SHOCKWAVE | C²

Shockwave Intravascular Lithotripsy (IVL) System with the Shockwave C² Coronary Intravascular Lithotripsy (IVL) Catheter

Instructions for Use (IFU)

Rx only

For use with the Shockwave Medical, Inc. IVL Generator and Connector Cable

Device Description

The Shockwave C² Catheter is a proprietary lithotripsy device delivered through the coronary arterial system of the heart to the site of an otherwise difficult to treat calcified stenosis, including calcified stenoses that are anticipated to exhibit resistance to full balloon dilatation or subsequent uniform coronary stent expansion. The IVL Catheter contains integrated lithotripsy emitters for the localized delivery of acoustic pressure pulse therapy. The lithotripsy technology generates acoustic pressure pulses within the target treatment site, disrupting calcium within the lesion allowing subsequent dilatation of a coronary artery stenosis using low balloon pressure. The system consists of the IVL Catheter, IVL Connector Cable and IVL Generator. The Shockwave C² Coronary IVL Catheter is available in four (4) sizes: 2.5x12 mm, 3.0x12 mm, 3.5x12 mm, and 4.0x12 mm. The Shockwave C² is compatible with a 6F guiding catheter and extensions, has a working length of 138 cm, and shaft depth markers at the proximal end. The catheter is coated with hydrophilic coating to 22.75 cm from the distal tip to reduce friction during device delivery. Refer to Figure 1 below for the Shockwave C² Coronary IVL Catheter components.

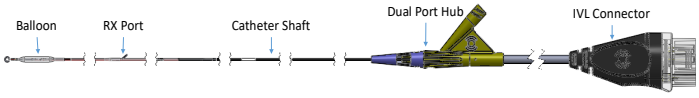

Figure 1: Shockwave C² Coronary IVL Catheter

The catheter shaft contains an inflation lumen, a guidewire lumen, and the lithotripsy emitters. The inflation lumen is used for inflation and deflation of the balloon with 50/50 saline/contrast medium. The guidewire lumen enables the use of a 0.014" (0.36 mm) guidewire to facilitate advancement of the catheter to and through the target stenosis. The system is designed as "Rapid Exchange" (Rx), so a length (190 cm – 300 cm) guidewire is indicated. The emitters are positioned along the length of the balloon working length for delivery of lithotripsy therapy. The balloon is located near the distal tip of the catheter. Two radiopaque marker bands within the balloon denote the working length of the balloon to aid in positioning of the balloon during treatment. The balloon is designed to provide an expandable segment of known length and diameter at a specific pressure. The proximal hub has two ports: one for inflation/deflation of the balloon and one for the connection to the IVL Connector Cable.

Indications for Use

The Shockwave Intravascular Lithotripsy (IVL) System with the Shockwave C² Coronary IVL Catheter is indicated for lithotripsy-enabled, low-pressure balloon dilatation of severely calcified, stenotic *de novo* coronary arteries prior to stenting.

Contraindications for Use

The Shockwave C² Coronary IVL System is contraindicated for the following:

1. This device is not intended for stent delivery.
2. This device is not intended for use in carotid or cerebrovascular arteries.

Warnings

1. Physicians must read and understand these instructions prior to use of the device. Failure to abide by the warnings in this labeling might result in damage to the device hydrophilic coating.
2. Do not use a device past the expiration date on the label. Use of expired product may result in patient injury.
3. Use the IVL Generator in accordance with recommended settings as stated in the IVL Generator Operator's Manual. DO NOT deviate from recommended settings as this may cause patient injury.
4. IVL Connector Cable is non-sterile and must be enclosed in a sterile sleeve prior to and during use.
5. Inspect all product components and packaging prior to use. Do not use the device if the device or the packaging has been damaged or if sterility has been compromised. Damaged product could result in patient injury.
6. Do not use the device if the balloon protective sheath cannot be removed easily prior to use. If excessive force is used, the catheter could be damaged. Damaged product could result in patient injury.
7. Ensure that the IVL Catheter is used with a 0.014" (0.36 mm) guidewire and is inserted through a 6F guiding catheter at least 0.068" (1.72 mm) ID. Failure to do so could result in inadequate device performance or patient injury
8. If an inability to inflate or maintain balloon pressure occurs, remove the catheter and use a new device.
9. Do not use excessive force or torque on the catheter as this could result in damage to the device components and result in patient injury.
10. The risk of a dissection or perforation is increased in severely calcified lesions undergoing percutaneous treatment, including IVL. Appropriate provisional interventions should be readily available.
11. Balloon loss of pressure was observed in 6.3% of patients in the clinical trial that were treated with the currently marketed product and was associated with a numerical increase in dissection which was not statistically significant and was not associated with MACE. Analysis indicates calcium length is a predictor of dissection and balloon loss of pressure.
12. Treat patients per standard medication or interventional procedures in the event of complications associated with the procedure or device.
13. IVL generates mechanical pulses which may cause atrial or ventricular capture in bradycardic patients. In patients with implantable pacemakers and defibrillators, the asynchronous capture may interact with the sensing capabilities. Monitoring of the electrocardiographic rhythm and continuous arterial pressure during IVL treatment is required. In the event of clinically significant hemodynamic effects, temporarily cease delivery of IVL therapy. In the CAD III study, there were no serious adverse events associated with IVL-induced capture including arrhythmia.

Precautions

1. This device should only be used by physicians trained in angiography and intravascular coronary procedures.
2. For preparation, operation, warnings and precautions, and maintenance of the IVL Generator and its accessories, refer to the IVL Generator Operator's Manual.
3. The catheter is intended for single (one) time use only. DO NOT re-sterilize and/or reuse. If a second catheter of the same size is necessary, DO NOT re-use the first catheter. Discard it before preparing the second catheter.
4. Use only an appropriately sized balloon for the vessel to be treated: 1:1 based on balloon compliance chart and reference vessel diameter. The largest diameter balloon should be used if 1:1 sizing is not available (such as, using a 4.0 mm IVL Catheter in a vessel with a reference diameter of 4.5 mm).
5. Inflate the balloon according to the balloon compliance chart. Balloon pressure should not exceed the rated burst pressure (RBP).
6. Use only the recommended 50/50 contrast/saline medium to inflate the balloon to ensure adequate lithotripsy delivery.
7. If the surface of the IVL Catheter becomes dry, wetting with normal saline will reactivate the hydrophilic coating. Wetting the catheter with solvents other than saline can compromise the coating integrity or performance.
8. Perform all device manipulations under adequate fluoroscopic guidance.
9. Do not advance or retract the catheter unless the balloon is fully deflated under vacuum. If resistance is met, determine the cause of the resistance before proceeding.
10. Care must be taken when manipulating, advancing and/or withdrawing the device past sharp objects as it may damage the hydrophilic coating.
11. Do not use or attempt to straighten a catheter if the shaft has become bent or kinked. Instead, prepare a new catheter.
12. During the procedure, appropriate antiplatelet/anticoagulant therapy must be provided to the patient as needed. Antiplatelet/anticoagulant therapy should be continued for a period of time to be determined by the physician after the procedure.
13. Emitter proximity to balloon may increase incidence of balloon loss of pressure. Ensure adequate balloon expansion prior to delivering lithotripsy and consider anatomical restrictions that may place the emitter too close to the balloon material.
14. If the IVL Catheter appears not to deliver lithotripsy therapy, remove and replace it with another catheter.
15. Precaution should be taken when treating patients with previous stenting within 5 mm of target lesion.
16. When using IVL in the vicinity of temporary or permanent implantable devices, observe for any potential interaction with the IVL acoustic pressure pulses. IVL pulses have the potential to interfere with some implanted electrical devices (e.g., ventricular support systems).
17. Precaution should be taken when handling the device after exposure to patient, e.g. contact with blood. Used product is considered biohazardous material and should be disposed of properly as per hospital protocol.

Adverse Effects

Potential adverse effects are consistent with standard catheter-based cardiac interventions and include, but are not limited to, the following:

- Abrupt vessel closure
- Allergic reaction to contrast medium, anticoagulant and/or antithrombotic therapy
- Aneurysm
- Arrhythmia
- Arteriovenous fistula
- Bleeding complications
- Cardiac tamponade or pericardial effusion
- Cardiopulmonary arrest

- Cerebrovascular accident (CVA)
- Coronary artery/vessel occlusion, perforation, rupture or dissection
- Coronary artery spasm
- Death
- Emboli (air, tissue, thrombus or atherosclerotic emboli)
- Emergency or non-emergency coronary artery bypass surgery
- Emergency or non-emergency percutaneous coronary intervention
- Entry site complications
- Fracture of the guide wire or failure/malfunction of any component of the device that may or may not lead to device embolism, dissection, serious injury or surgical intervention
- Hematoma at the vascular access site(s)
- Hemorrhage
- Hypertension/ Hypotension
- Infection/sepsis/fever
- Myocardial Infarction
- Myocardial Ischemia or unstable angina
- Pain
- Peripheral Ischemia
- Pseudoaneurysm
- Renal failure/insufficiency
- Restenosis of the treated coronary artery leading to revascularization
- Shock/pulmonary edema
- Slow flow, no reflow, or abrupt closure of coronary artery
- Stroke
- Thrombus
- Vessel closure, abrupt
- Vessel injury requiring surgical repair
- Vessel dissection, perforation, rupture, or spasm

In addition, patients may be exposed to other risks associated with coronary interventional procedures, including risks from conscious sedation and local anesthetic, the radiographic contrast agents used during angiography, the drugs given to manage the subject during the procedure, and the radiation exposure from fluoroscopy.

Risks identified as related to the device and its use:

- Allergic/immunologic reaction to the catheter material(s) or coating
- Device malfunction, failure, or balloon loss of pressure leading to device embolism, dissection, serious injury or surgical intervention
- Atrial or ventricular extrasystole
- Atrial or ventricular capture

Clinical Study Summary

The prospective, single arm, multi-center IDE study (Disrupt CAD III) of the Shockwave Intravascular Lithotripsy (IVL) System with the Shockwave C^2 Coronary IVL Catheter was conducted to evaluate the safety and effectiveness of the device to treat *de novo*, severely calcified, stenotic coronary lesions prior to stenting. Between January 9, 2019 and March 27, 2020, a total of 431 subjects were enrolled into the Disrupt CAD III study, including 384 pivotal subjects (referred to as the Pivotal Analysis Set) and 47 roll-in subjects. Subjects were enrolled at 47 investigational sites located in the United States and Europe. Subject follow-up to 24 months is complete.

The primary safety endpoint for the Disrupt CAD III study was freedom from major adverse cardiac events (MACE) at 30 days, which was a composite of cardiac death, myocardial infarction (MI) and target vessel revascularization (TVR). All MACE were adjudicated by an independent Clinical Events Committee (CEC). The primary safety endpoint was planned to be compared to a performance goal (PG) of 84.4% at a one-sided alpha level of 0.05.

The primary effectiveness endpoint for the Disrupt CAD III study was Procedural Success defined as stent delivery with a residual in-stent stenosis <50% (core laboratory assessed) and without in-hospital MACE. All MACE were adjudicated by an independent CEC. The primary effectiveness endpoint was planned to be compared to a PG of 83.4% at a one-sided alpha level of 0.05.

Data collected through June 20, 2022 on the pivotal subject cohort are provided below. A summary of baseline characteristics of pivotal subjects is provided in Table 1.

Table 1. Patient Baseline Characteristics (Pivotal Analysis Set)

Parameter	Pivotal (N=384)
Age (years), Mean ± StdDev	71.2 ± 8.6 (384)
Gender, % (n/N)	
Male	76.6% (294/384)
Female	23.4% (90/384)
Race, % (n/N)	
White	82.8% (318/384)
Black and African American	3.1% (12/384)
Asian	3.4% (13/384)
American Indian or Alaska Native	0.5% (2/384)
Native Hawaiian or Other Pacific Islander	0.3% (1/384)
Not Specified	9.9% (38/384)
Ethnicity, % (n/N)	
Hispanic or Latino	4.2% (16/384)
Not Hispanic or Latino	85.9% (330/384)
Not Specified	9.9% (38/384)
Diabetes Mellitus, % (n/N)	40.1% (154/384)
Hyperlipidemia, % (n/N)	89.1% (342/384)
Hypertension, % (n/N)	89.1% (342/384)
Prior Stroke or TIA, % (n/N)	7.6% (29/384)
Myocardial Infarction, % (n/N)	18.0% (69/384)
Prior Coronary Intervention[1], % (n/N)	46.9% (180/384)
Prior CABG, % (n/N)	9.4% (36/384)
Smoking/tobacco use (current), % (n/N)	12.2% (47/384)
Renal insufficiency[2], % (n/N)	12.0% (46/384)
Pacemaker, % (n/N)	4.7% (18/384)
ICD/CRT-D, % (n/N)	1.6% (6/384)

TIA = transient ischemic attack; CABG = coronary artery bypass graft; ICD = implantable cardioverter defibrillator; CRT-D = cardiac resynchronization therapy

1. Percutaneous transluminal coronary angioplasty (PTCA), drug-eluting stent (DES) or atherectomy procedures.
2. An increase in serum creatinine of ≥1.0 mg/dl over previous value requiring medical treatment but which does not require dialysis to resolve.

A summary of pre-procedural angiography as determined by the Core Lab for pivotal subjects is provided in Table 2.

Table 2. Pre-Procedural Angiography (Core Lab) (Pivotal Analysis Set)

Parameter	Pivotal (N=384)
Target Lesion Vessel, % (n/N)	
LAD	56.5% (217/384)
RCA	29.2% (112/384)
Circumflex	12.8% (49/384)
Left Main	1.6% (6/384)
Bypass graft	0.0% (0/384)
RVD[1] (mm), Mean ± StdDev (N)	3.03 ± 0.47 (381)
MLD (mm), Mean ± StdDev (N)	1.06 ± 0.36 (381)
% Diameter Stenosis, Mean ± StdDev (N)	65.1 ± 10.8 (381)
Lesion length (mm), Mean ± StdDev (N)	26.09 ± 11.68 (381)
Calcification, % (n/N), severe	100.0% (384/384)
Calcification Length (mm), Mean ± StdDev (N)	47.85 ± 18.81 (384)
Bifurcation/Trifurcation, % (n/N)	29.9% (115/384)

LAD = left anterior descending coronary artery; RCA = right coronary artery; RVD = reference vessel diameter; MLD = minimal lumen diameter; StdDev = standard deviation

1. Interpolated

A summary of post-IVL and post-stent angiography as determined by the Core Lab for pivotal subjects is provided in Table 3.

Table 3. Post-IVL and Post-Stent Angiography (Core Lab) (Pivotal Analysis Set)

Parameter	Pivotal (N=384)	
	Post-IVL	Post-Stent (In-Stent)
MLD (mm), Mean ± StdDev (N)	1.87 ± 0.48 (341)	2.74 ± 0.43 (381)
% Diameter Stenosis, Mean ± StdDev (N)	37.2 ± 13.5 (341)	11.9 ± 7.1 (381)
Acute Gain (mm), Mean ± StdDev (N)	0.82 ± 0.48 (339)	1.68 ± 0.46 (378)
MLD = minimal lumen diameter; StdDev = standard deviation		

Per the Disrupt CAD III protocol, all subjects required at least one stent to be placed after IVL treatment; 99.2% of pivotal subjects (381/384) received a stent.

The Primary Safety results on the Pivotal Analysis Set are summarized in Table 4. Among 383 pivotal subjects with evaluable primary safety endpoint data, the observed 30-day MACE free rate was 92.2% (353/383), with the corresponding one-sided lower 95% confidence limit of 89.9%, which was higher than the PG of 84.4%. The Primary Safety Endpoint was met based on the Pivotal Analysis Set (p<0.0001).

Table 4. Primary Safety Endpoint (30-day MACE) (Pivotal Analysis Set)

Primary Safety Endpoint	% (n/N) [95% Lower Confidence Interval][1]	Hypothesis	*P* value[2]	Conclusion
Freedom from MACE[3] within 30 days post-procedure	92.2% (353/383)[4] [89.9%]	H_0: $\pi_s \leq 84.4\%$ H_A: $\pi_s > 84.4\%$	<0.0001	Performance Goal Met

1. 95% lower confidence interval is calculated based on a one-sided asymptotic Wald (normal approximation-based) confidence interval for a binomial proportion. The standard error is calculated from the sample proportion.
2. P-value is calculated based on a one-sided asymptotic Wald (normal approximation-based) test for a binomial proportion at a 0.05 level of significance. The standard error is calculated from the sample proportion.
3. All MACE were adjudicated by an independent CEC. If full data were not available, the event was adjudicated based on the clinical judgement of the independent CEC. Missing data were not imputed and a sensitivity analysis was performed to assess endpoint robustness.
4. One subject was excluded from the primary safety endpoint analysis due to insufficient follow-up (< 23 days).

The components of the Primary Safety Endpoint are provided in Table 5 below.

Table 5. Primary Safety Endpoint Components (Pivotal Analysis Set)

Cumulative MACE Rates	In-Hospital N=384	30-Day Follow-up N=383[1]
MACE[2,3]	7.0% (27/384)	7.8% (30/383)
Cardiac Death	0.3% (1/384)	0.5% (2/383)
Non-Q-wave MI[4]	5.7% (22/384)	6.0% (23/383)
Q-wave MI	1.0% (4/384)	1.6% (6/383)
Target Vessel Revascularization	0.5% (2/384)	1.6% (6/383)

1. One subject was excluded from the primary safety endpoint analysis due to insufficient follow-up (< 23 days).
2. All MACE were adjudicated by an independent CEC. If full data were not available, the event was adjudicated based on the clinical judgement of the independent CEC. Missing data were not imputed and a sensitivity analysis was performed to assess endpoint robustness.
3. Some subjects failed >1 component of the MACE criteria; therefore, the categories are not mutually exclusive.
4. Myocardial Infarction (MI) is defined as CK-MB level > 3 times the upper limit of lab normal (ULN) value with or without new pathologic Q wave at discharge (periprocedural MI) and using the Fourth Universal Definition of Myocardial Infarction beyond discharge (spontaneous MI).

The Primary Effectiveness results on the Pivotal Analysis Set are summarized in Table 6. No pivotal subjects were missing data required to define Procedural Success (data related to stent delivery or final residual stenosis) and therefore all pivotal subjects were included in the primary effectiveness analysis (n=384). The observed procedural success rate was 92.4% (355/384), with the corresponding one-sided lower 95% confidence limit of 90.2%, which was higher than the PG of 83.4%. Therefore, the Primary Effectiveness Endpoint was met based on the Pivotal Analysis Set (p<0.0001).

Table 6. Primary Effectiveness Endpoint (Pivotal Analysis Set)

Primary Effectiveness Endpoint	% (n/N) [95% Lower Confidence Interval][1]	Hypothesis	*P* value[2]	Conclusion
Procedural Success[3]	92.4% (355/384) [90.2%]	H_0: $\pi_s \leq 83.4\%$ H_A: $\pi_s > 83.4\%$	<0.0001	Performance Goal Met

1. 95% lower confidence interval is calculated based on a one-sided asymptotic Wald (normal approximation-based) confidence interval for a binomial proportion. The standard error is calculated from the sample proportion.
2. P-value is calculated based on a one-sided asymptotic Wald (normal approximation-based) test for a binomial proportion at a 0.05 level of significance. The standard error is calculated from the sample proportion.
3. Procedural Success defined as stent delivery with a residual in-stent stenosis <50% (core laboratory assessed) and without in-hospital MACE (CEC adjudicated).

The components of the Primary Effectiveness Endpoint are provided in Table 7 below.

Table 7. Primary Effectiveness Endpoint Components (Pivotal Analysis Set)

Primary Effectiveness Endpoint: Procedural Success	N (%)
Procedural Success[1,2]	92.4% (355/384)
Stent Delivered[3]	99.2% (381/384)
< 50% Residual Stenosis	100.0% (381/381)
Without In-Hospital MACE	93.0% (357/384)

1. Procedural Success defined as stent delivery with a residual in-stent stenosis <50% (core laboratory assessed) and without in-hospital MACE (CEC adjudicated).
2. Some subjects failed >1 component of the Procedural Success criteria; therefore, the categories are not mutually exclusive.
3. Three subjects did not receive a stent; two were IVL Device Delivery Failures that did not receive any therapy on the day of the index procedure and one subject had failed stent delivery after successful IVL.

Table 8 provides a summary of site-reported device and/or procedure related serious adverse events (SAEs) observed through 24 months among pivotal subjects (by MedDRA Code).

Table 8. Summary of SAEs through 24 Months (Site Reported) (Pivotal Analysis Set)

	Device-Related[1]		Procedure-Related[2]	
System Organ Class / Preferred Term	Subjects % (n/N)	Events N	Subjects % (n/N)	Events N
Total Patients with Serious Adverse Events	**2.9% (11/384)**	**11**	**8.1% (31/384)**	**44**
Blood and lymphatic system disorders	**0.0% (0/384)**	**0**	**0.3% (1/384)**	**1**
Haemorrhagic anaemia	0.0% (0/384)	0	0.3% (1/384)	1
Cardiac disorders	**2.1% (8/384)**	**8**	**6.0% (23/384)**	**27**
Coronary artery dissection	0.8% (3/384)	3	2.9% (11/384)	11
Myocardial infarction	0.5% (2/384)	2	2.1% (8/384)	8
Arrhythmia	0.0% (0/384)	0	0.5% (2/384)	2
Angina pectoris	0.3% (1/384)	1	0.5% (2/384)	2
Cardiac arrest	0.0% (0/384)	0	0.0% (0/384)	0
Cardiac failure congestive	0.0% (0/384)	0	0.0% (0/384)	0
Coronary artery disease	0.0% (0/384)	0	0.0% (0/384)	0
Coronary artery occlusion	0.0% (0/384)	0	0.0% (0/384)	0
Coronary artery perforation	0.3% (1/384)	1	0.3% (1/384)	1
Coronary artery stenosis	0.0% (0/384)	0	0.0% (0/384)	0
Coronary artery thrombosis	0.0% (0/384)	0	0.3% (1/384)	1
Left ventricular failure	0.0% (0/384)	0	0.0% (0/384)	0
Myocardial ischaemia	0.3% (1/384)	1	0.3% (1/384)	1
Congenital, familial and genetic disorders	**0.0% (0/384)**	**0**	**0.3% (1/384)**	**1**
Congenital coronary artery malformation	0.0% (0/384)	0	0.3% (1/384)	1
General disorders and administration site conditions	**0.0% (0/384)**	**0**	**0.0% (0/384)**	**0**
Pain	0.0% (0/384)	0	0.0% (0/384)	0
Hepatobiliary disorders	**0.0% (0/384)**	**0**	**0.3% (1/384)**	**1**
Hepatic failure	0.0% (0/384)	0	0.3% (1/384)	1
Injury, poisoning and procedural complications	**0.5% (2/384)**	**2**	**1.0% (4/384)**	**4**
Vascular access site haematoma	0.0% (0/384)	0	0.3% (1/384)	1
Coronary artery restenosis	0.5% (2/384)	2	0.8% (3/384)	3

System Organ Class / Preferred Term	Device-Related[1] Subjects % (n/N)	Device-Related[1] Events N	Procedure-Related[2] Subjects % (n/N)	Procedure-Related[2] Events N
Investigations	**0.0% (0/384)**	**0**	**0.5% (2/384)**	**2**
Myocardial necrosis marker increased (elevated cardiac biomarker)	0.0% (0/384)	0	0.5% (2/384)	2
Nervous system disorders	**0.0% (0/384)**	**0**	**0.3% (1/384)**	**1**
Cerebrovascular accident	0.0% (0/384)	0	0.3% (1/384)	1
Dizziness	0.0% (0/384)	0	0.0% (0/384)	0
Seizure	0.0% (0/384)	0	0.0% (0/384)	0
Renal and urinary disorders	**0.0% (0/384)**	**0**	**0.3% (1/384)**	**1**
Renal failure	0.0% (0/384)	0	0.3% (1/384)	1
Respiratory, thoracic and mediastinal disorders	**0.0% (0/384)**	**0**	**0.3% (1/384)**	**1**
Respiratory failure	0.0% (0/384)	0	0.3% (1/384)	1
Vascular disorders	**0.3% (1/384)**	**1**	**1.3% (5/384)**	**5**
Hypertension	0.0% (0/384)	0	0.0% (0/384)	0
Hypotension	0.3% (1/384)	1	0.5% (2/384)	2
Shock	0.0% (0/384)	0	0.3% (1/384)	1
Embolism	0.0% (0/384)	0	0.3% (1/384)	1
Peripheral ischaemia	0.0% (0/384)	0	0.3% (1/384)	1

Note: A subject experiencing multiple occurrences of an adverse event was counted, at most, once per system organ class and preferred term. Adverse events are coded using MedDRA version 21.1.

1. Includes events reported with device relatedness as possible, probable or definite.
2. Includes events reported with procedure relatedness as possible, probable or definite.

The angiographic complications as identified by core laboratory assessment for pivotal subjects are provided in Table 9 below.

Table 9. Angiographic Complications (Core Lab) (Pivotal Analysis Set)

	Post-IVL	After Final Pre-Dil Before Stent	Post-Stent	Post OCT-IVUS	Final[1]
Any Serious Angiographic Complication[2]	2.6% (9/341)	1.6% (1/64)	0.8% (3/357)	0.0% (0/122)	0.5% (2/384)
Dissection[3]					
A	0.3% (1/341)	0.0% (0/64)	0.0% (0/357)	0.0% (0/122)	0.3% (1/384)
B	10.6% (36/341)	3.1% (2/64)	2.2% (8/357)	0.0% (0/122)	1.6% (6/384)
C	4.7% (16/341)	1.6% (1/64)	0.0% (0/357)	0.0% (0/122)	0.3% (1/384)
Severe Dissection (Type D to F)					
D	1.5% (5/341)	0.0% (0/64)	0.0% (0/357)	0.0% (0/122)	0.0% (0/384)
E	0.6% (2/341)	0.0% (0/64)	0.0% (0/357)	0.0% (0/122)	0.0% (0/384)
F	0.0% (0/341)	1.6% (1/64)	0.0% (0/357)	0.0% (0/122)	0.3% (1/384)
Perforation[4]					
Any	0.0% (0/341)	0.0% (0/64)	0.6% (2/357)	0.0% (0/122)	0.3% (1/384)
I	0.0% (0/341)	0.0% (0/64)	0.0% (0/357)	0.0% (0/122)	0.0% (0/384)
II	0.0% (0/341)	0.0% (0/64)	0.3% (1/357)	0.0% (0/122)	0.3% (1/384)
III	0.0% (0/341)	0.0% (0/64)	0.3% (1/357)	0.0% (0/122)	0.0% (0/384)
Abrupt Closure	0.0% (0/341)	1.6% (1/64)	0.0% (0/357)	0.0% (0/122)	0.3% (1/384)
Slow Flow	0.6% (2/341)	0.0% (0/64)	0.3% (1/357)	0.0% (0/122)	0.0% (0/384)
No Reflow	0.0% (0/341)	0.0% (0/64)	0.0% (0/357)	0.0% (0/122)	0.0% (0/384)

1. The final image is the one chosen by the core lab analyst based on optimal projection, image quality, etc. from the post-procedural images obtained after all devices have been removed and the procedure has been completed.
2. Serious angiographic complications include severe dissection (Type D to F), perforation, abrupt closure, persistent slow flow and no flow.
3. Dissections were categorized per the NHLBI classification system.
4. Perforations were categorized per the Ellis classification for coronary perforation

Supplemental Clinical Information

An analysis of long-term MACE (through 24 months) was conducted for pivotal subjects on the complete data set.

All MACE were adjudicated by the CEC, and of the events that occurred beyond 30 days, none were adjudicated by the CEC as being definitely or probably device-related.

Table 10. MACE through 24 Months (Pivotal Analysis Set)

	6 Months	12 Months	24 Months
Number of Subjects with Completed Follow-up Visits	373	367	346
MACE[1,2]	10.2%	13.6%	18.9%
Cardiac Death	0.8%	1.1%	2.7%
Non-Q-wave Myocardial Infarction[3]	7.8%	9.2%	11.3%
Q-wave Myocardial Infarction	1.6%	1.6%	1.6%
Target Vessel Revascularization	2.9%	5.8%	8.5%

Note: MACE rates were calculated as Kaplan-Meier estimates event rates with the number of events.

1. All MACE were adjudicated by an independent CEC.
2. Some subjects failed >1 component of the MACE criteria; therefore, the categories are not mutually exclusive.
3. Myocardial Infarction (MI) is defined as CK-MB level > 3 times the upper limit of lab normal (ULN) value with or without new pathologic Q wave at discharge (periprocedural MI) and using the Fourth Universal Definition of Myocardial Infarction beyond discharge (spontaneous MI).

Target Lesion Revascularization (TLR) Kaplan-Meier (K-M) estimates at 6,12, and 24 months are 2.4%, 4.3%, and 6.4%, respectively.

The effect of IVL on hemodynamics during the index procedure was assessed.

Table 11 summarizes the hemodynamic data for those subjects with IVL-induced capture (n=171) and those without (n=245). There were no instances of sustained ventricular arrhythmias in the group with IVL-induced capture, and there was no difference in the magnitude of BP drop between the two groups.

Table 11. Hemodynamic Effects of IVL-Induced Capture During Index Procedure (Safety Set)

Parameter	Subjects without IVL-induced capture (n=245)	Subjects with IVL-induced capture (n=171)	p-value
Pre-Procedure Heart Rate (bpm)	69.0 ± 11.9	65.9 ± 11.4	0.0094
Heart Rate ≤ 60 bpm	20.8% (51/245)	37.4% (64/171)	0.0002
Drop in Systolic BP during IVL Procedure	24.5% (58/237)	40.5% (66/163)	0.0007
Clinically Significant Drop in Systolic BP[1]	3.4% (2/58)[2,3]	1.5% (1/66)[4]	0.5988
Magnitude of Systolic BP Drop	23.5 ± 15.0	18.9 ± 14.2	0.0670
Sustained Ventricular Arrhythmia During or After IVL Procedure	0.4% (1/245)[2]	0% (0/171)	1.0000

1. Clinical significance determined by the investigator.
2. One subject experienced a drop in BP (23 mmHg) secondary to ventricular tachycardia which occurred during pre-dilatation prior to IVL and the procedure continued without further complication.
3. One subject experienced a drop in BP (50 mmHg) following two unsuccessful attempts to deliver a stent post-IVL, loss of guidewire position, difficulty placing a new guidewire, and subsequent PTCA.
4. One subject experienced a drop in BP (36 mmHg) after becoming transiently bradycardic and hypotensive following IVL; after treatment, the procedure continued without further complication.

An additional analysis by pooling individual patient-level data from the Disrupt CAD studies (CAD I-IV) based on uniform study inclusion/exclusion criteria and endpoint definitions, as well as the use of an independent angiographic core lab and Clinical Events Committee adjudication, was conducted. Across the four studies, a total of 683 subjects were enrolled from December 2015 to April 2020 at 72 sites from 12 countries including Australia, Europe, U.S. and Japan. The Safety Set population from CAD III and IV was used for this analysis.

A total of 42 subjects in the pooled safety set (6.1%, 42/683) had a prior PPM/ICD. Table 12 summarizes relevant adverse events in this subset including PPM/ICD-related adverse events (e.g., inappropriate shock, transient pacing inhibition), arrhythmias and hemodynamic events (including hypotension, cardiogenic shock and hemodynamic instability). In the pooled safety set, there were no PPM/ICD-related events and no hemodynamic adverse events. Three (3) subjects (7.1%, 3/42) with a PPM/ICD experienced an arrhythmia > 30 days following the index procedure; however, none were related to the study device (IVL) or the index procedure. All three subjects were enrolled in the Disrupt CAD III study; all had a medical history of arrhythmia; and all arrhythmia-related AEs occurred > 30 days following the index procedure.

In conclusion, the pooled safety analysis demonstrates there is no association between PPM/ICD adverse events and coronary IVL and support the conclusion that coronary IVL is safe in patients with an implanted PPM/ICD device.

Table 12. Summary of PPM/ICD Events (CAD I-IV Pooled Safety Set)

	CAD I[1]	CAD II[2]	CAD III[3]	CAD IV[4]	Pooled
Prior PPM/ICD	**11.7% (7/60)**	**5.8% (7/120)**	**6.3% (27/431)**	**1.4% (1/72)**	**6.1% (42/683)**
AEs Relevant to Potential PPM/ICD Interaction	**0.0% (0/7)**	**0.0% (0/7)**	**11.1% (3/27)**	**0.0% (0/1)**	**7.1% (3/42)**
PPM/ICD Events[5]	0.0% (0/7)	0.0% (0/7)	0.0% (0/27)	0.0% (0/1)	0.0% (0/42)
Arrhythmia	0.0% (0/7)	0.0% (0/7)	11.1% (3/27)[6]	0.0% (0/1)	7.1% (3/42)
Hemodynamic Events[7]	0.0% (0/7)	0.0% (0/7)	0.0% (0/27)	0.0% (0/1)	0.0% (0/42)
IVL-related AEs Relevant to Potential PPM/ICD Interaction	**0.0% (0/7)**	**0.0% (0/7)**	**0.0% (0/27)**	**0.0% (0/1)**	**0.0% (0/42)**
Adverse pacing/ICD[5]	0.0% (0/7)	0.0% (0/7)	0.0% (0/27)	0.0% (0/1)	0.0% (0/42)
Arrhythmia	0.0% (0/7)	0.0% (0/7)	0.0% (0/27)	0.0% (0/1)	0.0% (0/42)
Hemodynamic events[7]	0.0% (0/7)	0.0% (0/7)	0.0% (0/27)	0.0% (0/1)	0.0% (0/42)

1. CAD I includes all AEs reported during the study follow-up period (180 days).
2. CAD II includes all AEs reported during the study follow-up period (30 days).
3. CAD III includes all AEs reported as of June 28, 2020 during the study follow-up period (24 months).
4. CAD IV includes all AEs reported as of August 6, 2020 during the study follow-up period (24 months).
5. Inappropriate ICD shock, transient pacing inhibition
6. All 3 subjects had medical history of arrhythmia; no events were device-related and all occurred > 30 days after index procedure.
7. Hypotension, cardiogenic shock, hemodynamic instability

Post-Approval Study Summary

Shockwave Medical conducted a PMA Post Approval Study (PAS) to assess the utilization, safety, and effectiveness of the Shockwave Coronary IVL System in a "real-world" setting. The Disrupt CAD III PAS was a prospective, multicenter, observational, single-arm post-approval study using data collected from the National Cardiovascular Data Registry (NCDR®) CathPCI Registry®.

The safety endpoints for the Disrupt CAD III PAS are based on site-reported data and include all-cause death, procedure-related adverse events, and IVL-specific data points. The IVL-specific data points were IVL-related ventricular arrhythmia, IVL balloon loss of pressure and related serious dissections, and safety of IVL in patients with PPM/ICD.

Patients were enrolled in the CathPCI Registry who were confirmed to have a lesion treated with a Shockwave C[2] Coronary IVL Catheter (hereafter referred to as the "CathPCI Cohort"). Of the procedures in the CathPCI Cohort, 1,212 (6.4%) met the following eligibility criteria: severely calcified, stenotic *de novo* coronary artery lesions presenting with stable, unstable, or silent ischemia that are suitable for percutaneous coronary intervention (PCI) and had clinical characteristics similar to the Disrupt CAD III IDE study. This group is referred to as the "PAS Cohort" and is considered the enrolled population. Demographics for the PAS Cohort and overall CathPCI Cohort are summarized in Table 13.

Table 13: Patient Baseline Characteristics of CathPCI Cohort and PAS Cohort

Measure	CathPCI Cohort (N=18,893)	PAS Cohort (N=1,212)
Age (yrs), Mean ± StdDev	72.8 ± 9.8	73.4 ± 9.0
Gender		
Female	29.0% (5,475/18,893)	27.2% (330/1,212)
Male	71.0% (13,418/18,893)	72.8% (882/1,212)
Race, % (n/N)		
White	87.4% (15,953/18,243)	90.7% (1,061/1,170)
Black/African American	7.5% (1,376/18,243)	5.9% (69/1,170)
Asian	2.0% (373/18,243)	1.3% (15/1,170)
American Indian/Alaskan Native	0.6% (101/18,243)	0.2% (2/1,170)
Native Hawaiian/Pacific Islander	0.2% (39/18,243)	0.0% (0/1,170)
Hispanic Origin	5.9% (1,103/18,734)	5.6% (67/1,200)
Prior Percutaneous Coronary Intervention (PCI)	52.6% (9,933/18,893)	38.9% (471/1,212)
Prior Myocardial Infarction	34.7% (6,558/18,893)	20.6% (250/1,212)
MI within 30 Days	3.8% (721/18,893)	0.0% (0/1,212)
Prior Coronary Artery Bypass Graft	20.5% (3,880/18,893)	16.6% (201/1,212)
Diabetes Mellitus	51.8% (9,784/18,893)	44.3% (537/1,212)
Currently on Dialysis	7.5% (1,412/18,893)	0.0% (0/1,212)
Cerebrovascular Disease	21.7% (4,109/18,893)	17.3% (210/1,212)
Heart Failure	42.1% (7,960/18,893)	24.3% (295/1,212)
PCI Indication: STEMI	3.2% (611/18,881)	0.0% (0/1,212)
PCI Indication: NSTEMI-ACS	32.8% (6,200/18,881)	0.0% (0/1,212)
PCI Status: Emergency or Salvage	4.3% (815/18,889)	0.0% (0/1,212)
Cath Lab Visit Indication: Acute Coronary Syndrome (ACS)	38.1% (7195/18,893)	0.0% (0/1,212)
Other Indication of Cardiac Arrest or Instability	1.6% (301/18,893)	0.0% (0/1,212)

The Primary Safety results for the PAS and CathPCI Cohort are summarized in Table 14.

Table 14. Summary of Safety Data for the CathPCI Cohort and PAS Cohort

Safety Endpoint	CathPCI Cohort % (n/N)	PAS Cohort % (n/N)
All-Cause Death		
Death at Discharge	2.2% (423/18,893)	0.2% (3/1,212)
Procedure-Related Adverse Events (AEs)		
Any Procedure-Related AE	7.7% (1,458/18,893)	2.9% (35/1,212)
Coronary Artery Perforation	0.7% (129/18,893)	0.6% (7/1,212)
Coronary Artery Dissection (C and above)	0.9% (169/18,893)	0.4% (5/1,212)

A summary of IVL-specific data points for the CathPCI and PAS Cohorts is shown in Table 15. There were no instances of adverse device interaction (inhibition of pacing, inappropriate shock, required device reprogramming) reported in PPM/ICD patients.

Table 15. Safety Endpoint: IVL-Specific Data Points (from IVL Auxiliary Data Collection Form)

Measure	CathPCI Cohort % (n/N)	PAS Cohort % (n/N)
IVL Auxiliary Forms Completed	11.1% (2,077/18,776)[1]	12.6% (153/1,212)
Safety Endpoint: IVL-Related Ventricular Arrhythmia		
Sustained Ventricular Arrhythmia (during IVL device utilization)	0.2% (5/2,077)[2]	0.0% (0/153)
Cardiac Arrest	0.1% (3/2,077)[2]	0.0% (0/153)
Safety Endpoint: IVL Balloon Loss of Pressure and Related Serious Dissections		
Balloon Loss of Pressure/Rupture	1.2% (24/2,077)	1.3% (2/153)

Measure	CathPCI Cohort % (n/N)	PAS Cohort % (n/N)
Serious Coronary Dissection following Balloon Loss of Pressure/Rupture	0.0% (1/2,077)	0.0% (0/153)
Safety Endpoint: Safety of IVL in Patients with PPM/ICD		
Total Patients with Cardiac Implantable Electronic Device (CIED) (PPM or ICD)	6.9% (143/2,077)	7.8% (12/153)
Permanent Pacemaker (PPM)	67.1% (96/143)	50.0% (6/12)
Implantable Cardioverter Defibrillator (ICD)	32.9% (47/143)	50.0% (6/12)
Inappropriate Inhibition of Pacing during IVL Device Utilization (PPM or ICD)	0.0% (0/143)	0.0% (0/12)
Device Reprogramming Required During or After PCI Procedure (PPM or ICD)	0.0% (0/143)	0.0% (0/12)
Inappropriate ICD Shocks Delivered during IVL Device Utilization (for those with ICD)	0.0% (0/47)	0.0% (0/6)
1. 18,776 total episodes representing 18,893 procedures. 2. After data extract, it was confirmed with the sites that four (4) out of the five (5) instances of sustained ventricular arrhythmia and two (2) out of the three (3) instances of cardiac arrest were entered in error.		

The data collected from the CathPCI Registry provide important information on clinical outcomes in a ''real-world'' population; more than 1700 institutions currently participate in the CathPCI Registry, representing over 95% of US centers performing PCI procedures. All data in the registry are site-reported; there is no independent adjudication of adverse events or core lab assessment of angiographic characteristics. The registry data are comprised predominantly of in-hospital outcomes.

The Shockwave IVL System with Shockwave C^2 Coronary IVL Catheter continues to demonstrate safety with a low incidence of procedure-related adverse events including all-cause death, supporting the absence of unreasonable risk of illness or injury associated with the use of the device for its intended uses and conditions of use. These results confirm the overall safety profile of the Shockwave Medical Coronary IVL System for the treatment of subjects with highly calcified lesions in coronary arteries prior to stent placement.

Supplemental Clinical Information

The overall CathPCI Cohort consisted of both the PAS Cohort and patients who were indicated for PCI but did not have the same characteristics as the Disrupt CAD III IDE study. Demographics for the overall CathPCI and PAS Cohorts were similar; however, the CathPCI Cohort had a higher prevalence of cardiovascular risk factors including prior PCI, prior MI, prior CABG, diabetes, dialysis, cerebrovascular disease and heart failure. The CathPCI Cohort also included patients with a high degree of procedural urgency or cardiovascular instability which are correlated with poor outcomes including: MI within 30 days; PCI indication of STEMI or NSTEMI; PCI status of emergency or salvage; patients in cardiogenic shock or with acute heart failure symptoms; those presenting with acute coronary syndrome (ACS); and those with another indication of cardiac arrest or instability. These factors were exclusionary for the PAS Cohort.

An additional analysis confirmed the observed in-hospital mortality rate in both cohorts (CathPCI Cohort and PAS Cohort) is consistent with the predicted mortality rate generated from an established CathPCI model (Table 16). Using this model and associated bedside risk score, the observed in-hospital mortality rate for the PAS Cohort was 0.25% vs. 0.31% predicted (p=Non-Significant [NS]); the observed rate for the CathPCI Cohort was 2.24% vs 2.24% predicted (p=NS). The overall CathPCI Cohort was further stratified to show that the observed mortality rates for the highest risk patients with ACS are also consistent with the predicted rates, including those with a PCI indication of non-ST-elevation MI (NSTE-ACS) and ST-elevation MI (STEMI). As previously noted, patients with these characteristics were excluded from the PAS Cohort.

Table 16. Observed vs Predicted In-Hospital Mortality (based on CathPCI Bedside Risk Score)

Cohort	N	Observed In-Hospital Mortality	Predicted In-Hospital Mortality[1]	RR (95% CI)[2]	P-value
CathPCI Cohort	18,893	2.24%	2.24%	1.00 (0.91 – 1.10)	NS
PAS Cohort	1,212	0.25%	0.31%	0.79 (0.15 - 1.93)	NS
NSTE-ACS	6,200	3.55%	3.79%	0.94 (0.82 - 1.07)	NS
NSTE-ACS without Cardiogenic Shock or Cardiac Arrest	5,886	2.34%	2.40%	0.98 (0.82 - 1.15)	NS
STEMI	611	11.29%	11.63%	0.97 (0.76 - 1.21)	NS
STEMI without Cardiogenic Shock or Cardiac Arrest	490	4.90%	6.20%	0.79 (0.51 - 1.14)	NS

NS = non-significant

[1] Castro -Dominguez YS, et al. Predicting In-Hospital Mortality in Patients Undergoing Percutaneous Coronary Intervention. J Am Coll Cardiol. 2021 Jul 20;78(3):216-229. doi: 10.1016/j.jacc.2021.04.067. Epub 2021 May 3. PMID: 33957239.

[2] Vandenbroucke JP. A Shortcut Method For Calculating The 95 Percent Confidence Interval of the Standardized Mortality Ratio. (Letter). Am J Epidemiol. 1982 Feb; 115(2):303-4. doi: 10.1093/oxfordjournals.aje.a113306.

How Supplied

The IVL Catheter is supplied sterile via e-beam sterilization and is intended for single use only. Do not re-sterilize as this could damage the device and lead to patient injury. Do not reuse the device as this could result in cross-contamination that could result in patient injury. Carefully inspect all packaging for damage or defects prior to use. Do not use the device if there is any sign of breach of the sterile barrier, as this could indicate loss of sterility that could result in patient injury. Do not use the device if there is damage to the package, as this could lead to device malfunction and result in patient injury. Store the IVL Catheter in a cool, dark, dry place. Storage of the device in extreme conditions may damage the device and/or affect device performance that could lead to patient injury.

Required Devices for the Coronary IVL Procedure

The IVL Catheter is to be used exclusively with the IVL Generator, IVL Connector Cable and its accessories. The IVL Connector Cable is a remote actuator which connects the IVL Generator to the IVL Catheter and is used to activate the lithotripsy therapy from the IVL Generator. Refer to the IVL Generator and IVL Connector Cable Operator's Manual for preparation, operation, warnings and precautions, and maintenance of the IVL Generator and IVL Connector Cable.

Devices Required But Not Supplied By Shockwave Medical, Inc.

- 6F guide catheter and extension(s)
- 0.014" (0.36 mm) Guide Wire (190 cm – 300 cm Length)
- 5"x96" (13x244 cm) minimum Sterile Sleeve
- Indeflator

Folded Balloon Diameters:

- 0.044" max. for 2.5 mm
- 0.045" max. for 3.0 mm and 3.5 mm
- 0.047" max. for 4.0 mm

Shockwave C^2 Coronary IVL Catheter Balloon Compliance Chart

Pressure ATM -KPa	2.5x12 mm Ø (mm)*	3.0x12 mm Ø (mm)*	3.5x12 mm Ø (mm)*	4.0x12 mm Ø (mm)*
4 *– 405	**2.4**	**2.9**	**3.4**	**3.9**
5 -507	2.4	2.9	3.5	3.9
6** – 608	2.5	3.0	3.5	4.0
7 – 709	2.5	3.0	3.6	4.0
8 -811	2.5	3.0	3.6	4.1
9 – 912	2.5	3.0	3.6	4.1
10***-1013	2.5	3.1	3.7	4.1

Note: *Ø (mm) is ± 0.10 mm; 4 atm is IVL treatment balloon pressure
** 6 atm is nominal balloon pressure and post- treatment pressure
*** 10 atm is RBP (Rated Burst Pressure) of the balloon

Shockwave C^2 Coronary IVL System Sequence Chart

The following pulsing sequence must be followed during treatment. Do not utilize a pulsing sequence other than those outlined in the IVL System Sequence Chart below. Insertion of any size Shockwave C^2 IVL Catheter will automatically program the IVL Generator with the following treatment sequence:

Treatment Frequency	1 Pulse per 1 Second
Maximum Number of Continuous Pulses (1 cycle)	10 Pulses
Minimum Pause Time	10 Seconds
Maximum Total Pulses Per Catheter	Displayed on generator

In the event the user attempts to deliver more than the maximum number of continuous pulses allowed, the IVL Generator is designed to stop automatically. To resume pulsing, wait at least the minimum pause time before resuming therapy. The therapy button must be released and pressed again to resume therapy. For more information, refer to the IVL Generator and IVL Connector Cable Operator's Manual.

If the maximum pulse count is reached as displayed on the generator, the catheter shall not be used any further. If further therapy is needed, discard this catheter and obtain a new one. **Caution: Do not exceed 80 pulses in the same treatment segment**.

Procedural Steps

Caution: Refer to the IVL Generator and IVL Connector Cable Operator's Manual for preparation, operation, warnings and precautions, and maintenance of the IVL Generator and IVL Connector Cable.

Preparation

1. Prepare the insertion site using standard sterile technique.
2. Achieve preferred vascular access and place a guidewire and guide catheter.
3. Select a lithotripsy balloon catheter size that is 1:1 based on balloon compliance chart (above) and reference vessel diameter. The largest diameter balloon should be used if 1:1 sizing is not available (such as using a 4.0 mm IVL Catheter in a vessel with a reference diameter of 4.5 mm).
4. Remove the IVL Catheter from the package.
5. Prepare the lithotripsy balloon using standard technique. Fill a syringe with 5cc of 50/50 saline/contrast medium. Attach syringe to inflation port on catheter hub. Pull vacuum at least 3 times, releasing vacuum to allow the fluid to replace the air in the catheter.
6. Fill indeflator device with 10cc of 50/50 saline/contrast medium. Disconnect syringe and connect indeflator to inflation port of catheter hub ensuring no air is introduced to the system.
7. Remove the protective sheath and shipping mandrel from the IVL Catheter. **Warning:** Do not use the device if the protective sheath or shipping mandrel are difficult to remove or cannot be removed.
8. Flush the guidewire port with saline.
9. Wet the lithotripsy balloon and distal shaft with sterile saline in order to activate the hydrophilic coating. Do not wet the balloon with Isopropyl alcohol (IPA) as this can damage the hydrophilic coating integrity.
10. Insert the IVL Connector Cable into the sterile sleeve or probe cover.
11. Remove the cap from the proximal end and attach the IVL Catheter Connector (see Fig 1) to the IVL Connector Cable.
12. Attach the other end of the same IVL Connector Cable to the IVL Generator.

Caution: Care must be taken to avoid applying lithotripsy therapy, i.e. pressing the therapy button of the IVL Connector Cable while lithotripsy balloon is dry and/or un-inflated, as this may damage the balloon.

Delivering the Shockwave C² IVL Catheter to the Treatment Site

1. Position guiding catheter proximal to the treatment site.
2. If it is anticipated that the IVL Catheter may not cross the lesion, pre-dilatation or other vessel preparation may be performed using standard technique based on physician discretion.
3. Load the IVL Catheter over the exchange length (190 – 300 cm) 0.014" guidewire and through a guiding catheter and advance IVL Catheter to the treatment site.
4. Position the IVL balloon at the treatment site using the marker bands to aid in positioning.

Treating the Site with Intravascular Lithotripsy

1. Once the IVL Catheter is in place, record position using fluoroscopy.
2. If position is incorrect, adjust the lithotripsy balloon to the correct position.
3. Inflate lithotripsy balloon, not exceeding 4.0 atm to ensure the balloon is inflated and there is full apposition to the vessel wall.
   NOTE: Lithotripsy should not be delivered if the balloon is inflated to >4 atm as there is no increase in sonic output and higher pressure during treatment can increase the risk that the balloon loses pressure.
4. Deliver IVL treatment sequence for the pre-programed time of 10 seconds to deliver 10 pulses by pressing the therapy button on the IVL Connector Cable.
   NOTE: The IVL Generator is programmed to force a minimum pause time of 10 seconds following every 10 pulses delivered.
5. Inflate lithotripsy balloon to reference size per balloon compliance chart and record lesion response on fluoroscopy.
6. Deflate lithotripsy balloon and wait at least 10 seconds to re-establish blood flow. The balloon deflation time is up to 15 seconds, depending upon balloon volume.
7. Repeat steps 3, 4, 5, and 6 for additional treatment cycles until the lesion has been sufficiently dilated or if the catheter is re-positioned.
8. Additional treatments can be performed if deemed necessary. If multiple inflations are required due to a lesion length greater than the lithotripsy balloon length, the recommended balloon overlap is at least 2 mm to prevent geographic miss. However, care must be taken not to exceed 80 pulses maximum in the same treatment segment and therefore 160 pulses in an overlap segment.
9. Perform a completion arteriogram to assess post intervention result.
10. Deflate the device and confirm that the balloon is fully deflated prior to removing the IVL Catheter.
11. Remove the IVL Catheter. If there is difficulty in removing the device through the hemostatic valve due to the lubricity, gently grasp the IVL Catheter with sterile gauze.
12. Inspect all components to ensure that the IVL Catheter is intact. If a device malfunction occurs or any defects are noted on the inspection, flush the guidewire lumen and clean the outer surface of the catheter with saline, store the IVL Catheter in a sealed plastic bag, and contact Shockwave Medical, Inc. at complaints@shockwavemedical.com for further instructions.

Caution: IVL Catheter once pulled out of the body should not be reinserted for additional inflation or lithotripsy treatments. Balloon can be damaged in the process.

Patient Information

Physicians should instruct patients to seek medical attention immediately for signs and symptoms of recurrent ischemic heart disease. There are no known limitations to normal daily activities. Patients should be instructed to comply with the medication regimen as prescribed by their physician.

Return of Devices

If any portion of the Shockwave IVL System fails prior to or during a procedure, discontinue use and contact your local representative and/or email complaints@shockwavemedical.com.

Patents: www.shockwavemedical.com/patents

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Symbol	Definition
	Do not re-use
	Use by date
	Sterilized using irradiation
	Caution
	Manufacturer
	Do not use if package is damaged
	Keep dry
	Keep away from heat
	Batch code
	Catalogue number
	Rapid Exchange Catheter
	Do not resterilize
	Non-pyrogenic
	Consult instructions for use
	Contains 1 unit (Contents: 1)
	Recommended Guidewire
	Recommended Guide Catheter
	Crossing Profile
	Balloon Diameter

Symbol	Definition
	Balloon Working Length
UL	Catheter Working Length (Usable Length, UL)
PAT	Patents. Refer to www.shockwavemedical.com/patents
IVL	Intravascular Lithotripsy
	Caution: Federal (USA) Law restricts this device to sale by or on the order of a physician.
UDI	Indicates a carrier that contains Unique Device Identifier information.

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PN 62185 Rev G