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Changing the model of care during the COVID-19 pandemic: Same-day discharge of patients undergoing elective invasive cardiac procedures in Hong Kong

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ABSTRACT

Background: Despite an evidence-based protocol to facilitate same-day discharge (SDD) of patients undergoing elective intracoronary procedures, overnight hospitalization remains a routine practice.
Objectives: This study aimed to determine the frequency of SDD after intracoronary procedures among patients treated before and during the COVID-19 pandemic, and identify factors predictive of a decision for SDD.
Methods: This retrospective cohort study ($N = 680$) was based on registry data of a cardiac ambulatory center.
Results: The frequency of SDD was significantly higher in 2020 relative to 2019 ($p < 0.001$). No complication were identified during the next-day follow-up among SDD cohort. Compared to those who stayed overnight, SDD patients had a lower 30-day readmission rate ($p < 0.001$), but not 30-day mortality ($p = 1.000$). Radial access, some procedural-related and comorbidities of patients significantly predicted SDD.
Conclusions: SDD is safe and feasible when a dedicated protocol has been implemented. The findings support the routine use of this practice.

Introduction

Percutaneous coronary intervention (PCI) is recommended as the treatment-of-choice for patients with acute coronary syndrome and stable coronary artery disease with persistent symptoms despite optimal medical therapy.[1] While coronary artery disease is a highly prevalent condition and the leading contributor to the global disease burden,[2,3] PCI has become one of the most frequently performed medical procedures globally. Historically, overnight observation is the standard of care for patients who have undergone PCI, to observe and treat for potentially serious complications, such as stent thrombosis, myocardial ischemia, access site complications and bleeding. Indeed, the emerging use of the radial artery as a viable access site, together with advances in stent design, femoral site closure devices and adjunctive anticoagulants during the procedure has led to a decrease in the incidence of post-PCI complications. As such, empirical evidence is accumulating to support the safety of same-day discharge (SDD) of low-risk patients after PCI. Three meta-analyses consistently demonstrated the safety of SDD for patients after uncomplicated PCI.[4–6] Recent studies have examined the safety profile of SDD among patients with complex lesions,[7,8] and the evidence to date has not indicated an additional risk associated with SDD relative to an overnight hospital stay. Moreover, SDD is associated with higher patient satisfaction and lower costs incurred by both patients and healthcare systems.[9] Despite such encouraging findings, overnight observation remains the mainstay of practice for post-PCI care in many regions of the world,[10,11] including Hong Kong, leading to an evidence–practice gap.

Apart from PCI, advances in technology have led to more sophisticated intracoronary procedures to improve diagnostic accuracy and inform decisions about stent deployment in recent years. These procedures include fractional flow reserve (FFR) and instantaneous wave-free ratio (iFR) assessments, which use differences in pressure to precisely estimate the severity of lesions. Intravascular imaging techniques, such as intravascular ultrasound (IVUS), optical coherence tomography (OCT) and optical frequency domain imaging (OFDI), can provide detailed information about the vessel size, luminal area and plaque composition and thus guide cardiologists' decisions on myocardial revascularization.[1] Because these procedures are invasive and involve access to and manipulation of coronary lesions, anticoagulant agents and catheters with a minimum size of 6 Fr are

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often required for femoral or radial access. As such, patients undergoing these procedures are often keep overnight observation to monitor the incidence of post-procedural complications. To our best knowledge, the safety associated with SDD for patients undergoing these procedures has not be reported to date.

Queen Elizabeth Hospital, a major regional hospital in Hong Kong, provides a full range of cardiac services. In 2015, the hospital developed an evidence-based protocol to facilitate SDD of low-risk patients after invasive intracoronary procedures and thus optimize the model of care. Although the protocol was developed several years ago, it has not been implemented successfully. Cardiologists reluctant to change their standard practices represent the major barrier to implementation. In addition, the lack of local data to indicate the safety profile and patients' acceptance of SDD render the protocol not being adopted as a routine practice. With the emergence of the coronavirus disease 2019 (COVID-19) in December 2019 and subsequent pandemic, however, every effort has been made to contain the outbreak and prevent overwhelming the healthcare system. In Hong Kong, the Hospital Authority of Hong Kong, a statutory body that manages all public hospitals, first escalated its alert system to the Emergency Response Level in January 2020 and has since maintained this level. This change necessarily led to the suspension or cancellation of some non-urgent clinical patient services, including elective cardiac procedures, to reserve healthcare resources for combating COVID-19 and minimizing infection within hospital facilities. However, the medical service needs of patients with coronary artery disease cannot be neglected, particularly those scheduled to undergo PCI, who may have persistent ischemic symptoms. Therefore, our team made use of the available SDD protocol to strike a balance between the provision of service to our patients undergoing invasive intracoronary procedures and the risk of COVID-19 infection.

We believed that it would be worthwhile to revisit the model of care for patients undergoing elective intracoronary procedures in light of the remarkable advances in the field. Therefore, we conducted an observational study with the following objectives: (1) to compare the frequency of SDD in 2 recent consecutive years; (2) to report the in-hospital and next-day adverse clinical outcomes in the overnight stay and SDD cohort; (3) evaluate and compare the 30-day readmission and mortality associated with SDD versus an overnight stay after an invasive intracoronary procedure; (4) to identify the factors associated with SDD as potential future predictors of decisions for SDD.

Methods

The SDD protocol

According to the evidence-based protocol (Fig. 1), cardiac nurses should use a checklist to identify potential candidates for SDD according to criteria such as self-care ability, the presence of a caregiver at home during the first 24 h after discharge, renal function and frailty status. To allow adequate time for observation prior to discharge, patients who are potentially eligible for SDD should be scheduled to undergo procedures during earlier timeslots. After the procedure, cardiologists should determine the suitability of the patient for SDD according to whether the procedure was uneventful and smooth and did not involve complex PCI procedures, whether pre-procedural echocardiography revealed no significant impairment of the left ventricular ejection fraction, and successful access site wound closure are eligible for SDD. Then, nurses should determine whether the patient is free of ischemic symptoms and hemodynamically stable, with no bleeding or vascular complications at the puncture site within 6 hours after the procedure. Patients who meet these criteria and are discharged on the same day should be provided with verbal and written instructions regarding potential complications and the associated management strategies (Fig. 2). Patients and their caregivers should also be provided an emergency contact number in case they require professional advice. For the patients, a next-day follow-up at the ambulatory cardiac center should be arranged for a routine evaluation of the electrocardiogram, renal function and puncture site, and the prescribed medications (e.g., aspirin, statin and $P2Y_{12}$ inhibitor) should be dispensed for use until the next follow-up appointment.

Study design

This retrospective cohort study was based on the registry of the ambulatory cardiac center at Queen Elizabeth Hospital. The data of patients admitted for elective intracoronary procedures during January–July 2020 were collected. The data of patients admitted for the same procedures during January–July 2019 were also collected as a historical cohort for comparison. The following adverse clinical outcomes happened during hospitalization and identified during the next-day follow-up in SDD patients were retrieved: artery dissection, hypotension, acute myocardial infarction, stent thrombosis, arrhythmia, impaired liver and renal function, wound bleeding and hematoma. Potential predictors of SDD were identified from the literature and selected on the basis that they preceded the discharge of patients after the procedure. These potential predictors included socio-demographic and social factors, co-morbidities and procedure-related factors. The study protocol was approved by the ethics committee of the study hospital (reference number: KC/KE-21-0014/ER-2) and informed consent was waived.

Study population

This study was conducted at Queen Elizabeth Hospital in Hong Kong, a major regional public hospital that provides a wide range of healthcare services and is equipped with a well-structured ambulatory cardiac center. In Hong Kong, public hospitals provide more than 95% of all hospital services, which are heavily subsidized by the government. The study population comprised patients aged 18 years or older who underwent one of the above-listed elective invasive intracoronary procedures at our center. Patients who underwent diagnostic coronary angiography without the insertion of a coronary guidewire were excluded from this study.

Definitions

In this study, invasive intracoronary procedures include any diagnostic and/or therapeutic invasive intracoronary procedure involving the percutaneous insertion of a catheter, advancement of a guidewire to a coronary artery and engagement of the catheter tip with a coronary artery lesion. Eligible procedures include PCI, FFR, iFR, IVUS, OCT and/or OFDI. All of these procedures were scheduled electively on an outpatient basis for patients whose conditions were stable. The SDD cohort included patients who had undergone one or more of these procedures and were discharged home on the same calendar day. The non-SDD cohort included patients who had an overnight hospital stay after the procedure.

Data analysis

Continuous variables are presented as means and standard deviations, while categorical variables are presented as frequencies and percentages. Independent *t*-tests were used to compare the numbers of SDD cases in 2019 and 2020, in-hospital/next-day adverse clinical outcomes, 30-day readmission and mortality rates between SDD and non-SDD patients in both years. Statistical comparison of the clinical characteristics between the cohorts was performed by univariate analysis using the independent *t*-test, Mann–Whitney U test, Fisher's exact test or the chi-square test. A p value <0.05 was considered

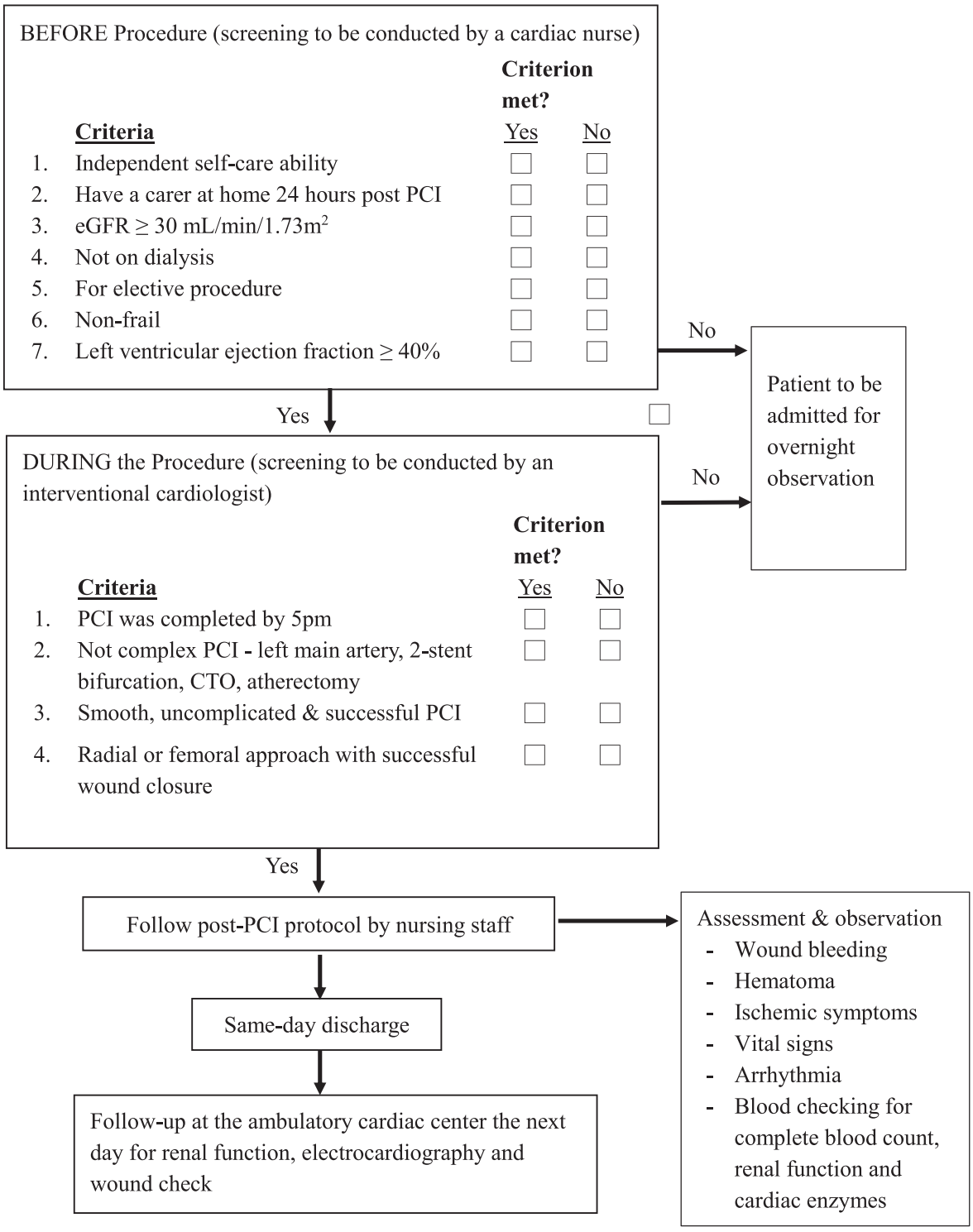

Fig. 1. The same-day-discharge protocol for elective cardiac procedures.

statistically significant. Variables having a p value <0.25 in the univariate analysis were entered simultaneously into the multivariate regression model.[12] The final model comprised predictors that remained significant at the 5% level. All statistical analyses were conducted using IBM SPSS version 26 (Armonk, NY, USA).

Results

The analysis included 680 patients, of whom 376 and 304 were treated during January–July 2019 and 2020, respectively. Compared with 2019 (n = 38, 10.1%), the frequency of SDD patients increased

Advice slip on discharge after Transcatheter Cardiac Procedures

1. The procedure is commonly performed through radial or femoral approach by doctors.
    - Trans-radial approach: You are advised to avoid excessive strength on the wrist within one week after the procedure, such as lifting an object with 10 pounds or more, which will hinder the wound healing.
    - Trans-femoral approach: You are advised to avoid frequent and excessive thigh bending within one week after the procedure, which will hinder the wound healing.
2. In order to prevent wound infection, you are advised to keep the wound dry and clean.
    - Under normal circumstances, you can take a shower 1 to 2 days after the procedure.
    - On the second day of discharge, you can clean the wound with diluted disinfectant or distilled water, and then cover it with adhesive bandage.
    - On the third day of discharge, the adhesive bandage is not necessary under normal circumstances.
3. In case of active bleeding and significant swelling over the wound, poor circulation of the affected hand or limb such as severe numbness, are detected after discharge, you have to press the wound firmly and lie in bed, and make the emergency call for ambulance service immediately.
4. The bruises over the wound are usually mild and will resolve in few days to weeks. You should pay attention to any redness, edema and discharge over the wound, please seek advice from healthcare professionals of the ward that you stayed during hospitalization.
5. You should adhere to the medication regime, attend medical follow-up and maintain a healthy lifestyle according to the instructions given by healthcare professionals.

Fig. 2. Written advice on discharge after transcatheter cardiac procedures.

significantly in 2020 (n = 68, 22.4%) ($p < 0.001$). After combining patients from these two years, the SDD and non-SDD cohorts consisted of 106 and 574 patients, respectively. The patients' baseline characteristics are presented in Table 1. They had a mean age of 68.08 ± 10.50 years, the majority (n = 496, 72.9%) were male, and 13.5% (n = 92) were current smokers. The three most common comorbidities were dyslipidemia, hypertension and diabetes mellitus. Nearly half of the patients had a history of PCI (n = 300, 44%), and 2.4% (n = 16) had undergone coronary artery bypass grafting. Furthermore, most of the patients had undergone PCI (n = 582, 85.6%) and/or IVUS (n = 456, 67.1%) at the index admission. During the procedures, heparin was used as the first-line anticoagulant at a mean dose of 7669 ± 3515 units. The radial approach (n = 563, 82.8%) was the most commonly used access site, followed by the femoral (n = 98, 14.4%) and both the radial and femoral sites (n = 19, 2.8%).

Table 2 shows the adverse clinical outcomes identified during the hospitalization of both cohorts and the next-day follow-up of SDD patients. There were no adverse clinical events identified among the SDD cohort, including access site bleeding and hematoma, arrhythmia, stent thrombosis, hypotension, acute coronary events, or hepatic and renal dysfunction. For the overnight hospitalization cohort, nearly all the adverse clinical events happened during or shortly after the procedure, except wound hematoma and impairment of liver and renal function (Table 2). No significant between-cohort difference was observed in terms of 30-day mortality [n = 0, 0% (SDD cohort) vs. n = 2, 0.3% (non-SDD), p = 1.000]. However, the SDD cohort had a significantly lower 30-day readmission rate compared with the non-SDD cohort [n = 0, 0% (SDD cohort) vs. n = 51, 8.9% (non-SDD cohort), $p < 0.001$].

We found that male sex, a history of cerebrovascular or peripheral disease, a higher serum creatinine concentration, a lower left ventricular ejection fraction and a procedure involving PCI, OCT or IVUS were associated with a greater likelihood of an overnight stay after the procedure, whereas iFR and FFR were associated with a greater likelihood of SDD (Table 1). A higher number of implanted stents, a greater number of involved vessels or lesions, a longer procedural time and a larger heparin dose were also associated with an overnight stay, whereas vascular access via the radial approach was associated with a greater likelihood of SDD.

The multivariate logistic regression analysis (Table 3) indicated that vascular access via the radial approach (odds ratio [OR] = 9.117, 95% confidence interval [CI] = 6.069–24.128, $p < 0.001$) and

Table 1
Sample characteristics and between-cohort comparisons.

	All patients(*N*=680)	Same day discharge(*N*=106)	Overnight hospitalization(*N*=574)	*p*-value
Demographic characteristics				
Age (years)[#]	68.08 (10.50)	67.43 (9.40)	68.2 (10.69)	0.492
Gender (male)	496 (72.9%)	68 (64.2%)	428 (74.6%)	0.032
Clinical characteristics				
Body mass index[#]	24.52 (3.76)	24.55 (3.72)	24.51 (3.78)	0.936
Smoker	92 (13.5%)	12 (11.3%)	80 (14.0%)	0.348
Diabetes mellitus	333 (49.1%)	43 (40.6%)	290 (50.7%)	0.058
Hypertension	482 (70.9%)	72 (67.9%)	410 (71.4%)	0.486
Dyslipidemia	514 (75.6%)	87 (82.1%)	427 (74.4%)	0.109
Arrhythmia	104 (75.6%)	19 (17.9%)	85 (14.8%)	0.462
Cerebrovascular or peripheral vascular disease	72 (10.6%)	5 (4.7%)	67 (11.7%)	0.038
Chronic obstructive pulmonary disease	64 (5.0%)	4 (3.8%)	30 (5.2%)	0.635
Chronic kidney disease	60 (8.8%)	5 (4.7%)	55 (9.6%)	0.135
Heart failure	105 (15.4%)	10 (9.4%)	95 (16.6%)	0.078
Prior acute myocardial infarction	60 (8.8%)	5 (4.7%)	55 (9.6%)	0.135
Prior PCI	300 (44.1%)	40 (37.7%)	260 (45.3%)	0.167
Prior coronary artery bypass grafting	16 (2.4%)	1 (0.9%)	15 (2.6%)	0.489
Premorbid mobility				0.495
Walking	662 (97.5%)	105 (99.1%)	557 (97.2%)	
Wheel chair	17 (2.5%)	1 (0.9%)	16 (2.8%)	
Creatinine (umol/L) [#]	108.59 (117.29)	88.22 (25.67)	112.39 (126.93)	<0.001
Left ventricular ejection fraction (%)[#]	53.82 (8.46)	56.4 (6.90)	53.33 (8.65)	0.001
Hemoglobin (g/dL) [#]	13.25 (2.47)	13.41 (1.57)	13.21 (2.60)	0.443
Platelet ($x10^9$L) [#]	235.87 (65.82)	234.44 (65.30)	236.13 (65.97)	0.809
Procedure details				
Type of Procedure				
IVUS	456 (67.1%)	27 (25.5%)	429 (74.7%)	<0.001
IFR	86 (12.6%)	55 (51.9%)	31 (5.4%)	<0.001
FFR	18 (2.6%)	8 (7.5%)	10 (1.7%)	0.003
OCT	71 (10.4%)	4 (3.8%)	67 (11.7%)	0.014
OFDI	27 (4.0%)	2 (1.9%)	25 (4.4%)	0.290
PCI	582 (85.6%)	35 (33.0%)	547 (95.3%)	<0.001
POBA/DEB	7 (1.0%)	0 (0%)	7 (1.2%)	0.320
PCI attempted but failed	14 (2.1%)	5 (4.7%)	9 (1.6%)	0.052
Number of stent implanted				<0.001
0 stent	98 (14.4%)	71 (67.0%)	27 (4.7%)	
1 stent	195 (28.7%)	20 (18.9%)	175 (30.5%)	
2 stents	193 (28.4%)	12 (11.3%)	181 (31.5%)	
≥3 stents	194 (28.5%)	3 (2.8%)	191 (33.3%)	
Number of vessels treated				<0.001
0 vessel	73 (10.7%)	62 (58.5%)	11 (1.9%)	
1 vessel	417 (61.3%)	31 (29.2%)	386 (67.2%)	
2 vessels	173 25.4%)	10 (9.4%)	163 (28.4%)	
3 vessels	17 (2.5%)	3 (2.8%)	14 (2.4%)	
Number of lesions				<0.001
0 lesion	73 (10.7%)	62 (58.5%)	11 (1.9%)	
1 lesion	181 (26.6%)	19 (17.9%)	162 (28.2%)	
2 lesions	211 (31.0%)	17 (16.0%)	194 (33.8%)	
≥3 lesions	215 (31.6%)	8 (7.5%)	207 (36.1%)	
Access site				<0.001
Radial	563 (82.8%)	103 (97.2%)	460 (80.1%)	
Femoral	98 (14.4%)	3 (2.8%)	95 (16.6%)	
Both radial and femoral	19 (2.8%)	0 (0%)	19 (3.3%)	
Procedural time (minute)[#]	74.87 (4.93)	38.21 (15.74)	81.62 (41.75)	<0.001
Dose of heparin (unit) [#]	7669.63 (3515.40)	6750 (1244.41)	7837.13 (3761.73)	<0.001
Use of life support device (ECMO/Impella/IABP)	4 (0.6%)	0 (0%)	4 (0.7%)	1.00

Remarks: [#]Results of independent *t*-test;
DEB = drug-eluting balloon; ECMO = extracorporeal membrane oxygenation; FFR = fractional flow reserve; IABP = intra-aortic balloon pump; IFR = instantaneous wave free ratio; IVUS = intravascular ultrasound; OCT = optical coherence tomography; OFDI = optical frequency domain imaging; PCI = percutaneous coronary intervention; POBA = plain balloon angioplasty.

dyslipidemia (OR = 6.698, 95% CI = 1.827–14.559, $p = 0.004$) were significantly associated with SDD. A longer procedural time (OR = 0.956, 95% CI = 0.935–0.977, $p < 0.001$), and a procedure involving PCI (OR = 0.014, 95% CI = 0.010–0.053, $p < 0.001$) or IVUS (OR = 0.197, 95% CI = 0.081–0.483, $p < 0.001$), and greater number of stents deployment (OR = 0.024, 95% CI = 0.011–0.438, $p = 0.012$) predicted a higher likelihood of an overnight hospital stay after the procedure.

Discussion

In this study, we compared the frequency of SDD among patients undergoing elective interventional intracoronary procedures before and during the COVID-19 pandemic and the rates of complications between the SDD and non-SDD cohorts, and evaluated potential predictors associated with SDD. As noted above, although we established an SDD protocol at our center several years ago, the SDD rates have

Table 2
In-hospital/next-day adverse clinical outcomes.

	Same day discharge (*N*=106)	Overnight hospitalization (*N*=574)
Dissection	0 (0%)	11 (1.9%)
Stent thrombosis	0 (0%)	1 (0.2%)
Acute myocardial infarction	0 (0%)	5 (0.9%)
Hypotension	0 (0%)	14 (2.4%)
Arrhythmia	0 (0%)	10 (1.7%)
Impaired liver function	0 (0%)	2 (0.3%)
Impaired renal function	0 (0%)	1 (0.2%)
Wound bleeding	0 (0%)	3 (0.5%)
Wound hematoma	0 (0%)	15 (2.6%)

Table 3
Multivariate predictors of same-day discharge.

Predictor	Odds ratio	95% confidence interval	*p*-value
Radial access	9.117	6.069 – 24.128	<0.001
PCI	0.014	0.010 – 0.053	<0.001
IVUS	0.197	0.081 – 0.483	<0.001
Procedural time	0.956	0.935 – 0.977	<0.001
Number of stents deployed	0.024	0.011 – 0.438	0.012
Dyslipidemia	6.698	1.827 – 14.559	0.004

remained low due to a lack of implementation. However, the practice of overnight observation to ensure patient safety after an invasive intracoronary procedure is largely historical and is not supported by solid evidence. Therefore, our review of the model of care for patients undergoing such procedures is timely. Compared with the pre-COVID-19 era, we observed a significant increase in the frequency of SDD among patients who underwent invasive intracoronary procedures in 2020, when the entire world was impacted by COVID-19. The related pandemic offered a golden opportunity to implement SDD in a cardiac unit, and ours was the first center in Hong Kong to do so. During the pandemic, cardiologists' hesitation to endorse SDD was tempered by their intent to reserve more hospital beds and manpower to fight COVID-19 and a wish to reduce the risk of nosocomial infection among hospital inpatients. The patients also expressed a strong preference for earlier discharge due to the fear of infection. To the best of our knowledge, this is the first study to document the increased frequency of SDD among patients undergoing invasive intracoronary procedures during the COVID-19 pandemic. Indeed, the prolonged influence of COVID-19 has led to the extension of the SDD strategy to patients undergoing even more sophisticated procedures, such as transcatheter aortic valve replacement.[13]

Even though we observed an increase in the frequency of SDD during the pandemic, the observed rate of 22.4% is low, given the accumulating evidence of the good safety profile and benefits of this practice. We note that this evidence–practice gap is not exclusive to Hong Kong. In other developed countries such as the United States and Australia, the frequency of SDD after PCI is approximately 7% and 3%, respectively.[10,11] Safety concerns are cited as the major hindrance to the implementation of SDD. However, studies have shown that early complications after PCI, such as acute stent thrombosis, abrupt vessel closures and access site complications, often become apparent within 6 h upon the completion of PCI and rarely occur between 6 and 24 h post-procedure.[14,15] Therefore, overnight observation has minimal value in terms of patients' safety.

Consistent with the literature,[4–6] our study supports the safety of SDD for patients undergoing intracoronary procedures. The risk of 30-day mortality was comparable between the cohorts, and the SDD cohort had a statistically lower rate of 30-day readmission than the overnight cohort. Such findings may reflect the fact that our center has exercised greater caution when selecting candidates for SDD, which may have translated into minimal complications and fewer readmissions within 30 days after procedures. As our study was conducted at a high-volume center for invasive intracoronary procedures in Hong Kong, the rich experience of the interventionists helped to reduce the complication risks among all patients, regardless of cohort.

We also found that the significant predictors of SDD included both the patients' co-morbidities and procedural factors. Among these, radial access was most strongly associated with SDD in our study, consistent with the findings of other studies.[16,17] Compared with radial access, hemostasis is more difficult to achieve with femoral access, which is associated with prominent concerns such as major bleeding and vascular complications. Therefore, SDD is more likely to be applied to patients who have undergone procedures with radial access. Furthermore, a meta-analysis of 24 studies found that compared with femoral access, radial access was associated with significantly lower risks of all-cause mortality and major adverse cardiovascular events.[18] The superior safety profile of radial access would encourage the healthcare team to discharge patients on the same day after the procedure. We also found that patients undergoing PCI and IVUS were less likely to be discharged on the same day. In addition, the number of implanted stents, which reflect the severity of the underlying coronary artery disease, was also identified as a significant factor. As compare to other intracoronary procedures for diagnostic purpose, PCI involves a unique step of deploying stents to the coronary lesions. Such a step often accompanied with a greater volume of contrast and heparin to be given during the procedure. In addition, acute stent thrombosis remains a nightmare of PCI, which is a great concern of cardiologists when considering the time to discharge patients.[8] Altogether, these factors incur additional risks to PCI patients, which may explain why they were less likely to be discharged on the same day. For IVUS, it is the most common imaging modality adopted in our center to guide the decision of stent deployment, particularly for those borderline and complex lesions involving left main artery. As such, its significant association with longer length of stay after the procedure is expected. Patients with complex PCI, left main artery involvement, two-stent bifurcation, complete total occlusion and atherectomy currently are not considered candidates for SDD in our center. We note that evidence supporting the safety of SDD for these high-risk patients is accumulating rapidly,[8] and these exclusion criteria may be lifted in the near future. We further found that the patient's age was not a significant predictor of SDD. This finding might be related to the age-dependent nature of several criteria in our SDD protocol, such as self-care ability, frailty level and co-morbidity. That is, older patients might have deemed ineligible for SDD by these factors rather than by age per se.

A clear protocol to guide the selection of appropriate patients is crucial to the implementation of SDD, and its continued success also relies on the provision of post-discharge support to patients.[14] SDD involves a rapid shift of the direct responsibility for care from healthcare professionals to the patients. In this sense, it is important to prepare the patients and their caregivers to take up the responsibility of self-care to reduce complications. At our center, nurses conduct a risk assessment of patients to determine their self-care ability and frailty status and the availability of a family member who can offer immediate support in the first 24 h after discharge. However, the frailty assessment was done only with the eyeball test, referring to the subjective clinical judgment of patients' frailty status by observing their appearance and gait. This assessment method is subjective and prone to inter-rater variability,[19,20] which may jeopardize the efficacy of the protocol to select the best candidates for SDD. The cardiovascular patient population is aging and increasingly complex. Frailty is highly prevalent in this population, affecting 10% to 60% of patients.[21] As such, it is essential to optimize the SDD protocol by incorporating a simple, yet reliable and valid frailty assessment tool. Patients and their caregivers are also provided structured education on post-procedural care to ensure that they acquire the knowledge and skills to

prevent and manage adverse events that may arise. We also believe that rapid access to healthcare professionals for professional advice on potential adverse events that occur outside of the hospital and prompt next-day follow-ups to identify and manage any adverse events are crucial care components of our SDD protocol. Further, we note that the inclusion of a recommendation on the appropriate length of stay after elective intracoronary procedures in the American College of Cardiology/American Heart Association/European Society of Cardiology practice guidelines would certainly reduce worry among interventionists with regard to patient safety and medico-legal aspects. In this vein, the American College of Cardiology recently published an expert consensus pathway on SDD after PCI, which outlined a checklist encompassing clinical, social and system factors, to facilitate decision-making by the clinical team.[22] Our protocol includes all the major items suggested by this consensus statement.

The findings of our study should be interpreted cautiously due to the following limitations. First, this study was observational and retrospective in nature, and the level of evidence is less convincing than that of evidence from randomized controlled trials. Second, our study might have failed to capture other procedural-related decisions that affected the clinical outcomes of the patients, such as the coronary reperfusion flow after stenting and the location of stent placement. Third, this was a single-center study with a small sample size, and the findings may not be generalizable to other settings. Fourth, we reported only short-term outcomes and lack longitudinal follow-up data to indicate longer-term potential complications.

Conclusion

With a clear protocol, good post-discharge support and comprehensive assessment by the healthcare team, SDD appears to be a safe and feasible strategy for low-risk patients undergoing invasive intracoronary procedures. In this study, we observed no major adverse outcomes measured at 30-day follow-up after the procedures, such as death, stent thrombosis or other major cardiovascular events, among patients discharged on the same day after the procedures. We recommend a more vigorous study design (e.g., randomized controlled trials) to evaluate the safety of SDD, before an extensive implementation of SDD to improve the satisfaction of patients undergoing these procedures and preserve inpatient resources for higher-acuity patients.

Disclosure statement

No potential conflict of interest was reported by the authors.

Declarations of Competing Interest

None.

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