20 cm; popliteal disease >5 cm or extending into trifurcation; any popliteal CTO

Table 1. *Cont.*

(B)	
Infra-Popliteal (IP) Grading	
0	Mild or no significant (<50%) disease
1	Focal stenosis <3 cm not including TP trunk
2	Total length of target artery disease <1/3 (<10 cm); single focal CTO (<3 cm not including TP trunk or target artery origin)
3	Total length of target artery disease 1/3–2/3 (10–20 cm); CTO 3–10 cm (may include target artery origin, but not TP trunk)
4	Total length of target artery disease >2/3 length; CTO >1/3 (>10 cm) of length (may include target artery origin); any CTO of TP trunk

GLASS

FP Grade	Infrainguinal GLASS stage (I-III)				
4	III	III	III	III	III
3	II	II	II	III	III
2	I	II	II	II	III
1	I	I	II	II	III
0	NA	I	I	II	III
	0	1	2	3	4
	IP Grade				

NA. Not applicable

After selection of the target arterial path (TAP), the segmental femoropopliteal (*FP*) and infrapopliteal (*IP*) grades are determined from high-quality angiographic images. Using the table, the combination of FP and IP grades is assigned to GLASS stages I to III, which correlate with technical complexity (low, intermediate, and high) of revascularization.

RESEARCH OBJECTIVE

*Evaluate the relationship between GLASS grade and possibility of **Technically Successful Endovascular Intervention** and **Limb Preversion**.*

Research Method

- Retrospective

- From June 2020 to June 2022.

- Sample: 92 lower limbs in 92 patients.

- **Selection criteria**:

- Patients with CLTI according to the global vascular disease guidelines (GVG) are treated with endovascular intervention / DSA
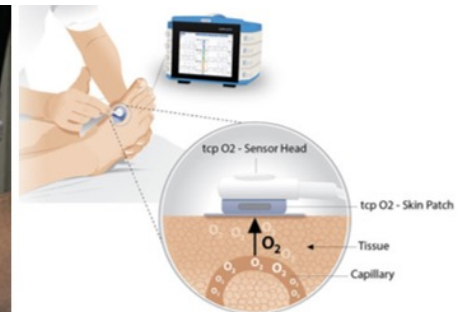
Research Method

- **Exception**:

- Patients with narrowing > 50% or occlusion of the attached aorta-iliac artery.

- Patients have been treated to reduce and occlude the bottom layer of the artery comfortably using bypass, vascular grafting or Hybrid techniques on the same side of the previously intervened leg.

- Patients have the following accompanying diseases: inflammation, vasculitis, Buerger's disease, venous disease, connective tissue disease...

RESULTS – DISCUSSION
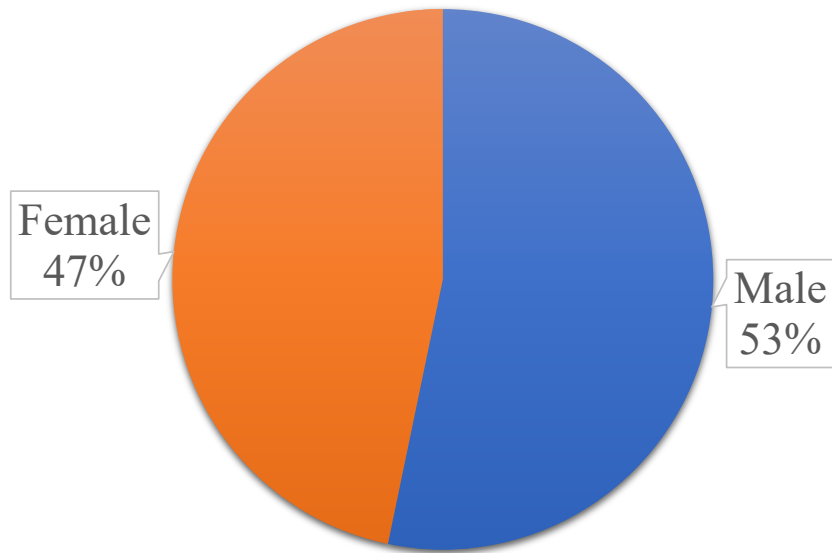
	GLASS I N = 32	GLASS II N = 39	GLASS III N = 21	p
Age	73,56 ± 8,72	70,85 ± 12,02	70.86 ± 9,88	0,5**
Male	17 (53,13%)	21 (53,84%)	11 (52,38%)	0.994*

	GLASS I N = 32	GLASS II N = 39	GLASS III N = 21	p
Smoking	13 (40,63)	22 (56,41)	9 (42,86)	0,363*
Diabetes	19 (59,38)	25 (64,10)	15 (71,43)	0,67*
Hypertension	22 (68,75)	34 (87,18)	18 (85,71)	0,118*
Coronary Artery Disease	13 (40,63)	24 (61,54)	12 (57,14)	0,197*
Heart Failure	4 (12,5)	16 (41,03)	8 (38,09)	0,023*
Haemodialysis	4 (12,5)	8 (20,51)	4 (19,05)	0,658*
Cerebrovascular disease	2 (6,25)	3 (7,69)	2 (9,52)	0,908*
Dyslipidaemia	13 (40,63)	20 (51,28)	16 (76,19)	0,038*

*Phép kiểm định χ^2

**Characteristics of 92 patients with
critical limb threatening ischaemia (CLTI) staged
according to the Global Limb Anatomic Staging System**

RESULTS - DISCUSSION

Prediction of the Technical Success of Endovascular Therapy in Patients with Critical Limb Threatening Ischaemia Using the Global Limb Anatomical Staging System

Takahiro Tokuda [a,*], Yasuhiro Oba [a], Ryoji Koshida [b], Yoriyasu Suzuki [a], Akira Murata [a], Tatsuya Ito [a]

[a] Department of Cardiology, Nagoya Heart Centre, Nagoya, Aichi, Japan
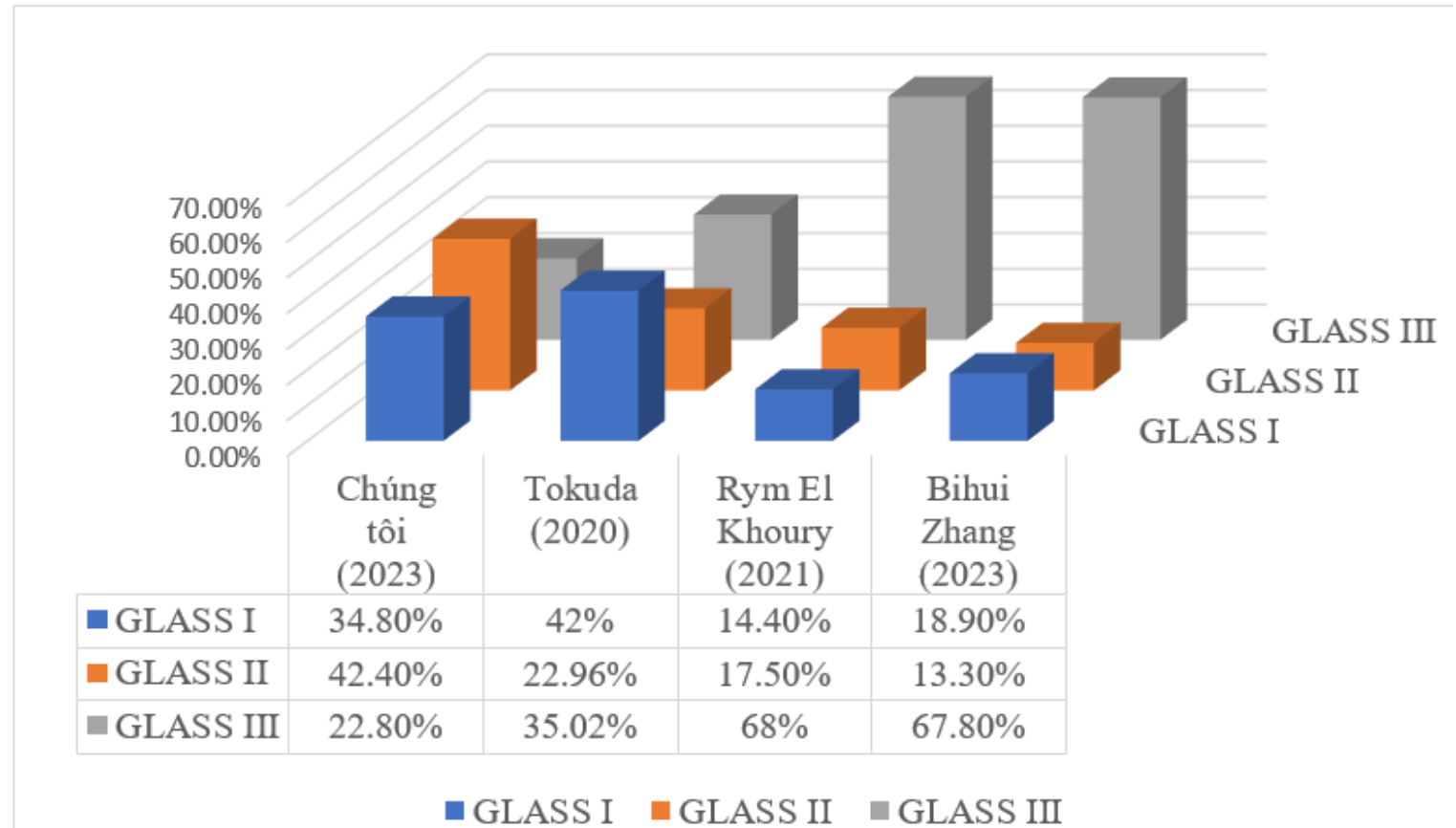[b] Department of Cardiology, Toyohashi Heart Centre, Toyohashi, Aichi, Japan

Table 1. Characteristics of 257 patients with critical limb threatening ischaemia (CLTI) staged according to the Global Limb Anatomic Staging System (GLASS) to determine the grade of difficulty for target artery path (TAP) for the endovascular treatment of their 400 lesions

Patient characteristics	GLASS I $n = 108$	GLASS II $n = 59$	GLASS III $n = 90$	p
Age − years	72.6 ± 9	73.8 ± 7	74.7 ± 8	.17
Male	82 (75.9)	42 (71.2)	58 (64.4)	.21
Hypertension	72 (66.7)	42 (71.2)	56 (62.2)	.52
Diabetes mellitus	78 (72.2)	45 (76.3)	73 (81.1)	.34
Dyslipidaemia	43 (39.8)	30 (50.9)	37 (41.1)	.36
Haemodialysis	89 (82.4)	42 (71.2)	75 (83.3)	.16
Ejection fraction <40%	17 (15.7)	8 (13.6)	13 (14.4)	.89
Coronary artery disease	78 (72.2)	41 (69.5)	66 (73.3)	.88
Cerebrovascular disease	36 (33.3)	16 (27.1)	17 (18.9)	.070
Current smoking	15 (13.9)	5 (8.5)	5 (5.6)	.13
Cilostazol use	55 (50.9)	34 (57.6)	40 (44.4)	.28

Data are presented as n (%) or mean ± standard deviation. GLASS = Global Limb Anatomic Staging System.

RESULTS - DISCUSSION

	Chúng tôi (2023)	Tokuda (2020)	Rym El Khoury (2021)	Bihui Zhang (2023)
■ GLASS I	34.80%	42%	14.40%	18.90%
■ GLASS II	42.40%	22.96%	17.50%	13.30%
■ GLASS III	22.80%	35.02%	68%	67.80%

■ GLASS I   ■ GLASS II   ■ GLASS III

COMPARISON OF GLASS DISTRIBUTION RATIOS BETWEEN STUDIES

RESULTS

Lesion characteristics	GLASS I n = 32	GLASS II n = 39	GLASS III n = 21	P
Lesion				
Femoralpoliteal artery	13 (40.63)	5 (12.82)	1 (4.76)	< 0.001*
Infrapoliteal artery	14 (43.75)	9 (23.08)	5 (23.81)	
Both	5 (15.63)	25 (64.1)	15 (71.43)	
Vascular access				
Ipsilateral CFA	31 (96.88)	36 (92.31)	16 (76.19)	0.02*
Contralateral CFA	1 (3.12)	3 (7.69)	2 (9.52)	
Upstream	0 (0)	0 (0)	3 (14.28)	
Presence of P0 or P1	29 (90.63)	34 (87.18)	13 (61.9)	0.016*
Time Intervention (mins)	60.76 ± 28.1	70.2 ± 32.9	82.32 ± 19.93	0.032**
Pre-op ABI	0.332 ± 0.22	0.32 ± 0.26	0.13 ± 0.18	0.013**
Endovascular technique				
Ballon only	16	18	14	0.3*
Stenting	16	21	7	

Characteristics of 92 lesions and the endovascular procedures in 92 patients

RESULTS

Prediction of the Technical Success of Endovascular Therapy in Patients with Critical Limb Threatening Ischaemia Using the Global Limb Anatomical Staging System

Takahiro Tokuda [a,*], Yasuhiro Oba [a], Ryoji Koshida [b], Yoriyasu Suzuki [a], Akira Murata [a], Tatsuya Ito [a]

[a] Department of Cardiology, Nagoya Heart Centre, Nagoya, Aichi, Japan
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Table 2. Characteristics of 400 lesions and the endovascular procedures in 257 patients with critical limb threatening ischaemia (CLTI) staged according to the Global Limb Anatomic Staging System (GLASS) to determine the grade of difficulty for target artery path (TAP)

Lesion characteristics	GLASS I n = 183	GLASS II n = 95	GLASS III n = 122	p
Femoropopliteal artery				
Lesion length — mm	26.1 ± 19	61.8 ± 45	80.6 ± 72	<.001
Total occlusion	2 (1.1)	30 (31.5)	38 (31.1)	<.001
Severe calcification	15 (13.9)	10 (16.9)	26 (28.9)	<.001
Infrapopliteal artery				
Target infrapopliteal artery				<.001
Anterior tibial artery	69 (37.7)	44 (46.3)	64 (52.5)	
Peroneal artery	63 (34.4)	27 (28.4)	12 (9.8)	
Posterior tibial artery	51 (27.9)	24 (25.3)	46 (37.7)	
Lesion length — mm	128.2 ± 78	173.6 ± 77	221.4 ± 75	<.001
Total occlusion	40 (21.9)	36 (38.3)	88 (72.1)	<.001
Severe calcification	48 (26.2)	26 (27.4)	56 (46.3)	<.001
Angiosome TAP	123 (67.2)	63 (66.3)	94 (77.1)	.11
Presence of P0 or P1	181 (98.9)	94 (99.0)	106 (86.9)	<.001

Successful EVT

Successful EVT	GLASS I n = 32	GLASS II n = 39	GLASS III n = 21	P
Khoa, Luân	30 (93.75)	33 (84.62)	13 (61.9)	0.012

Successful EVT	GLASS I n = 183	GLASS II n = 95	GLASS III n = 122	P
Tokuda	177 (96.7)	92 (96.8)	64 (52.5)	< 0.001

RESULTs - COMPLICATION

	Distal Embolisation	Puncture site haemorrhage / haematoma	Dissection	Vascular rupture	A-V Fistula	Pseudo aneurysm
■ Chúng tôi	4.00	11.00	9.00	1.00	0	0
■ Tokuda	3.00	3.00	6.00	3.00	3	0

■ Chúng tôi ■ Tokuda
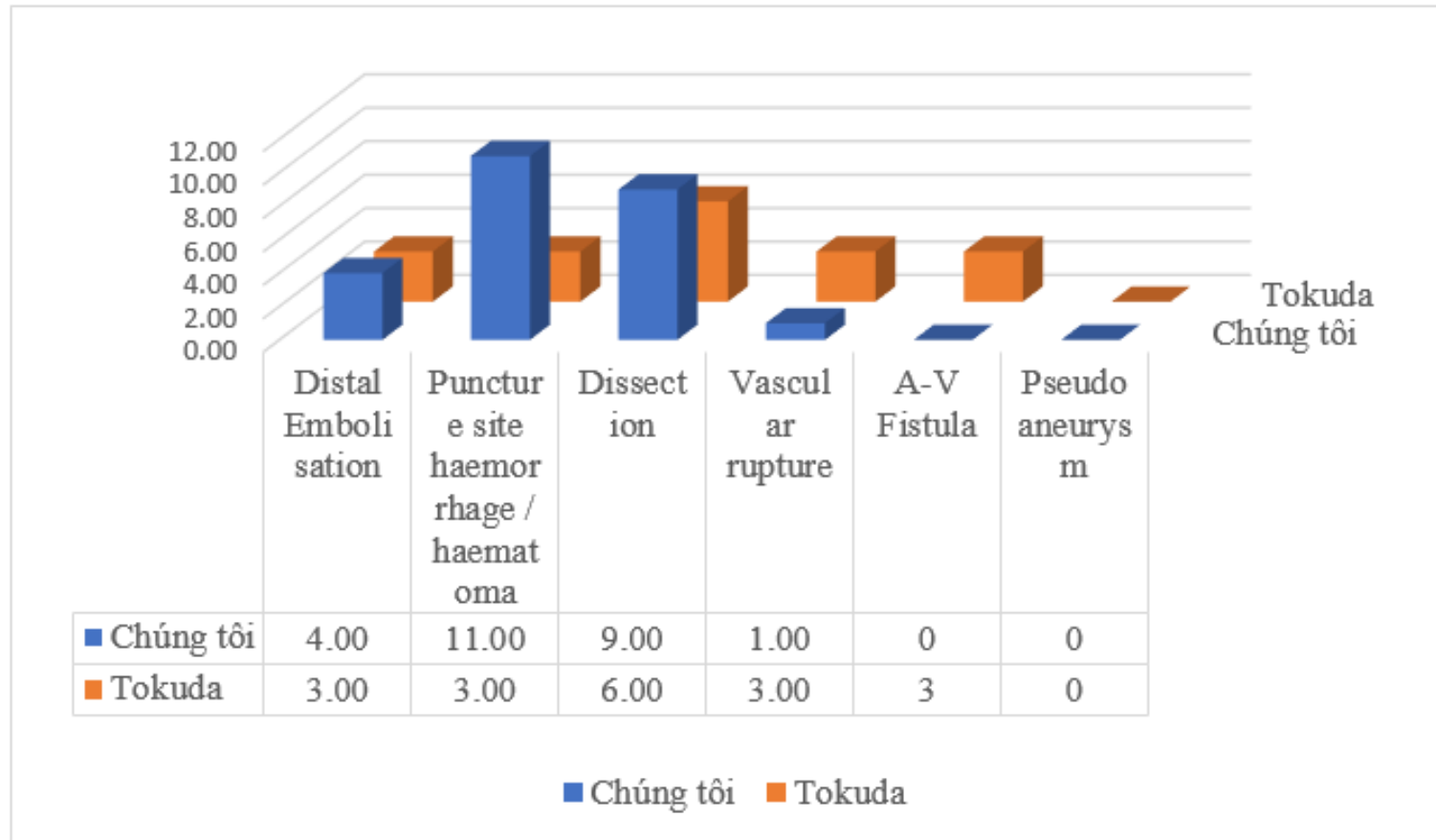
Compare complications of endovascular intervention

MORTALITY AND MAJOR AMPUTATION

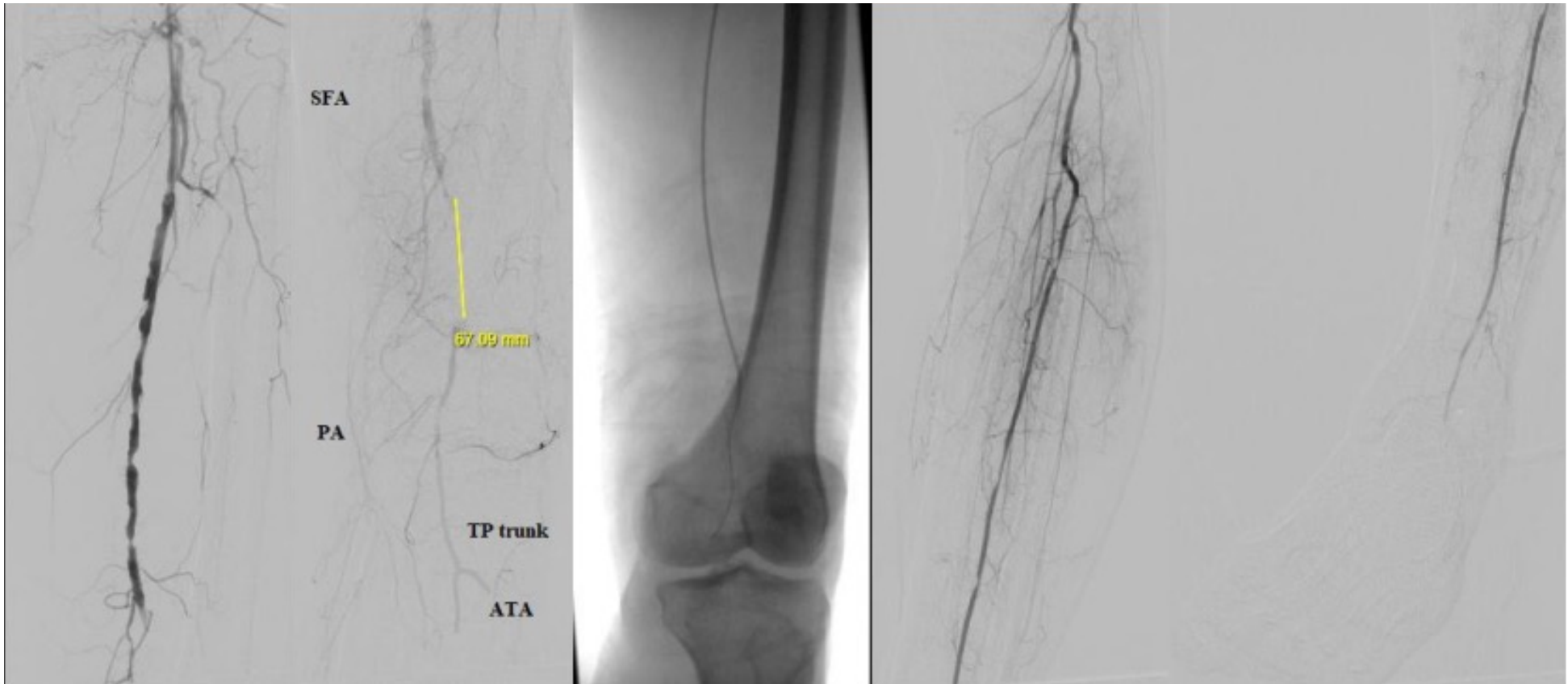| Mortality	GLASS I n = 32	GLASS II n = 39	GLASS III n = 21	P
Khoa, Luân	0	0	2 (9.25)	0.039

Major amputation	GLASS I n = 32	GLASS II n = 39	GLASS III n = 21	P
Khoa, Luân	1 (3.13)	3 (7.69)	5 (23.81)	0.032

Mortality	GLASS I n = 183	GLASS II n = 95	GLASS III n = 122	P
Tokuda	0 (0)	1 (2.3)	1 (2.9)	0.42

Major amputation	GLASS I n = 183	GLASS II n = 95	GLASS III n = 122	P
Tokuda	14 (7.7)	5 (5.3)	14 (11.5)	0.24

CASE REPORT: D.V.H Male – 82 yrs

CASE REPORT: D.V.H Male – 82 yrs

Sterling SL Balloon Dilatation Catheter - Boston Scientific

CASE

ELUVIA™
Drug-Eluting Vascular Stent System

Radiopaque tip   Inner shaft
Radiopaque stent markers
Middle shaft
Middle shaft radiopaque marker band
Outer blue stabilizing shaft
Thumbwheel
Safety lock
Flushing luer
Pull grip
Ergonomic handle
Boston Scientific

CASE
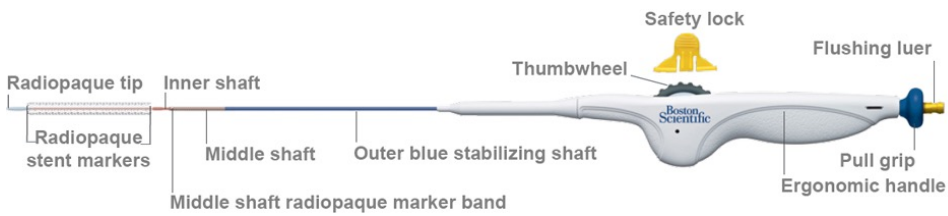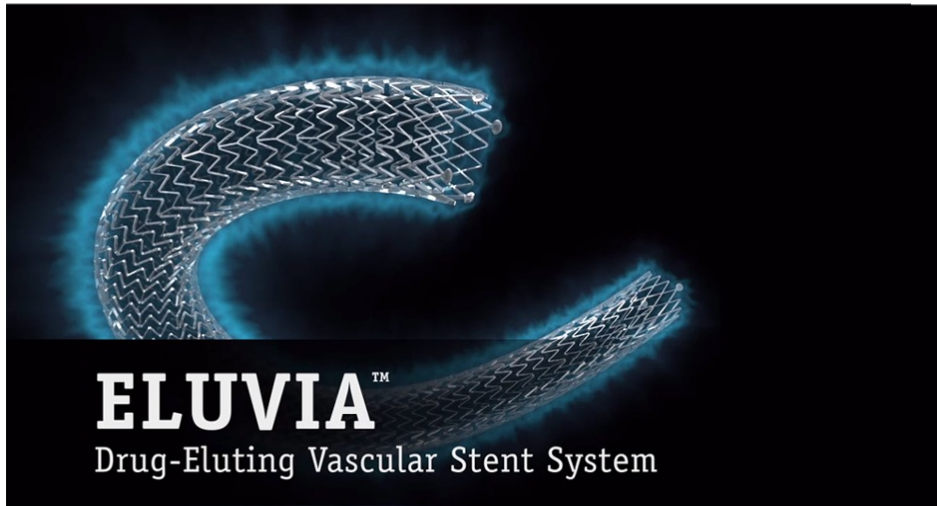
DICUSSION

Author Takahiro Tokuda and colleagues (2020): predicting the technical success of endovascular intervention - using the GLASS grading system

Retrospective study, 400 lesions in 257 patients, divided into 3 groups according to GLASS classification (I, II and III).

Technical failure rates in GLASS I, II and III grades are 3.3%, 3.2% and 47.5%, respectively.

Multivariate analysis, the absence of blood flow to the arch of the foot (type P2), ***GLASS III group lesions, chronic occlusive lesions and severe calcification are predictive factors → technical failure***. [13].

DICUSSION

Takuho Shirasu et al (2022), meta-analysis of the predictive ability of GLASS grading with technical success and hind limb recanalization status.

Research analysis from 7 cohort studies and 1 randomized controlled trial on a sample size of 2483 limbs in 2204 patients.

Results: there was a significant difference between GLASS groups 1, 2 and GLASS 3 groups in terms of limb preservation rate ($p < 0.001$).

GLASS I, II and III → technical failures were **3.9%, 5.3% and 27.9%**, respectively [11].

In our study, these rates are **6.25%, 15.38% and 38.1%** respectively.

DICUSSION

Rym El Khoury et al (2021), evaluated the relationship between GLASS class and prognosis in revascularization of the inferior femoral artery in chronic limb-threatening anemia.

Prospective study, 194 lower limbs in 167 patients.

Results: lesions belonging to GLASS grades I, II and III accounted for 14%, 18% and 85% respectively.

The technical failure rate in GLASS III lesions was **22%**. [22]

CONCLUSION

Our research together with the above studies shows:
1. The level of anatomical complexity gradually increases from GLASS I to III, the rate of technically successful intervention gradually decreases, and the intervention time becomes longer.
2. Along with GLASS grade, foot perfusion status is a prognostic factor for limb amputation
3. At GLASS III grade, the majority of cases are multilevel lesions.
4. Endovascular intervention remains a gentle recanalization method, with most cases requiring only local anesthesia. Most intervention times do not exceed 90 minutes.
5. Regarding long-term outcomes, GLASS grade is also a factor that helps us predict the ability to preserve the limb, the ability to maintain recanalization of the target artery and death. These outcomes also tend to decrease from GLASS I to GLASS III.
6. Thus, we conclude that the GLASS classification is highly applicable in stratifying vascular lesions as well as the rate of successful endovascular intervention and limb preservation rate.