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Embolisation of a covered stent during bailout of a coronary perforation — a case of double jeopardy

Migracja stentu powlekanego w czasie naprawy perforacji tętnicy wieńcowej — przypadek podwójnego zagrożenia

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Abstract

Coronary perforation is a rare, but very serious, complication of percutaneous coronary intervention (PCI), which may be type I (extra luminal crater), II (myocardial or pericardial staining), or III (contrast streaming). Type III perforations, the most serious of all, are managed with reversal of anticoagulation and prolonged balloon tamponade, covered stents, and rarely emergency surgical repair.

Here, we report the case of a 74 year-old diabetic and hypertensive female who had suffered a type III perforation during PCI by predilatation with a semicompliant balloon of the mid left anterior descending artery (LAD) lesion as it was calcified. During deployment of the covered stent, it became embolised into the guiding catheter as we tried to forcefully push the stent, but could not do so as the bed was not fully prepared. It was successfully retrieved with a semicompliant monorail balloon, and deployed to seal the perforation. The LAD was finally stented with another drug-eluting stent distally overlapping with the covered stent proximally, achieving the optimal result.

Key words: coronary perforation, percutaneous coronary intervention, covered stent, stent embolisation

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Introduction

Coronary perforation is an exceedingly rare, but very serious, complication of percutaneous coronary intervention (PCI). Its incidence varies from 0.1–0.5%, with mortality reaching up to 19% depending on the complexity of the procedure and the severity of the perforation. It may be just limited to an extra luminal crater, or it can complicate into pericardial effusion with or without tamponade which may require either deployment of a covered stent, or rarely emergency surgery [1]. Advanced age, female sex, chronic total occlusion, type C lesions, tortuous vessels, high-pressure balloon dilatation, and plaque modification using rota-ablation, a cutting or a scoring balloon, are a few of the risk factors [2].

Case report

A 74 year-old diabetic and hypertensive female presented with exertional angina of Canadian Cardiovascular Society (CCS) class II of two years' duration, with recent worsening for the past six weeks, despite guideline directed medical therapy. Her blood pressure was adequately controlled by medication. Her treadmill test was strongly positive for exercise induced myocardial ischaemia. Her haemogram and routine biochemistry were normal. An electrocardiogram showed ST-T changes suggestive of left ventricular hypertrophy. Echocardiography revealed mild concentric left ventricular hypertrophy, grade-II diastolic dysfunction, and normal systolic function with an ejection fraction of 60%. Her coronary angiogram (which was performed outside our

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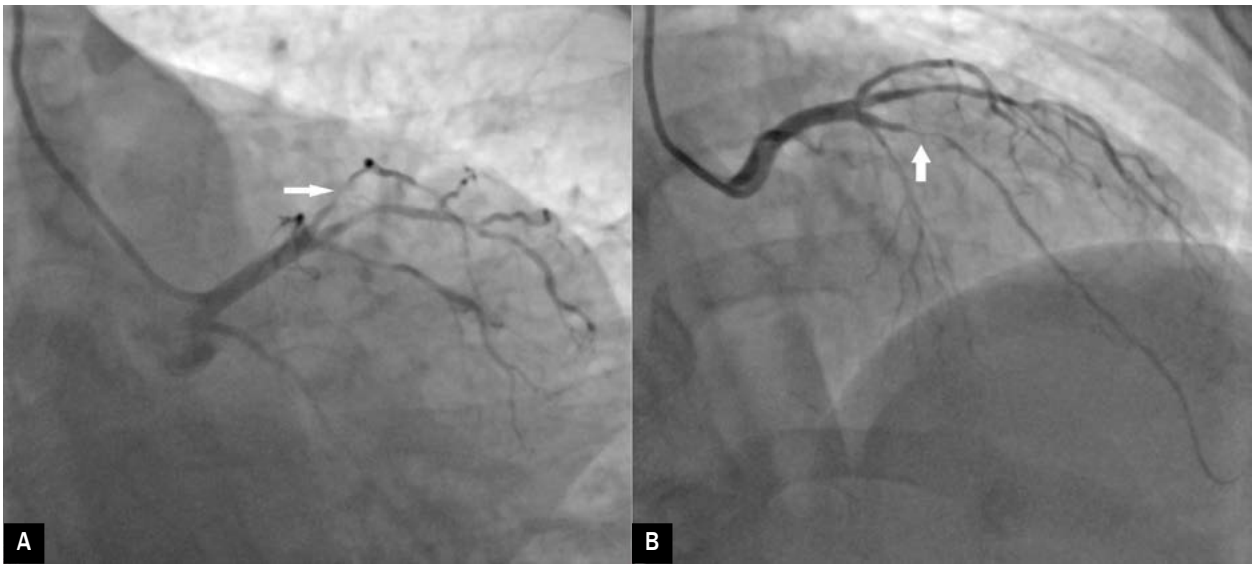

Figure 1. Coronary angiogram of left system showing diffuse disease with critical stenosis in mid left anterior descending (LAD) artery. LAD and left circumflex artery have separate ostia (**A** — antero-posterior caudal view; **B** — antero-posterior cranial view)

institute) suggested a diffuse and calcified lesion with 90% stenosis in the mid left anterior descending artery (LAD) (Figure 1). She visited our institute for PCI of the involved segment, which was planned through the transfemoral route after her consent.

After accessing the right femoral artery with a 6 F sheath and administering unfractionated heparin (100 U/kg), the left main artery was hooked with a 6 F Extra Backup guide catheter (EBU Medtronic, USA). The lesion was crossed with a 0.014" runthrough wire (Terumo, Japan) and was gradually predilated using 1.5 × 10 mm and 2 × 10 mm sapphire semicompliant balloons (Orbus Neisch, Netherlands) at 18 atm pressure as the lesion was not getting properly dilated. During dilatation by a 2.5 × 10 mm sapphire noncompliant balloon, the patient complained of severe chest pain (Figure 2A). Her blood pressure fell to 100/76 mm Hg. The balloon was withdrawn into the guide catheter and a check angiogram revealed grade III coronary perforation as contrast was streaming from the vessel (Figure 2B). Intravenous infusion of normal saline was started. The same 2.5 × 10 mm balloon was parked proximal to the site of the perforation and inflated for five minutes at 4 atm pressures with a constant watch over her haemodynamics as well as electrocardiography (ECG). This was repeated four times, but the leak was persistent (Figure 3A). A 2.75 × 18 mm Graftmaster (Jostent) coronary stent graft (Abbott, USA) was attempted to be deployed across the lesion, but as the bed was not fully dilated it could not be delivered despite a forceful push. The Graftmaster was withdrawn, but only a balloon came out of the haemostatic valve, suggesting stent dislodgement. On careful fluoroscopic review, the Graftmaster seemed to be visible at the tip of the guiding catheter (Figure 4A). As the situation was precarious, it was decided to recapture the embolised stent instead of pulling the entire system (*i.e.* stent, guide catheter and wire). Therefore, another 2 × 10 mm sapphire balloon was carefully pushed inside the dislodged covered stent, and then the stent-balloon assembly was gradually pushed across the perforated segment (Figure 4B), deployed at 18 atm pressure (Figure 5A, B), and post dilated using 2.5 × 10 and 2.75 × 18 mm sapphire noncompliant balloons at 16 atm pressure. Once the perforation had been sealed and the covered stent appeared adequately dilated, another 2.5 × 18 mm Endeavour Resolute zotarolimus-eluting stent (Medtronic, USA) was deployed distally overlapping with the Graftmaster proximally at 12 atm pressure achieving TIMI (Thrombolysis in Myocardial Infarction) III flow (Figure 6A, B). After sealing with the covered stent, blood pressure shot up to 118/86 mg, pain subsided, and ECG was normalised. Echocardiography was repeated over the next 72 hours so as to rule out late tamponade. She was discharged in a stable condition with ticagrelor — 180 mg, acetylsalicylic acid —75 mg, rosuvastatin — 40 mg, metoprolol — 100 mg, ramipril — 10 mg, hydrochlorthiazide — 12.5 mg, and gilbenclaimide — 2 mg once daily. She has been regularly followed up over the last 18 months, and is asymptomatic with the same drug regime.

Discussion

Coronary artery perforation may result in anything from minimal contrast staining to a complete rupture causing cardiac tamponade which can be lethal [3]. It is the outcome of dissection or intimal flap which may completely penetrate

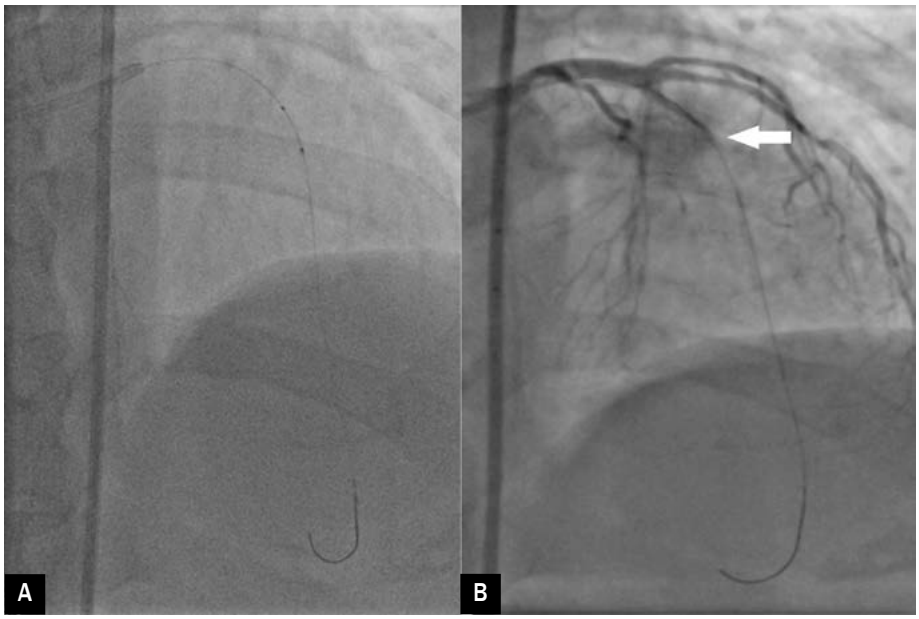

Figure 2. Predilatation being performed with semicompliant balloon (**A**); contrast streaming from mid left anterior descending (LAD) indicating perforation (white arrow showing spilling of contrast; **B**)

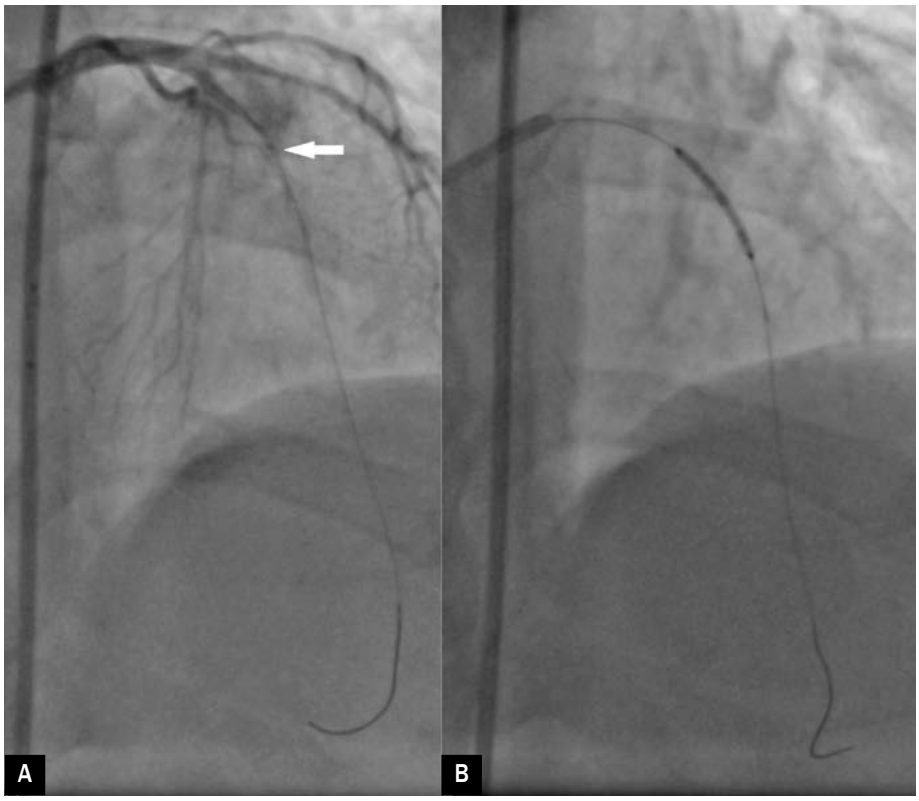

Figure 3. Contrast still streaming from site of perforation after balloon tamponade (white arrow showing spilling of contrast; **A**); covered stent being attempted to be positioned across the site of perforation (**B**)

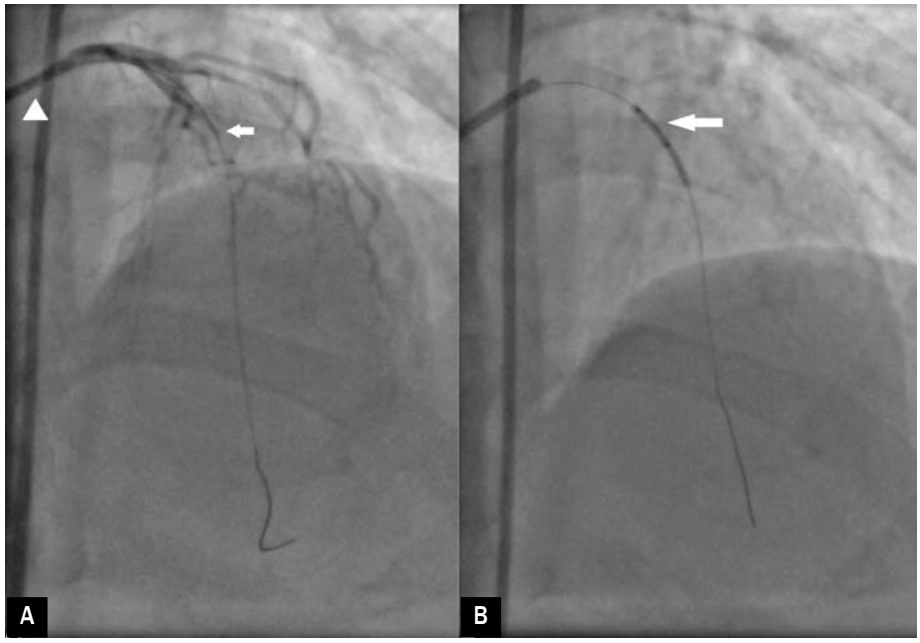

Figure 4. Embolised stent (white arrowhead) seen at the tip of the guiding catheter (**A**); embolised stent positioned across the site of perforation with the help of small semicompliant balloon (**B**)

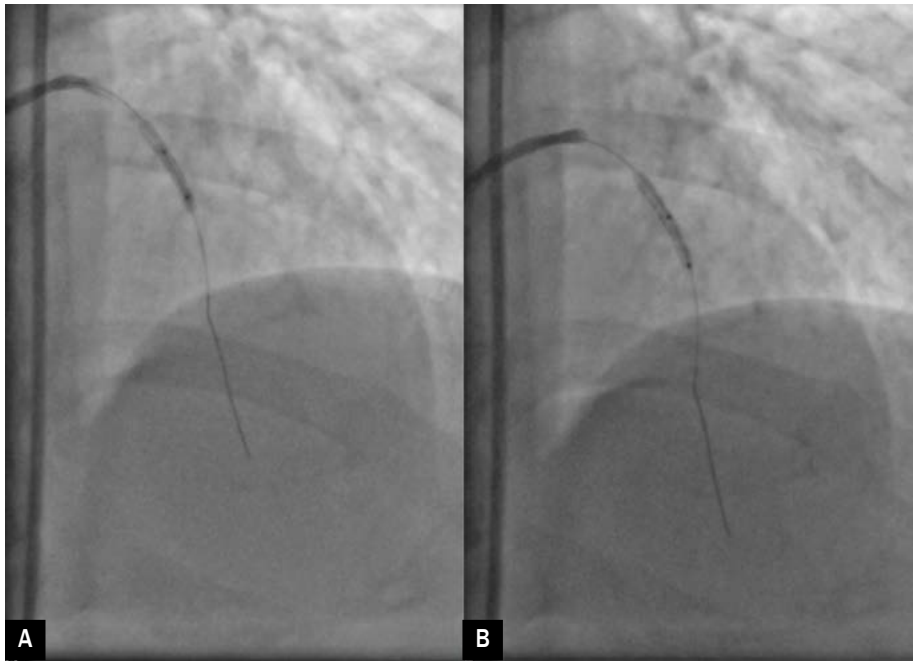

Figure 5A, B. Covered stent was inflated with 2 × 10 semicompliant balloon all across its length

the arterial wall. During PCI, guide wire manipulation from sub-intimal passage to false lumen, predilatation with oversized balloon, advancement and inflation of balloon or stent, calcified and tortuous vessel are a few of the causes. In a study by Shimony et al. of 57 perforations out of 9,568 interventions, wires, balloons, and stents were responsible for 52%, 26%, and 21% of the cases respectively [4]. Perforations vary from type I — extra luminal crater without extravasations, to type II — pericardial or myocardial blushing, and type III — perforation ≥ 1-mm diameter with contrast streaming and cavity spilling as defined by Ellis et al. [5]. Only close monitoring is required for type I and II perforations, which are predominately guidewire-induced and tend to seal spontaneously [1]. Sometimes, prolonged

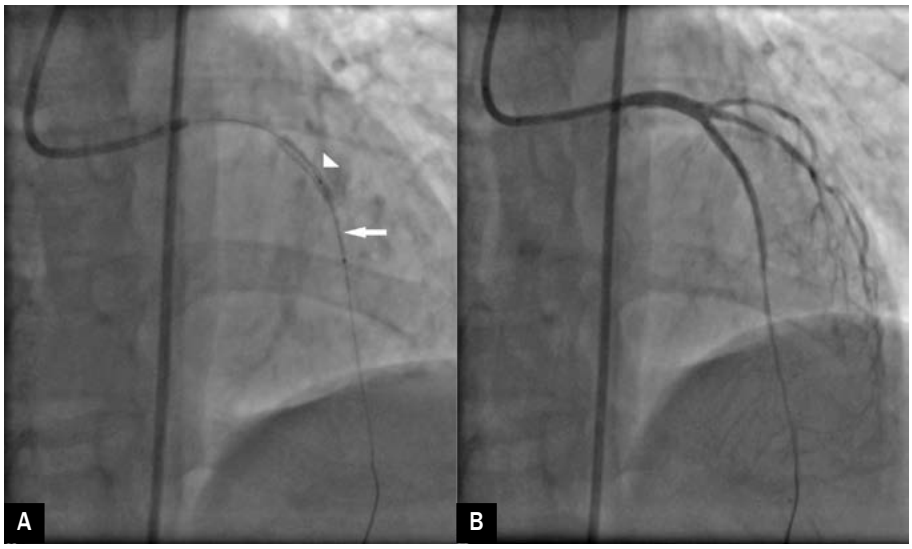

Figure 6. 2.5 × 18 mm Endeavour Resolute being deployed distally overlapping with the Graftmaster proximally (**A**); final angiogram revealed well opposed stents with TIMI (Thrombolysis in Myocardial Infarction) III flow in left anterior descending (LAD) and complete sealing of perforation (**B**)

and repeated balloon inflation proximal to the site of the perforation, and reversal of anticoagulation with protamine to keep an activated clotting time (ACT) < 150 seconds may be required. In cases of distal perforations, micro coils, gel foam, thrombin, fibrin-glue, collagen, autologous subcutaneous fat, and polyvinyl alcohol (PVA) particles are the options. Proximal perforations causing haemopericardium or haemodynamic instability require either the implantation of a covered stent, bare metal stents with narrow struts, or immediate surgical exploration [6].

Covered stents are bulkier, less flexible, have higher profiles, and are less easily deliverable as their 'trackability' across the tortuous and calcified vessels is difficult. The target vessel must be of an appropriate size as the current generation of covered stents are available in only limited sizes and diameters. If covered stents fail, emergency surgery is the only option in a precarious situation, which itself is associated with significant morbidity and mortality [1]. However, only 3–5% of cases require surgery because the percutaneous approach is successful in the majority of cases [3, 7]. A Graftmaster Jostent (covered stent; Abbott Vascular, USA) consists of an ultrathin, biocompatible, and expandable polytetrafluoroethylene (PTFE) layer sandwiched between two coaxially aligned stainless steel stents. The PTFE layer acts as a mechanical barrier which seals the perforation. Autologous veins or an equine pericardium are being utilised in the newer generation of covered stents to improve flexibility and also decrease thrombogenicity [8]. Lansky et al. have described the deployment of 52 Graftmasters to seal 41 perforations, with an overall procedure success rate of 96% with no in-hospital myocardial infarction, death or the need for emergency surgery, thereby making its use reliable and highly effective [9]. When a major side branch is likely to be occluded, cardiac surgery may be exercised as an alternative treatment option, as all covered stents carry the inherent risk of side branch occlusion. These stents are associated with an increased incidence of sub-acute stent thrombosis, restenosis, and target lesion revascularisation because of increased thrombogenicity and delayed endothelialisation. Therefore, dual-antiplatelet therapy must be maintained for a minimum of 12 months [10].

As the current generation of stents come with premounted systems, so the risk of stent embolisation has drastically reduced [11]. Extreme angulation, unfavourable anatomy, coronary calcification, underestimation of stent size, inadequate predilatation, and direct stenting are some of the risk factors of stent embolisation. Stent dislodgement from the delivery system most often occurs when the stent balloon assembly is pulled back into the guiding catheter [12]. In our case, underlying calcium was the hurdle which led to the bed being inadequately prepared, despite graduated predilatation with multiple balloons. Secondly, the stent was forcefully pushed across an angulated branch which didn't allow it. Therefore, plaque modification should be done with rota ablation, a scoring balloon, a cutting balloon, or a high-pressure balloon before attempting to deliver the stent in such a situation.

Low-profile angioplasty balloon catheters, gooseneck snares, myocardial biopsy forceps, and multipurpose baskets are just a few of the percutaneous techniques that can be deployed to retrieve embolised stents from coronary and peripheral circulation. In our case, as the embolised

stent was within the guiding catheter, a wire was placed in the distal artery. The small balloon assisted not only in its retrieval, but also in its delivery across the perforated segment. In this case, it might have been more suitable and useful to pull the entire assembly and rewire the vessel, had there been no perforation. Therefore, in cases of perforation or dissection, the utmost care should be taken to keep the wire as distal as possible because it will act as a 'rail road', allowing all devices including balloon, coil, and stent to bail out.

Conflict(s) of interest

The authors declare no conflict of interest.

Streszczenie

Perforacja tętnicy wieńcowej to rzadkie, lecz bardzo poważne powikłanie przezskórnej interwencji wieńcowej (PCI). Wyróżnia się trzy stopnie perforacji: typu I — krater pozanaczyniowy, typ II — zacienienie kontrastem miokardium lub nasierdzia oraz typ III — wynaczynienie kontrastu. W leczeniu perforacji typu III, które są najpoważniejsze, stosuje się odwrócenie antykoagulacji i długotrwałą tamponadę balonową, stenty powlekane i, rzadko, naprawczy zabieg chirurgiczny w trybie nagłym.

W niniejszej pracy przedstawiono przypadek 74-letniej kobiety z cukrzycą i nadciśnieniem tętniczym, u której w trakcie PCI doszło do perforacji III stopnia. Miało to miejsce w momencie wstępnego rozszerzania zwapniałej zmiany zlokalizowanej w środkowej części gałęzi przedniej zstępującej lewej tętnicy wieńcowej (LAD). Podczas umieszczania w naczyniu powlekanego stentu nastąpiło jego przemieszczenie, kiedy na siłę próbowano go przepchnąć przez zmianę, co było niemożliwe ze względu na to, że nie przygotowano odpowiednio miejsca implantacji. Stent udało się przechwycić półpodatnym balonem typu *monorail*, a następnie zaimplantować w zmianie w celu uszczelnienia miejsca perforacji. Stentowanie LAD przeprowadzono ostatecznie przy użyciu innego stentu uwalniającego lek, umieszczonego proksymalnie na zakładkę ze stentem powlekanym, co pozwoliło uzyskać optymalny wynik zabiegu.

Słowa kluczowe: perforacja tętnicy wieńcowej, przezskórna interwencja wieńcowa, stent powlekany, migracja stentu

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