

Choices of stent and cerebral protection in the ongoing ACST-2 trial: A descriptive study

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WHAT THIS PAPER ADDS

Technical innovations in stent design and cerebral protection (CPD) may improve the outcome of carotid artery stenting (CAS). The present study reports whether interventionalists tailor their choice of stent and CPD according to plaque echolucency or severity of stenosis in the Asymptomatic Carotid Surgery Trial-2 (ACST-2), the largest interventional trial comparing CAS with carotid endarterectomy (CEA).

ABSTRACT

Objectives

Several plaque and lesion characteristics have been associated with an increased risk for procedural stroke during or shortly after carotid artery stenting (CAS). Whilst technical advancements in stent design and cerebral protection devices (CPD) may help reduce the procedural stroke risk and anatomy remains important, tailoring stenting procedures according to plaque and lesion characteristics might be a useful strategy to reduce stroke associated with CAS. In this descriptive report of the ongoing Asymptomatic Carotid Surgery Trial-2 (ACST-2), we assessed whether choice for stent and use or type of CPD was influenced by plaque and lesion characteristics.

Materials and methods

Trial patients who underwent CAS between 2008 and 2015 were included in this study. Chi-square statistics were used to study the effects of plaque echolucency, ipsilateral pre-occlusive disease (90-99%) and contralateral high grade stenosis (>50%) or occlusion on interventionalists' choice for stent and CPD. Differences in treatment preference between specialties were also analysed.

Results

In this study, 831 patients from 88 ACST-2 centres were included. Almost all procedures were performed by either interventional radiologists (50%) or vascular surgeons

(45%). Plaque echolucency, ipsilateral pre-occlusive disease (90-99%) and significant contralateral stenosis (>50%) or occlusion did not affect the choice of stent or either the use of cerebral protection and type of CPD employed (ie, filter/flow reversal). Vascular surgeons used a CPD significantly more often than interventional radiologists (98.6% versus 76.3%, $p<0.001$) but this choice did not appear to be dependent on patient characteristics.

Conclusions

In ACST-2, plaque characteristics and severity of stenosis did not primarily determine interventionalists' choice of stent or use or type of CPD, suggesting that other factors like vascular anatomy or personal and centre preference may be more important. Stent and CPD use was highly heterogeneous among participating European centres.

Key words: Carotid Artery Stenosis; Carotid Artery Stenting; Plaque Echolucency; Stent Design; Cerebral Protection Devices; Randomized Controlled Trial

INTRODUCTION

In Europe, despite advances in medical therapy and a reduction in smoking, stroke remains the third leading cause of mortality and the most important cause of long-term disability. Carotid artery stenosis is thought to cause up to 20% of all ischaemic strokes.¹ Randomized controlled trials have shown that both carotid endarterectomy (CEA) and carotid artery stenting (CAS) are effective in preventing long term stroke caused by tight carotid stenosis.^{2,3}

Concerns remain about the higher periprocedural (<30 days) stroke rate following CAS.⁴ Analysis of the underlying pathophysiological mechanism of these procedural strokes has shown that most strokes occur on the day of the procedure.⁵ Better patient selection and technical developments could make stenting as safe as surgery. Technical advances in stenting include use of cerebral protection devices (CPD), which have been shown to reduce brain embolization during CAS.⁶ Cerebral protection with flow reversal devices reduce brain embolization when compared to distal filter devices.⁷

Stent design might also influence outcome of CAS. Closed cell stents are thought to prevent extrusion of vulnerable plaque through the stent, while open-cell stents provide more flexibility in tortuous vessels. The use of closed cell stent design has shown to reduce post-procedural stroke when compared with open cell design.⁸

Interventionalists will be influenced by patient anatomy and may be influenced by other patient characteristics in their choice of stent type and/or CPD use. Plaque echolucency is thought to be a marker of plaque vulnerability and has been associated with higher periprocedural risk.⁹ High-grade contralateral disease might make proximal occlusion devices less suitable because of relatively long endovascular occlusion time. During filter protected CAS, patients with echolucent, vulnerable plaque or pre-occlusive ipsilateral disease may be at higher risk of ipsilateral stroke.¹⁰

99 As a consequence, although anatomic characteristics are of great importance
100 when choosing stent and CPD, tailoring this choice to individual lesion characteristics
101 might reduce periprocedural risk in carotid artery stenting. In the on-going second
102 Asymptomatic Carotid Surgery Trial (ACST-2), choice of stent and cerebral protection
103 device is left to interventionalists' discretion. We aimed to assess whether
104 interventionalists' choices are influenced by the reported plaque- and lesion
105 characteristics.

METHODS

Trial protocol and patient selection

ACST-2 is an ongoing, large-scale, randomized controlled trial comparing CEA with CAS in patients with asymptomatic carotid stenotic disease (ie, no ipsilateral stroke, TIA or amaurosis fugax in the past 6 months). The trial protocol has been described previously.¹¹

Patients are eligible for ACST-2 when there is tight carotid stenosis, revascularization is thought to be necessary and there is substantial uncertainty as to whether CEA or CAS is the more appropriate treatment. Carotid imaging must be done before randomisation in order to show that the anatomy is appropriate for both procedures and patients should reasonably expect to have at least 5 years of good quality life following intervention.

In the present study, we included patients who had undergone CAS and had a verified 1-month follow-up, which included the details of the procedure. This analysis includes data collected up to December 2015, when over 2000 patients had been enrolled in ACST-2.

ACST-2 was approved by the East of England – Cambridgeshire and Hertfordshire Ethics Committee. Individual collaborating centres also obtained approval from their local ethics committees before patients could be included in the trial.

Carotid artery stenting

ACST-2 is designed to reflect everyday clinical practice and therefore all interventionalists participating in ACST-2 should follow their locally approved protocol for CAS. All CE marked stents and cerebral protection devices can be used in ACST-2. Interventionalists performing CAS have to have independently approved track records, documenting their experience and success with the procedure.

Stents in the trial may be of open cell-, closed cell- or hybrid design. New generation, double-layer membrane mesh stents are now also being used in ACST-2, but were excluded from this analysis due to low numbers at time of data extraction. The use of CPD was recorded for all patients. Three main types of CPD being used in ACST-2 include: distal filters, proximal occlusion and distal balloon occlusion, but distal balloon devices were excluded from analysis of CPD type, again due to low numbers.

Plaque echolucency, defined as Gray-Weale type I (uniformly anechoic or hypoechoic) or type II (predominantly (>50%) hypoechoic) ¹² and the severity of ipsi- and contralateral stenosis was determined by duplex ultrasonography. Angiographic data was not collected by the trial office.

Statistical analysis

Statistical analysis was performed using SPSS (IBM Version 22, 2013). Baseline patient characteristics of patients with echolucent and non-echolucent plaques were compared using a chi-square test and a two-sample T-test was used to compare the mean of continuous variables. For the analysis of stent design, hybrid stents were combined with closed cell stent design. Chi-square testing was used to analyse whether plaque echolucency, ipsilateral pre-occlusive disease (90 – 99%) and contralateral high-grade stenosis (>50%) or occlusion influenced stent choice or use of CPD. Differences in treatment preferences by specialty of interventionalists were also analysed. Since ACST-2 is an ongoing trial scheduled to report initial results in 2020, influence of stent and CPD choice on procedural outcome cannot be analysed at this stage. A p-value<.05 was considered significant for all analyses.

RESULTS

Patient characteristics

Between January 2008 and December 2015, 2045 patients were randomized in ACST-2. At the time of analysis, the trial office had received and verified information on the procedure for 878 patients that underwent CEA and for 831 that had undergone CAS.

The 831 patients in this study were recruited from 88 centres in 27 countries. Interventional radiologists (IR) (50%) and vascular surgeons (45%) performed the majority of procedures, whilst the remaining 5% was performed by cardiologists. Baseline patient characteristics are summarized in Table 1. Plaque echolucency was assessed in 528/831 (64%) patients and 250/528 (47%) of these were said to have echolucent plaques (Gray-Weale type I or II). No significant differences in baseline characteristics were found between patients with echolucent- and nonecholucent plaques. Severity of carotid stenosis was somewhat higher, on both ipsi- ($p=0.002$) and contralateral side ($p<0.001$), in patients where echolucency was not assessed, possibly because of the amount of calcification present.

Stent design

Thirteen different stents were used. The Wallstent (Boston Scientific, Natick, MA, USA) was the most popular closed cell stent and the Precise (Cordis – Cardinal, Bridgewater, NJ, USA) the commonest open cell stent (Table 2a). Fifteen patients were excluded from this analysis, either because the name of the stent used is still awaited, or because a membrane mesh stent was used. In the remaining 816 patients, closed cell stents were used more often (44%) than open cell stents (36%) and hybrid stents (20%). Thirty centres including more than 1 patient (range 2-19), used the same stent in each trial patient. Of these, seventeen (101 patients) used a closed stent and thirteen centres (59 patients) used an open stent only. The majority (35 centres, 582 patients)

used more than one stent design and only seven of these sites had an apparent “favourite” stent design (5 preferred closed stents and 2 open stents).

Choice of stent design is summarized in Table 2b. Stent choice significantly differed between specialties ($p<0.001$), with surgeons using a higher proportion of open-cell stents compared to IR ($p=0.008$).

Stent choice appeared not to be influenced by patients having ipsilateral 90-99% stenosis ($p=0.432$) or by the presence of contralateral stenosis $>50\%$ or occlusion ($p=0.746$). Plaque echolucency also seemed to have had no effect on stent choice ($p=0.843$). Results remained similar when hybrid stents were analysed as a separate group.

Cerebral protection device

Ten different CPD were used in 726/831 (87%) patients (Table 3a). Filters were commonest (580/726, 79%), followed by proximal occlusion devices (142/726, 20%). Many (49/88) centres that recruited more than 1 patient (range 2-33), had consistent CPD usage, thirty-seven (239 patients) using only filter devices, and in 9 (64 patients) no CPD for any trial procedure. However, over half the trial patients (24 centres, 481 patients) were treated in centres that had a clear variation in types of CPD. Analysis of the use of any cerebral protection and type of CPD is summarized in Table 3b. IR used cerebral protection less frequently than other specialties (76% versus 99%, $p<0.001$). The decision to use cerebral protection was not associated with any of the lesion characteristics analysed. Plaque echolucency ($p=0.871$) and contralateral high-grade stenosis or occlusion ($p=0.318$) had no effect on the type of CPD (filter or proximal occlusion) chosen by interventionalists.

Geographical variance

209 Data from the six highest recruiting countries is summarized in Table 4, and
210 there was broadly consistent practice across 5/6 top recruiting countries with closed
211 cell stents predominating. In Italy (n=189), a CPD was used for all cases, echolucency
212 was assessed most frequently (90%) and surgeons performed almost all the
213 interventions (98%). In the United Kingdom (UK), the second highest recruiting country,
214 all interventions (n=129) were performed by IR, but echolucency was only entered for
215 26% of patients and a CPD was deployed in 74% of interventions. In Sweden (n=82), to
216 date, hybrid stent design was used most commonly (42%).

217 Clinical practice in the top 10 recruiting centres is summarized in Table 5. In
218 these centres, all recruiting more than 20 patients, a minimum of 3 different stents was
219 used and all centres used both open- and closed stents. Highest recruiting centres used
220 CPD in nearly all procedures (98%), but some used only one type of CPD (4/10).

221

DISCUSSION

In this cohort study of the on-going ACST-2 trial, where patients were equally suitable for both CEA and CAS, we aimed to assess any influence of plaque echolucency, ipsilateral stenosis and contralateral carotid disease on interventionalists' choice of stent design or cerebral protection during stenting.

In our results, no clear association between plaque characteristics and treatment choice was found. This suggests that interventionalists base their choice primarily on parameters such as vascular anatomy.

Plaque echolucency is influenced by lipid rich necrotic core, high macrophage count and intraplaque haemorrhage.¹³ All have been associated with a higher risk of stroke from asymptomatic carotid stenosis^{14,15} and with an adverse outcome following carotid artery stenting. In the Imaging in Carotid Angioplasty and Risk of Stroke in Carotid Stenting study (ICAROS), echolucent plaque (OR=7.1, 95% CI 2 – 25, p=0.002) and degree of stenosis >85% (OR=5.8, 95% CI 2 – 22, p=0.01) were independent predictors of periprocedural neurological complications.¹⁶

For high-risk, symptomatic or echolucent, atherosclerotic plaque, a closed stent design with a smaller free cell area theoretically offers better embolic protection than open cell stents. In a large study from the American Vascular Registry, where plaque type was not recorded, it was concluded that outcomes after CAS were not significantly influenced by stent design. However, in symptomatic, but not asymptomatic patients, the open-cell stent group had a higher 30-day stroke rate than the closed cell group.¹⁷ Several other studies also found a significantly lower periprocedural risk with closed-cell design stents.^{8,18} In a dual centre US and Belgian study of 701 patients, the difference in periprocedural risk between open and closed cell stent design was highest for symptomatic patients (open: 11.1% vs closed: 3.0%, OR=4.1, p=0.01) and those with echolucent plaques (8.1% vs 2.2%, OR=3.1, p=0.03), supporting the argument that

closed cell stent design provides more effective protection of the potentially vulnerable plaque.¹⁹

In ACST-2, use of CPD is left to interventionalists' discretion. Embolization of debris released during the catheterization phase of CAS may cause stroke and use of CPD could help prevent this. We found that IR do not use CPD in 25% of cases, while vascular surgeons routinely use CPD (98%). This difference in practice may therefore not be due to patient characteristics.

Distal filter devices (580/726, 79.8% of total CPD) preserve antegrade flow, but their main disadvantage is the need to cross the lesion before opening the filter. Smaller embolic particles can escape through the filter pores and the filter can also occlude. Proximal occlusion devices (PO) allow protection before crossing the stenotic lesion, but patients may be intolerant of flow reversal in up to 20% of cases.²⁰ PO devices also require larger sheaths and some imaging difficulties may be caused by flow changes in the ICA.

It was shown in the Prevention of Cerebral Embolization by Proximal Balloon Occlusion Compared to Filter Protection during Carotid Artery Stenting study (PROFI) that new brain lesions found on MR-DWI are less common in patients treated with (PO) devices than with filters (45% versus 87%, $p=0.001$).²¹ In patients with echolucent plaques treated with DF-protected CAS, Montorsi found that significantly higher rates of micro-embolization (on TCD) occurred during four phases of CAS (lesion crossing, stent crossing, stent deployment and stent dilation), when compared with PO devices.²²

In the ICAROS study, use of cerebral protection reduced ipsilateral event rate (2.3% versus 5.0%, $p=0.19$). However, in those with echolucent plaques, use of CPD (of which 96% were distal filters) was associated with an increased risk of stroke when compared with unprotected CAS (12.5% versus 5.2%, $p=0.15$).¹⁶

273 These results suggest that, for echolucent plaques, it is desirable to initiate
274 protection before crossing the lesion and PO devices may be safer than filters, unless
275 flow reduction is poorly tolerated.

276 Although closed cell design and proximal occlusion devices may be more
277 appropriate for patients with high-risk plaques and a filter device may be a better choice
278 in patients with contralateral high-grade stenosis or occlusion, we found no association
279 between the characteristics under consideration and operator choice of stent or of CPD.

280 This lack of association may be explained by differences in patient anatomy or
281 clinical practice, with each centre (or individual) following their own specific protocol
282 for stenting procedures. As guidelines do not recommend the use of certain stents or
283 CPD according to individual patient characteristics, interventionalists often use stents
284 and CPD they are familiar with. Filter type CPD were introduced earlier and
285 interventionalists therefore have more experience with these devices.

286 Choice of stent and CPD may, at least partly, be based on financial
287 considerations. The financial saving after shorter hospital stay with CAS may be offset
288 by higher device costs when compared with CEA. In the Carotid Revascularization
289 Endarterectomy versus Stenting (CREST) trial, costs of CEA were not substantially
290 different from CAS.²³ However, national reimbursement rules or hospital contracts
291 could influence stent and CPD choice.^{24,25}

292 Vascular anatomy, both in the arch and in the carotid artery itself, is important in
293 the choice of device and use of protection and was assessed before entry in ACST-2.

294 Our study had several limitations. ACST-2 is an on-going trial and data on
295 periprocedural events will not be published until the trial is complete, so we cannot
296 relate stent type and CPD choice to periprocedural risk. Secondly, we had no knowledge
297 of anatomical factors that might have influenced interventionalists in their choice of
298 stent and CPD.

300 *Conclusion*

301 In the Asymptomatic Carotid Surgery Trial-2, patient characteristics like plaque
302 echolucency, ipsilateral pre-occlusive disease or contralateral occlusion did not appear
303 to primarily determine interventionalists' choice of stent or CPD. Stent and CPD use was
304 highly heterogeneous among participating European centres.

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355

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357 None

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TABLES & FIGURES

Table 1. Baseline characteristics and plaque echolucency					
	Nonecholucent (n=278)	Echolucent (n=250)	p-value ¹	Not assessed (n=303)	p-value ²
Ipsilateral carotid diameter reduction (%)					
Mean (SD)	79% (8.5)	79% (8.5)	0.566	80% (9.1)	0.189
< 80%	102 (36.7%)	92 (36.8%)	0.793	113 (37.3%)	0.002
80 – 89%	121 (43.5%)	114 (45.6%)		104 (34.3%)	
90 – 99%	55 (19.8%)	44 (17.6%)		86 (28.4%)	
Contralateral carotid diameter reduction (%)					
Mean (SD)	32% (29.5)	35% (30.5)	0.235	39% (35.2)	0.030
0 – 49%	196 (70.5%)	162 (64.8%)	0.449	159 (52.5%)	<0.001
50 – 69%	46 (16.5%)	47 (18.8%)		79 (26.1%)	
70 – 99%	18 (6.5%)	24 (9.6%)		32 (10.6%)	
Occluded	18 (6.5%)	17 (6.8%)		33 (10.9%)	
Side of intervention					
Right	151 (54.3%)	139 (55.6%)	0.767	161 (53.1%)	0.618
Anaesthetic technique					
General	14 (5.0%)	6 (2.4%)	0.113	11 (3.6%)	0.908
Medical History					
Atrial Fibrillation	13 (4.7%)	21 (8.4%)	0.082	23 (7.6%)	0.527
Renal Disease	27 (9.8%)	29 (11.6%)	0.490	27 (8.9%)	0.426
Diabetes	88 (31.7%)	73 (29.2%)	0.541	84 (27.7%)	0.399
Systolic Blood Pressure (mmHg)					
Mean (SD)	140.6 (16.5)	142.0 (14.9)	0.317	140.2 (16.4)	0.386
> 160 mmHg	38 (13.7%)	33 (13.2%)	0.875	44 (14.5%)	0.666
Diastolic Blood Pressure (mmHg)					
Mean (SD)	79.6 (9.7)	80.3 (8.9)	0.372	78.9 (9.4)	0.134
> 90 mmHg	57 (20.7%)	49 (19.6%)	0.796	54 (17.8%)	0.428
Medical Therapy at Randomization					
Antiplatelet	259 (93.8%)	229 (92.0%)	0.403	261 (86.4%)	0.002
Anticoagulant	17 (6.2%)	25 (10.0%)	0.102	26 (8.6%)	0.398
Anti-hypertensive	250 (90.0%)	227 (91.2%)	0.816	252 (83.4%)	0.001
Lipid-lowering	233 (84.4%)	211 (84.7%)	0.920	246 (81.5%)	0.246

Table 1. Baseline patient characteristics and plaque echolucency

¹ *p-value* between patients with echolucent and nonecholucent plaques.

² *p-value* between patients with echolucency assessed and not assessed.

Table 2a. Stents used		
Design	Name (Manufacturer)	Number (%)
Open	Precise (Cordis – Cardinal)	108 (13.0%)
	Acculink (Abbott)	88 (10.6%)
	Protégé (Covidien – Medtronic)	86 (10.3%)
	ViVEXX (CR Bard)	7 (0.8%)
	Zilver (Cook Medical)	3 (0.4%)
Closed	Wallstent (Boston Scientific)	200 (24.1%)
	XAct (Abbott)	149 (17.9%)
	Adapt (Boston Scientific)	10 (1.2%)
Hybrid	Cristallo Ideale (Medtronic)	154 (18.5%)
	Sinus RX (Optimed)	8 (0.9%)
	Mer (Balton)	1 (0.1%)
Membrane	Roadsaver (Terumo)	6 (0.7%)
	CGuard (Inspire MD)	4 (0.5%)
	Stent name awaited	5 (0.6%)
Total		831

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Table 2b. Interventionalists' choice of stent				
	Open n=292	Closed n=524	Total n=816	P-value*
Specialty (%)				
Surgeons	143 (39)	221 (61)	364	<0.001
Radiologists	124 (30)	286 (70)	410	
Cardiologists	25 (60)	17 (41)	42	
Plaque echolucency (%)				
Nonecholucent	85 (31)	188 (69)	273	0.843 ¹
Echolucent	74 (30)	170 (70)	244	
Not assessed	133 (45)	166 (56)	299	
Ipsilateral carotid diameter reduction (%)				
< 90%	231 (37)	402 (64)	633	0.432
90 – 99%	61 (33)	122 (67)	183	
Contralateral carotid disease (%)				
<50%	168 (33)	341 (67)	509	0.103
50 – 99%	98 (41)	144 (60)	242	
Occluded	26 (40)	39 (60)	65	

Table 2b. Interventionalists' choice for open- or closed (including hybrid stent design), * *p-value* according to chi-square test. Membrane mesh stents excluded from this analysis.

¹ Chi-square test comparing echolucent with nonecholucent

Table 3a. Use of cerebral protection devices		
Type CPD	Name (Manufacturer)	Number (%)
Filter	Emboshield (Abbott)	204 (24.5%)
	Filterwire (Boston Scientific)	159 (19.1%)
	Spider (Medtronic – Covidien)	112 (13.4%)
	Accunet (Abbott)	57 (6.9%)
	Angioguard (Cordis)	43 (5.2%)
	Fibernet (Medtronic)	1 (0.1%)
	Filter uncategorised	4 (0.5%)
Proximal Occlusion	Mo.Ma Ultra (Medtronic)	114 (13.7%)
	Gore Flow Reversal (Gore)	28 (3.4%)
Distal Balloon	TwinOne (Minvasys)	3 (0.4%)
	Viatrac (Abbott)	1 (0.1%)
None used		105 (12.6%)
Total		831

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Table 3b. Interventionalists' choice in cerebral protection								
	CPD usage			P-value	Type CPD used			P-value
	Used	Not used	Total		Distal Filter	Proximal Occlusion	Total	
	n=726	n=105	n=831		n=580	n=142	n=722	
Specialty (%)								
Surgeons	365 (98)	6 (2)	371	<0.001	297 (82)	67 (19)	364	0.324
Radiologists	318 (76)	99 (24)	417		246 (78)	69 (22)	315	
Cardiologists	43 (100)	0 (0)	43		37 (86)	6 (14)	43	
Plaque echolucency (%)								
Nonecholucent	245 (88)	33 (12)	278	0.401 ¹	201 (83)	42 (17)	243	0.888 ¹
Echolucent	226 (90)	24 (10)	250		185 (82)	40 (18)	225	
Not assessed	255 (84)	48 (16)	303		194 (76)	60 (24)	254	
Ipsilateral carotid diameter reduction (%)								
< 90%	571 (88)	75 (12)	646	0.096	459 (81)	109 (19)	568	0.535
90 – 99%	155 (84)	30 (16)	185		121 (79)	33 (21)	154	
Contralateral carotid disease (%)								
<50%	462 (89)	55 (11)	517	0.057	369 (80)	91 (20)	460	0.584
50 – 99%	209 (85)	37 (15)	246		164 (80)	43 (21)	207	
Occluded	55 (81)	13 (19)	68		47 (86)	8 (15)	55	

Table 3b. Use of cerebral protection. In case CPD used, choice for type of CPD (excluding distal balloon devices).

¹ Chi-square test between echolucent and nonecholucent

Table 4. Geographical variance of clinical practice									
Country	No patients	No centres	Centre assessment of EL ¹	Patients with EL assessed	Intervention done by radiologist	CPD used	Open stent	Closed stent ²	Most popular stent (%)
Italy	189	15	14	90%	2%	100%	24%	76%	XAct (38%)
UK	129	20	11	26%	100%	74%	36%	64%	Precise (30%)
Serbia	82	2	2	67%	100%	98%	20%	80%	Wallstent (38%)
Sweden	82	3	3	34%	68%	93%	27%	63%	Cristallo (42%)
Belgium	45	6	4	87%	7%	96%	73%	27%	Acculink (73%)
Germany	44	8	8	82%	41%	84%	26%	64%	Wallstent (50%)

Table 4. Geographical variance of clinical practice in the six highest recruiting countries.

¹ Number of centres with at least 1 patient where echolucency was assessed

² Including hybrid stent design

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Table 5. Clinical practice in high-volume centres							
Centre	No. patients	Inclusion period	Specialty	No. stents used	Designs used	CPD used	CPD type used
1	92	'10-'15	S	6	O,H,C	100%	PO,DF
2	49	'09-'15	IR	5	O,H,C	96%	DF
3	41	'08-'15	IR	7	O,H,C,M	93%	PO,DF
4	35	'08-'14	S	3	O,H,C	94%	PO,DF
5	33	'09-'15	IR	4	O,C	100%	DF
6	33	'08-'15	IR	5	O,H,C,M	100%	PO,DF
7	28	'14-'15	S	3	O,C	100%	DF
8	27	'09-'15	S	4	O,H,C,M	100%	PO,DF
9	22	'08-'15	S	6	O,H,C	100%	PO,DF
10	21	'12-'15	S	5	O,H,C	100%	PO

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Table 5. Clinical practice in top 10 recruiting centres.

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IR=Interventional Radiologists S=Surgeons O=Open H=Hybrid C=Closed

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M=Membrane-mesh PO=Proximal occlusion DF=Distal Filter

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