Colour Doppler sonographic diagnosis of upper limb venous thromboses

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INTRODUCTION

Thromboses of the upper limb are rare in comparison to those of the lower-extremity veins. In older studies upper limb venous thromboses have a 1–2% share of all the thromboses [1,2]. Common causes of these thromboses are compression syndromes of the upper thoracic outlet, traumas, tumours or intravenous catheters [3–7]. In particular, the extensive use of intravenous catheters has increased the frequency of upper limb thromboses in hospital.

Plethysmographic and Doppler ultrasonographic examinations can give additional information about malfunctioning venous flow in cases of clinical suspicion of an upper limb venous thrombosis. Several years ago this diagnosis could only be confirmed by using phlebography. This has changed since colour Doppler sonography has been introduced [5,7,8–10]. Colour Doppler sonography gives not only additional information about the surrounding tissue, but also about proximal or distal blood-flow disturbances. In a prospective study colour Doppler sonography has been shown to have a sensitivity of 94% and a specificity of 96% for subclavian-vein thrombosis [9,11]. The thromboses were diagnosed by visualization of the thrombus, absence of spontaneous flow and absence of phasicity of flow with respiration. Prospective studies which compare venous compression in grey scale ultrasound as the only test for upper limb venous thromboses to phlebography are not available.

Colour Doppler sonography is the first choice to diagnose thromboses in clinically symptomatic patients. There might be false negatives in small proximal subclavian vein thromboses [9,12].

Here we present an overview of relevance of the thromboses of the upper limb at the Essen University Hospital and the advantages of colour Doppler diagnosis.

MATERIAL AND METHODS

From 1992 to 1996, 827 consecutive patients staying at the hospital were referred to our Angiological Department with clinical symptoms of a thrombosis. The most common reasons for the patient's referral to our department were tumescence of the upper extremity and/or pain and/or a visible collateral circulation.

In all patients a colour Doppler sonography was carried out. This was always performed on recumbent patients using a 5.4 MHz convex transducer, starting in the middle of the clavicule in the lateral axis of the vessel. After adjusting the quality of the B-mode and colour-mode the clavicular artery and vein were looked at longitudinally. The vein was pictured as far distal and proximal as possible. The thromboses were diagnosed by visualization of the thrombus in incomplete compressible veins. An absence of spontaneous blood flow, absence of phasicity of blood flow with respiration and a lack of blood flow augmentation during manual compression of the arm muscles were additional criteria. The blood flow criteria and compression tests were always used together. Blood flow criteria were necessary to obtain information on proximal parts of the dorsal veins which could not be compressed. A thrombosis was excluded if the vein was completely compressible in B-mode using the transducer for compression and showed normal blood flow. We extended the investigation to the axillary and...
brachial veins. Finally the jugular vein was investigated and tested for respiratory-flow modulation and for possible compression with the transducer. A thrombosis was assumed if thrombotic material in the vein was seen, the vein was not completely compressible and showed only a partial blood flow which could not be modulated by respiration.

This examination was always performed on both sides of the body. To ensure the validity of ruling out deep vein thrombosis a second investigation was performed 3 to 4 days later. A longer follow-up was not necessary for the further treatment of the patients during their stay in hospital.

RESULTS

Eight-hundred and twenty-seven patients were examined using colour Doppler sonography suspecting a thrombosis of the upper extremity. The patients were referred to our Angiological Department showing clinical symptoms of a thrombosis for no longer than 3 days. The thrombosis was ruled out in 493 cases. These patients showed superficial phlebitis, lymphoedema, inflammatory periphlebitis after infusions or completely normal findings.

The other 334 patients (218 male, 116 female) had thromboses in one or more veins of the upper limb. The age ranges of the patients were as follows: 0–20 years, 3%; 20–40 years, 28%; 40–60 years, 35%; 60–80 years, 28%. Two-percent were older than 80 years and there was no age documented in 4% of the cases. As Table 1 shows the most frequent thrombosis found was subclavian-vein thrombosis. Circumscript isolated thrombosis of the subclavian vein was found in 28% of all patients suffering from a thrombosis but the subclavian vein was involved in 69% of all thromboses of the upper extremity. The axillary vein was affected either in combination with the subclavian vein or the brachial veins. Isolated thrombosis of the jugular vein was diagnosed almost as often as a combined thrombosis of the internal jugular and the subclavian vein. With around 9% of all thromboses, an isolated brachial vein thrombosis was not a rare finding. Two-hundred and one thromboses occurred on the right side and only 116 on the left side.

All of our patients were originally hospitalized in other departments of our clinic. The primary disease was a malignant tumour in 182 cases (Figure 1). From the solid tumours 23 were a carcinoma of the breast (Table 2). Eight patients had an active HIV infection.
and only eight thromboses were due to a trauma. In patients without a malignant tumour isolated subclavian vein thromboses were most frequent (Figure 2).

In our files a direct association of the thrombosis with a central venous catheter or intravenous port-system could be shown in 96 cases. However, almost all patients had peripheral or central venous catheters during their hospital treatment, days or weeks before the thrombosis became clinically symptomatic. This number could not be calculated exactly because of insufficient documentation. From the 96 central venous catheter or venous port-systems which were associated with a thrombosis, 61 were on the right side, 26 on the left side and 9 were bilateral. However, within the group of patients without a central venous device thromboses of the right side were also predominant. The proportion of isolated jugular vein thromboses and combined jugular and subclavian vein thromboses was higher in the group of patients with central venous devices (Figure 3).

In the group of patients in which thrombosis was ruled out 72 had a central venous catheter or intravenous port-system.

**DISCUSSION**

In the years from 1992 to 1996 the university hospital of Essen treated about 42,4500 inpatients a year. A high proportion of these patients suffered from...
cancer or serious trauma, or received intensive care unit treatment.

The Angiological Department was consulted by all other departments of the clinic. Considering the total number of inpatients and the seriousness of the affected patients' primary diseases, thrombosis of the upper limb is still a rare event. However, it has not been determined whether all the thromboses of the upper limb were actually diagnosed, since factors like the experience of the physician in charge or the patient's subjective condition played a role. On the other hand, a lot of patients with mild clinical symptoms were investigated and a number of small thromboses of the brachial veins were found. This indicates that the intention to look for thrombosis of the upper extremity was high.

The frequency of upper limb thromboses stated by other authors is not really comparable to our data. We found no study which tried to give information about the number and distribution of thromboses of the upper extremity or the relevance of these thromboses in hospital. One study reported about 227 cases of thrombosis between 1972 and 1993 [13], another about 39 thromboses in 91 patients investigated from 1988 to 1989 [14]. A study from a hospital in Basel, Switzerland, presented 96 thromboses diagnosed between 1976 and 1983 [1]. All thromboses in these studies were predominantly diagnosed using phlebography and not only found in patients who received hospital treatment. These three studies taken together describe a much lower frequency of thromboses of the upper extremity than we do, but do not represent the problem of thromboses during hospital treatment. The fact that the Department of Angiology is well integrated in the University Hospital of Essen ensures the awareness of all colleagues for such thromboses. Although the number of the described thromboses in our study seems to be very high, other studies in the literature gave no evidence that there might be a high number of false-positive cases. There are more likely to be false-negative findings in the case of isolated small proximal subclavian vein thrombosis [6,11,12] or in lower limb thrombosis [15]. Furthermore, because of the possibility of false-negative cases and the lack of a long-term follow-up, the number of thromboses is likely to be underestimated. However, studies on the accuracy of colour Doppler sonography in peripheral venous thrombosis of the lower limb may not be comparable to colour Doppler investigation of the upper limb due to anatomical differences.

No information is present about the association of subclavian and internal jugular vein thromboses because phlebography of the upper extremity did not show the internal jugular vein exactly. Our data show that 41% of all patients who had a subclavian vein thrombosis had an additional thrombosis of the internal jugular vein.

In the literature the most common causes of thrombosis of the upper limb were compression syndromes as the thoracic-outlet syndrome (17-40%), intravenous catheters, pacemaker probes or malignant tumours. The large number of patients with a primary malignant disease is also confirmed by our data. We did not consider upper-limb compression syndromes as possible causes of the thromboses since all of our patients were already hospitalized for other reasons. They did not suffer from thrombotic events after physical work of the shoulder-arm muscles. None of our patients suffered from paraesthesia or other symptoms of nerve irritations which could be caused by a thoracic-outlet syndrome. However, some of the patients with thrombosis may have clinical asymptomatic thoracic-outlet syndromes.

Venous port-systems have been introduced in addition to the standard central-venous catheters. A venous port-system as a permanently implanted system can lead to upper-extremity thromboses, although it is not known whether the risk of a thrombosis with these permanently implanted systems is higher than the risk caused by central venous catheters [16].

The reasons for the clinical symptoms developed by patients who had no thrombosis of the upper limb were numerous. Retrospectively it is not possible to identify differences in quality and quantity of clinical symptoms among patients with or without a thrombosis. To rule out misdiagnosed thromboses or silent progresses we routinely performed follow-up examinations.

CONCLUSION

Considering the number of patients treated, thrombosis of the upper limb at a large university hospital is still rare. Due to the huge number of patients with malignant tumours the frequency of the upper-limb thrombosis in our hospital is relatively high compared with others. The use of colour Doppler sonography allows an early and safe diagnosis of the thrombosis without straining the patient and its extensive use increases the number of diagnosed thromboses. The involvement of the internal jugular vein can be judged. Today a primary performance of phlebography to rule out an upper-limb thrombosis is usually not necessary.

REFERENCES

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