

Percutaneous removal of endocardial implantable cardioverter-defibrillator lead displaced to the right pulmonary artery

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Abstract

We describe a case of percutaneous removal of endocardial implantable cardioverter-defibrillator lead displaced to the right pulmonary artery. The procedure was performed from two accesses; from the lower one (femoral) and then, due to technical problems, from the upper one (subclavian). In the last stage the flattened Dotter's basket was introduced to the heart inside the Byrd dilator and then fastened to the described lead as the external 'splint'. This solution is an alternative to the recommended use of the internal metal leader with anchoring function in case of significant malformation of the internal lumen of the lead. The procedure we describe is an example of the sort of individual, original solution indispensable for the efficient and safe removal of untypically displaced leads. (Cardiol J 2010; 17, 3: 293–298)

Key words: permanent stimulation, lead displacement, lead removal

Introduction

Percutaneous endocardial lead removal is becoming common among patients with pacemakers (PPM) or defibrillators (ICD). General indications for lead removal were included in HRS 2009 (Heart Rhythm Society) recommendations [1]. The technique of percutaneous lead removal uses two ways of access to the heart, upper and lower. Upper access through the subclavian veins is reserved for the leads with proximal ends accessible from the PPM/ICD pocket, while lower access through the femoral veins is preferable for the migrating or strongly ingrown leads in to the cardiovascular walls. Assessment of the particular anatomy and mutual lead position determines which access is

chosen. Sometimes a sudden change of access route is necessitated by procedural technical difficulties. The presented case of a 27 year-old woman is an example of the need to create ad hoc solutions involving a change of access route.

Case description

A 27 year-old woman, treated with permanent defibrillation for ten years, was qualified for the procedure after being saved from a ventricular fibrillation episode. In this case, the indication for the implantation was the prophylaxis of secondary sudden cardiac death in a patient with hypertrophic cardiomyopathy. A single-lead system, implanted through the subclavian vein, consisting of a one-coil,

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Received: 9.03.2009

Accepted: 8.05.2009

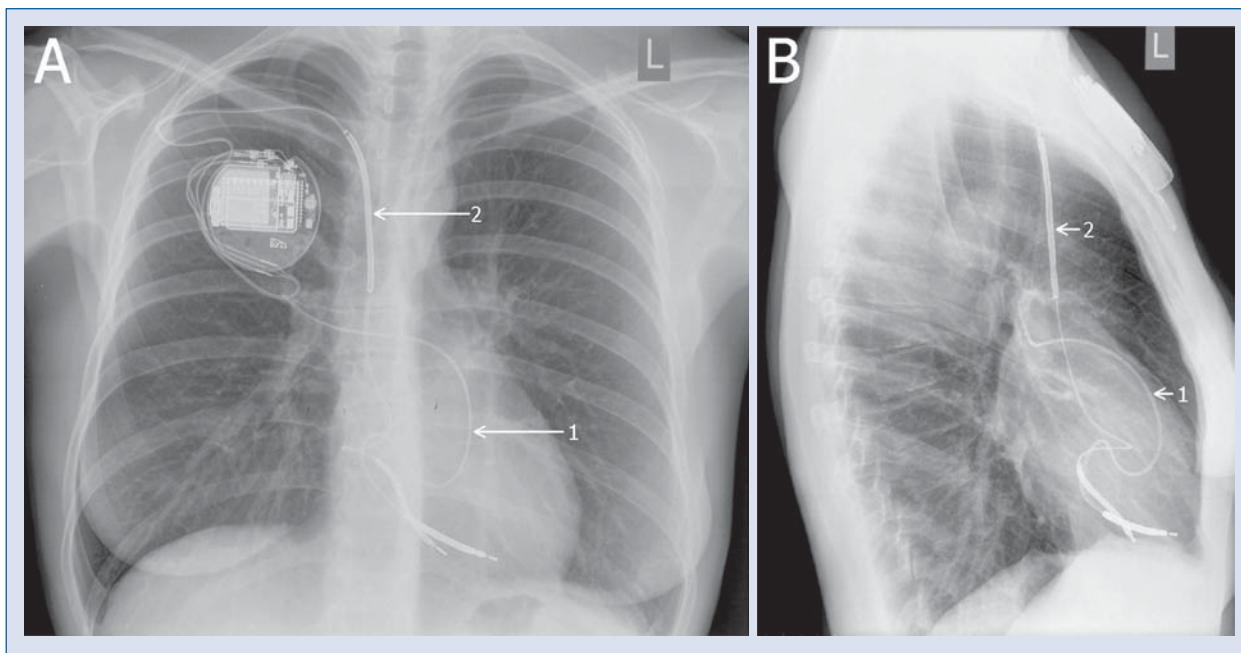


Figure 1. Chest X-ray before the leads' removal: **A.** Posterior-anterior projection; **B.** Lateral projection; arrow 1 — displaced lead; arrow 2 — right-side lead.

silicone-insulated, passive fixation lead, was connected to the cardioverter in the subcutaneous pocket of the left subclavian region.

Five years after system implantation, including 16 months after planned cardioverter-defibrillator exchange, the purulence of the pocket occurred. That was the reason for what was then, and unfortunately is often still today, seen as the optimal solution. The attempt at direct traction proved unsuccessful. Therefore, the lead was shortened by cutting it off the cardioverter and 'secured in the tissues' of the subclavian region. This was believed to become a satisfactory separation of the shortened lead from the pocket infection.

We assume such management to be faulty because the range of infection on the lead is difficult or even impossible to assess. Moreover, the unsuccessful attempt at a direct traction was the reason for the deformation of the internal lead lumen as well as faulty tension in it, which most probably triggered the subsequent dislocation to the large blood vessels and the heart. The cardioverter was removed from the pocket with simultaneous implantation, via the right subclavian vein, of a single-lead, double-coil system of passive fixation together with the cardioverter installation into the subcutaneous pocket under the right clavicle.

Over the following years, the patient gave birth to two children, both by Caesarean section. She

underwent periodic, adequate anti-arrhythmic interventions.

A few weeks before admission to the clinic, irregular electric discharges and noises received by the lead indicated the impairment of the functioning lead. Diagnostics revealed the displacement of the left lead end to the right pulmonary artery (Fig. 1A, B). Retrospective analysis indicated a dislocation of no clinical significance having occurred a few years before. Such a diagnosis was based on doctor's investigations, chest X-ray, echocardiography and lab tests, none of which revealed chronic pulmonary embolism.

It was decided to remove the old implanted right lead. The removal of the inactive lead dislocated to the pulmonary bed was also believed necessary, despite its current clinical insignificance.

Lead removal procedure

The procedure was initiated by removal of the displaced lead.

Step 1

We decided to use the Scout Pro 7 F (Biotronik) set (Fig. 2) instead of Byrd Workstation [2] to be installed to the left femoral vein for that purpose. Via the set, the pigtail 6 F (Cordis) with the lead

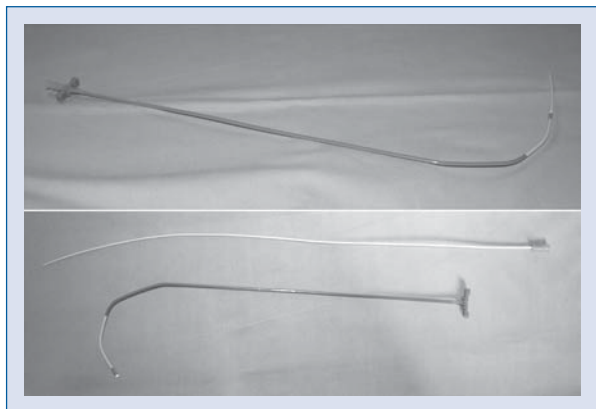


Figure 2. Operative field picture: the Scout Pro 7 F Biotronik set.

winded onto it was retracted to the vena cava inferior (Fig. 3A, B). The Dotter's basket [2] was inserted from the same access and opened in the vicinity of

the freely moving proximal end of the lead (Fig. 3C). The end was grasped and attempted to be torn off the right endocardium adhesion. However, the coil and the head were so much ingrown to the endocardium that releasing it from the lower access by the above procedure could only be done by pulling it to pieces.

Step 2

The lead was caught once again by the Dotter's basket and Scout Pro 7 F was removed. We introduced the white Byrd dilator on the Dotter's basket which was visible outside patient's body as it served the protrusion of the lead. We used one of five polypropylene Byrd dilators. White colour indicates inner sheath ID/OD 11.5/13.6 F and outer sheath ID//OD 14.1/16.3 F (Fig. 3D, E) [2]. The 41/46 cm long dilator used in the procedure proved to be too short by 5 cm, however (Fig. 3F). A change of access from lower to upper, by the subclavian vein, was instantly decided upon.

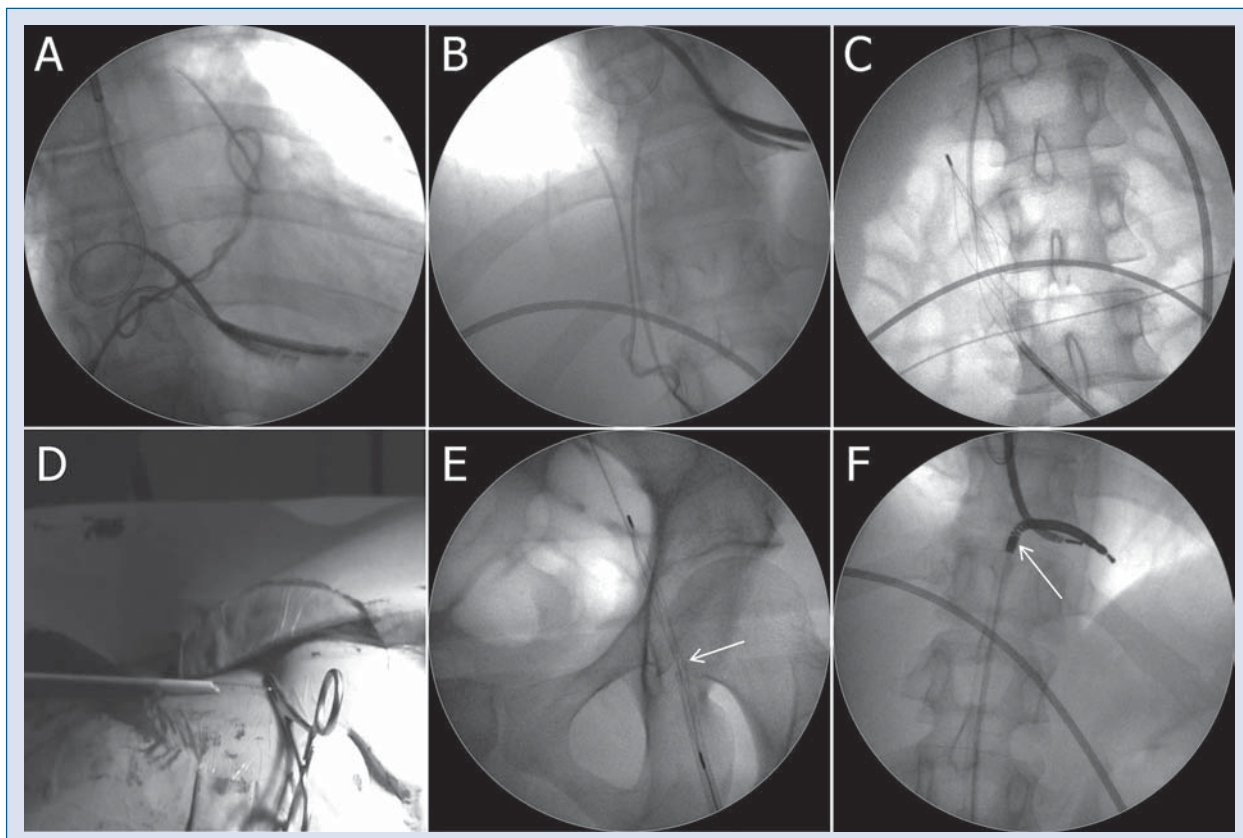


Figure 3. Intrasurgical figures. **A.** Fluoroscopy: winding of the lead on the pigtail in the lumen of the right ventricle; **B.** Fluoroscopy: the pigtail pulls the lead to the vena cava inferior; **C.** The free end of the lead in the vena cava inferior is caught by Dotter's basket; **D.** Operative field picture: a white Byrd dilator being introduced along the Dotter's basket's rod from the left femoral vein access; **E.** Fluoroscopy: a white Byrd dilator on the lead caught by the Dotter's basket; arrow: end of the dilator's sheath; **F.** Fluoroscopy: the white Byrd dilator sheath reaching the beginning of the coil of the lead only, a few centimeters from the distal lead's end; arrow: end of the dilator sheath.

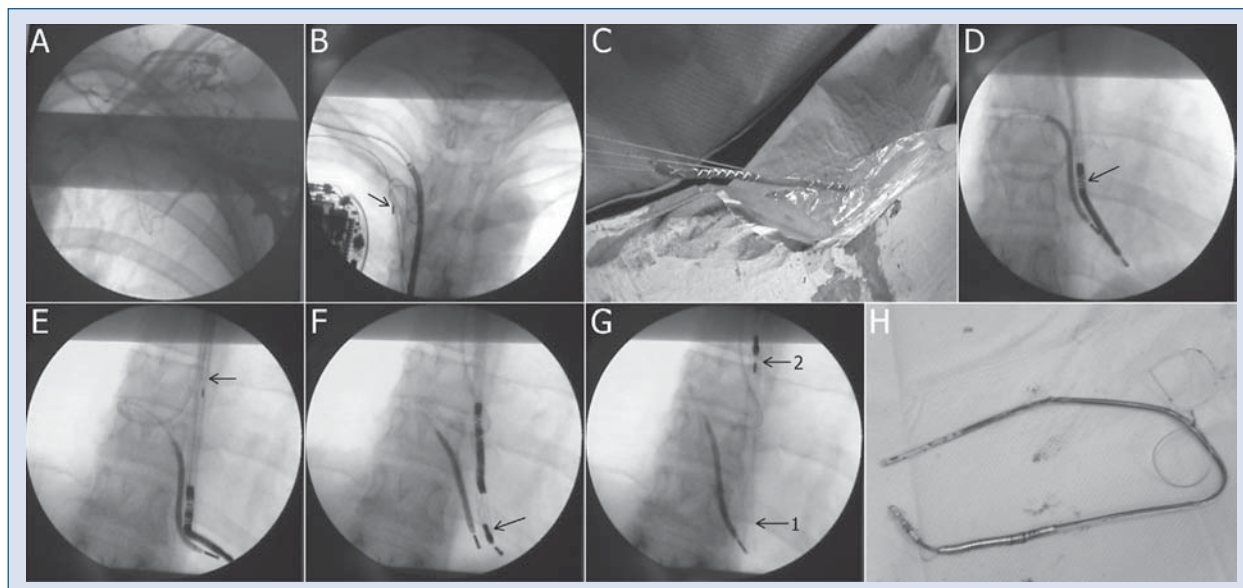


Figure 4. Intrasurgical figures. **A.** Fluoroscopy: left-side venography presenting no lumen in the left subclavian vein and well-developed collateral circulation; **B.** Fluoroscopy: Dotter's basket introduced by the right subclavian vein catches the lead (arrow); **C.** Operative field picture: a removed proximal lead's end with double ligatures tied to it removed outside the vein outlet; **D.** Fluoroscopy: Byrd dilator sheath on the lead; arrow: end of the dilator sheath; **E.** Fluoroscopy: Byrd dilator on the lead with the visible closed Dotter's basket inside the Byrd dilator sheath; arrow: a closed Dotter's basket; **F.** A final stage of cutting the lead from the adhesions; arrow: end of the dilator sheath; **G.** Fluoroscopy: the torn off lead in one piece visible inside the Byrd dilator sheath; arrow 1 — Byrd dilator's sheath leaning against the endocardium; arrow 2 — lead's distal end inside the sheath; **H.** The removed lead after the procedure.

Step 3

At first, access from the left subclavian vein was suggested in order to avoid traumatizing the right region. However, the intrasurgical venography revealed the obliteration of the vein (Fig. 4A). Therefore the access was changed for the right subclavian vein with the use of Seldinger's technique. Through the lumen of the inserted sheath via Seldinger's technique, the Dotter's basket was introduced and used to grasp the lead's end (Fig. 4B). The sheath which disturbed the lead-basket complex removal from the subclavian vein was taken off. Immediately the Dotter's basket allowed to expose the lead to be seen outside the body (Fig. 4C).

Step 4

With the lead outside the subclavian vein, the ligatures were tied to it in order to remove the whole lead (Fig. 4C). The recommended specialist anchoring leader (e.g. Liberator Cook) was not passed into the vein lumen due to significant lengthening of the lead itself which narrowed its lumen. The deformation of the lead was the result of the

direct traction procedure performed 5 years previously, as well as our present actions.

Step 5

At the later stage of the procedure the newly created construction, i.e. the lead with the ligatures, was inserted into the white Byrd dilator (Fig. 4D). Unfortunately the whole 'device' proved to be not strong enough and did not create an adequate countertraction for excision of the lead from the adhesions in the heart. To help the situation, the construction was strengthened by inserting the flattened Dotter's basket into the Byrd dilator. Simultaneously passing the lead through the meshes of the Dotter's basket while inserting it to the dilator's sheath, the basket was finally fully fastened on the lead, a few cm from the ventricular lead coil (Fig. 4E). In this way, external lead strengthening, a sort of 'splint', was achieved, which enabled a successful excision and removal of the whole lead from the heart (Fig. 4E-H).

A week later, removal of the right lead, which proved to be technically easier and more straightforward, was undertaken (Fig. 5A). The lead had its

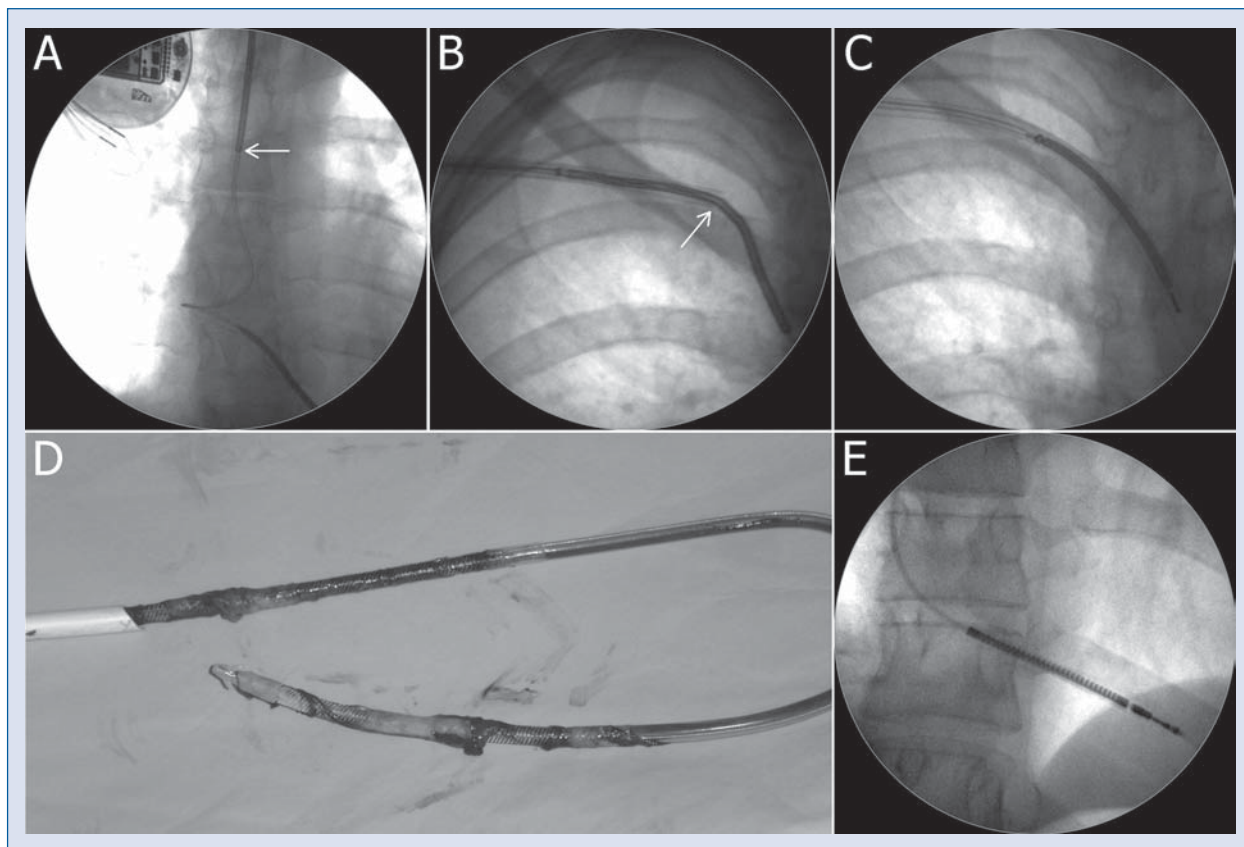


Figure 5. Intrasurgical figures. **A.** Fluoroscopic picture of the heart before the second lead removal; arrow: right-side lead; **B.** Fluoroscopy: the Byrd dilator introduced along the lead from the right cardioverter pocket access; arrow: end of the dilator sheath; **C.** Fluoroscopy: a torn off lead visible inside the white Byrd dilator sheath; **D.** The removed lead protruding from the white Byrd dilator sheath; **E.** A fluoroscopic picture of the heart after a new lead implantation.

proximal end accessible from the cardioverter pocket which enabled its removal with the use of the internal leader and white Byrd dilator (Fig. 5B–D). At that point, the Seldinger system was installed for implantation of the new ICD lead (Fig. 5E). The patient left hospital with a new ICD system installed and has been under the care of her home cardiology center. She has been in good general condition so far.

Discussion

There may be several reasons why adhesion to the pulmonary artery after years of leads presence there was not so strong. It has often been noted that extremely strong adhesions were created at the contact place of proximal displaced leads ends and great vein vessels [3, 4]. Weak adhesions could be because of:

- a different structure of the artery wall as opposed to the vein wall;
- different dynamics of blood current;

- a ‘safe’ proximal lead’s end’s existence when the torn off, metal wire was deep inside the silicone insulation.

Regarding this third reason, long ago we observed a case of displacement of the lead through the heart chambers culminating in the death of the patient [5]. The lead destroyed between the clavicle at the first rib i.e. in crush syndrome was torn off and pushed to the pulmonary artery by the blood current. The torn off end with the unwound metal wire could be compared to a bottle brush in the cardiovascular system tearing off the endothelium of the atrium. As a result, there was a partial obliteration of the atrium and creation of a cluster of granulation in a pulmonary artery. The granulation resulted in pulmonary embolism. Bearing the currently described case in mind, we believe that the fact that the metal wire end was hidden deep in the insulation saved the endothelium. We also suppose that the displacement of the infected proximal end resulted in the lead dependent vasculitis and obli-

teration of the left subclavian vein. It could be the reaction of the organism to separate the pocket purulence from the endocardium. In the described case, several original modifications of the removal procedure were used. Literature has not thus far presented any use of Byrd dilator from the lower access with the construction consisting of the Dotter's basket and the lead grasped by it. We think it is possible to remove the lead from such access using the above modification but with a longer dilator. We disagree with opinions of the lead removal constructors that the use of counter traction by the Byrd workstation from the lower access only is sufficient to remove the lead from the adhesions to the heart and blood vessels with no need to use rotation-cutting forces of Byrd dilators. The purely theoretical opinion leads to the production of Byrd dilators only in two lengths sufficient for upper access but not always for the lower access.

Despite this, we have in the past successfully performed lead removals using a Byrd dilator from the lower access [6]. During the presented procedure there was also a need for the use of dilator from the lower access. This could not however be achieved, due to its insufficient length. It was also proved that an alternative technique to an internal anchoring leader is possible. In case of significant malformation of the lead, a well proven technique of ours is an external strengthening of the lead creating a kind of 'splint' which enables its grasping in case of displacement. In the presented case, the Dotter's basket constituted the 'splint' as it was a metal rod with an additional strong external movable grasping point on the electrode.

Conclusions

1. The lead displaced to the pulmonary artery can be removed percutaneously.

2. The removal of so-called 'difficult leads' requires the use of individual, original technical solutions.
3. Accessible instruments do not satisfy all the possible needs resulting from technical and anatomical conditions.
4. In particular, there is a shortage of longer Byrd dilators as well as external anchoring leaders for cases when malformed lead lumen blocks the internal anchoring leaders such as 'Locking Stylet' or 'Liberator' from entering the lead.

Acknowledgements

The authors do not report any conflict of interest regarding this work.

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