

Evidence Table

Reference	Evidence level	Methods, key findings, outcomes or recommendations
<p>Applegate, R., Sacrinty, M., Kutcher, M., Kahl, F., Gandhi, S., Santos, R., & Little, W. (2008). Trends in vascular complications after diagnostic cardiac catheterization and percutaneous coronary intervention via the femoral artery, 1998 to 2007. <i>JACC. Cardiovascular Interventions</i>, 1(3), 317-326.</p>	<p>IV</p>	<p>The study evaluated the complications associated with diagnostic cardiac catheterisation and interventional catheterisation. Additionally, covariate effects on the risk of vascular complications were evaluated</p> <p>FINDINGS</p> <ul style="list-style-type: none"> • The incidence of vascular complications decreased significantly for diagnostic cardiac catheters, 1.7% versus 0.2%, and interventions cardiac catheters, 3.1% versus 1.0%, from 1998 to 2007 ($p < 0.001$). • Effective haemostasis is obtained by manual compression. • Femoral artery is associated with an increased risk of retroperitoneal bleeding. • Interventional catheters have a statistical significant higher rate of complications compared to diagnostic cardiac catheters ($p < 0.05$)
<p>Chair, S., Yu, M., Choi, K., Wong, E., Sit, J., & Ip, W. (2012). Effect of early ambulation after transfemoral cardiac catheterization in Hong Kong: a single-blinded randomized controlled trial. <i>Anadolu Kardiyoloji Dergisi: AKD = The Anatolian Journal Of Cardiology</i>, 12(3), 222-230.</p>	<p>II</p>	<p>The study compared the effect of early ambulation (4 hours) and late ambulation (12 hours) on the patients' puncture site pain, vascular complications, back pain, urinary discomfort, satisfaction level and general well-being perception.</p> <p>FINDINGS</p> <ul style="list-style-type: none"> • Ambulation at 4 hours post cardiac catheter significantly reduced patients' back pain compared to ambulation at 12 hours. • Ambulation at 4 hours post cardiac catheter significantly reduced patients' urinary discomfort compared to ambulation at 12 hours. • Ambulation at 4 hours post cardiac catheter significantly increased general well-being compared to ambulation at 12 hours.

		<ul style="list-style-type: none"> Ambulation at 4 hours post cardiac catheter had no significant difference on puncture site pain or satisfaction level of patients. Ambulation at 4 hours post cardiac catheter caused no significant increase in puncture site bleeding and therefore does not increase the risk of bleeding.
<p>Wilcoxson, V. L. (2012). Early Ambulation After Diagnostic Cardiac Catheterization via Femoral Artery Access. <i>Journal For Nurse Practitioners</i>, 8(10), 810-815.</p>	<p>IV</p>	<p>The study investigated the risk of vascular complications in patients who ambulated 2-3 hours post diagnostic cardiac catheterisation compared to 6 hours. Additionally, it studied the effect of early ambulation on patient comfort and hospital costs.</p> <p>FINDINGS</p> <ul style="list-style-type: none"> Early mobilization of 2-3 hours after diagnostic cardiac catheterisation via the femoral artery does not significantly increase the risk of vascular complications. Early ambulation (2-3 hours compared to 6 hours) has beneficial results on patient comfort and satisfaction and reduces hospital costs.
<p>Yilmazer, M., Ustyol, A., Güven, B., Oner, T., Demirpençe, S., Doksöz, O., & ... Tavli, V. (2012). Complications of cardiac catheterization in pediatric patients: a single center experience. <i>The Turkish Journal Of Pediatrics</i>, 54(5), 478-485.</p>	<p>IV</p>	<p>Retrospectively analyzed 519 catheterisation procedures to analyze the prevalence of complications and the risk factors related cardiac catheterisation.</p> <p>FINDINGS</p> <ul style="list-style-type: none"> The incidence of complications from all cardiac catheters was 6.2%. The most common complications were arterial thrombosis and transient arrhythmias. The incidence of complications post interventional cardiac catheters was higher (9.7%) when compared to diagnostic cardiac catheters (5.4%). Younger age, particularly < 1 year of age, is the strongest predictor of the development of any complication (p=0.02). Among the 32 complications, arrhythmias were the

		<p>most common (41%). The two major arrhythmia complications were ventricular tachycardia and complete atrioventricular block. Other arrhythmias included persistent ST elevation, supraventricular tachycardia, sinus bradycardia, and bundle branch block.</p> <ul style="list-style-type: none"> • The risk of complications was independently increased if the patient was <1 year of age, <5 kg or had an interventional procedure. • There was no significant association between gender and complications.
<p>Altioek, M., Yurtsever, S., & Kuyurtar, F. (2007). Review of the methods to prevent femoral arteriotomy complications and contrast nephropathy in patients undergoing cardiac catheterization: cardiac catheterization and care approaches in Turkey. <i>Journal Of Cardiovascular Nursing</i>, 22(6), 452-458.</p>	<p>VI</p>	<p>A descriptive study to examine the approaches utilised by varying hospitals to prevent cardiac catheter complications.</p> <p>FINDINGS</p> <ul style="list-style-type: none"> • Majority of complications including bleeding and haematoma occurred during bed rest and within the first 2 hours post procedure. • Frequent nursing monitoring in the first hours is effective in decreasing complications. • Elevation of the bed should be at most, a 15- to 30-degrees, and patient lies flat. • Bed rest for at least 4 to 6 hours, keeping the leg at the access site still is required post procedure. • Different institutions have varying times for patient mobilisation after cardiac catheter. 24.1% mobilize patients after 4 hours, 55.2% after 6 hours, and 20.65% after 8 hours. • 75.9% of the institutions monitored the vital signs and insertion site every 15 minutes for the first hour postprocedure and then every hour. • If bleeding occurred manual pressure was used to achieve haemostasis in 100% of cases.
<p>Ellis, S., Bhatt, D., Kapadia, S., Lee, D., Yen, M., & Whitlow, P. (2006).</p>	<p>IV</p>	<p>Baseline, procedural, and outcome data was prospectively collected on all patients undergoing interventional cardiac catheters (n=28,378). One hundred percent patient follow-</p>

<p>Correlates and outcomes of retroperitoneal hemorrhage complicating percutaneous coronary intervention. Catheter Cardiovasc Interv, 67, 541–545.</p>		<p>up through hospital discharge was obtained. A case control cohort study (76 RPH and 76 non-RPH patients) was utilized to examine the care of patients with RPH and risk factors of developing RPH.</p> <p>FINDINGS</p> <ul style="list-style-type: none"> • One hundred and sixty-three patients (0.57%) developed retroperitoneal haemorrhage (RPH). • The average time of RPH diagnoses was 2.4 hours (interquartile range 1-7hours) post procedure. • Of the patients the developed RPH, 57.9% required red blood cell transfusion (median 2 units, maximum 67 units), 18.4% required platelet transfusion, 13.2% required fresh frozen plasma, and 8.1% required protamine. • Appropriate management of the femoral access site and the patient once this complication is suspected may minimize adverse outcomes. • Nurses must assess the insertion site and be knowledgeable of signs and symptoms of RPH. • Appropriate treatment of RPH includes volume and blood product support as well as correction of thrombin and platelet inhibition. • When RPH is suspected CT scanning is not always required and, in fact, delays related to CT scans can delay treatment and therefore have negative patient outcomes.
<p>Farouque, H., Tremmel, J., & Shabari et al. (2005). Risk factors for the development of retroperitoneal hematoma after percutaneous coronary intervention in the era of glycoprotein IIb/IIIa inhibitors and vascular closure devices. J Am Coll Cardiol, 45 (1), 363–368.</p>	<p>IV</p>	<p>A retrospective analysis of 26 cases of retroperitoneal haematoma (RPH) after interventional cardiac catheter to determine prevalence, clinical features, and risk factors of RPH.</p> <p>FINDINGS</p> <ul style="list-style-type: none"> • RPH occurred in 26 (0.74%) patients undergoing interventional cardiac catheter. • Signs and symptoms of RPH include abdominal pain (42%), groin pain (46%), back pain (23%), diaphoresis (58%), external groin haematoma

		<p>(31%), fluctuating BP response (42%), bradycardia (31%) and hypotension (92%).</p> <ul style="list-style-type: none"> • Blood loss anemia was a universal feature (100%) of patients with RPH, with a mean fall in haematocrit of 11.5 + - 5.1 points from baseline in RPH patients, as compared with 2.3 + - 3.3 points in control subjects (p < 0.0001). • Time to first clinical sign of RPH was 157.6 + - 162.9 minutes post procedure until occurrence of first clinical feature. • All RPH episodes were ipsilateral to the femoral artery puncture. • Asymptomatic RPH was rare, with 96% of cases having at least one symptom. • Lower abdominal tenderness ipsilateral to the puncture site was another common finding and underscores the importance of a careful physical examination of the abdomen in evaluating suspected cases of RPH. • Awareness of the determinants and clinical features of RPH may aid in prevention, early recognition, and prompt treatment. • Almost 75% of cases presented within the first 3 hours post the procedure, which highlights the need for vigilance monitoring during the first few post procedural hours.
<p>Harper, J. (2007). Post-diagnostic cardiac catheterization: development and evaluation of an evidence-based standard of care. <i>Journal For Nurses In Staff Development: JNSD: Official Journal Of The National Nursing Staff Development Organization</i>, 23(6), 271-276.</p>	<p>IV</p>	<p>Retrospectively studied the complications that occurred post-diagnostic cardiac catheters, the timing of the complications and the immediate treatment of the complications. Thereafter the study explored the implementation of a post cardiac catheter care plan.</p> <p>FINDINGS</p> <ul style="list-style-type: none"> • Forty-four percent of vascular complications occurred within 2 hours after haemostasis. • The median time of occurrence of vascular complications was 5 hours after haemostasis, with the latest

		<p>occurrence 24 hours after haemostasis.</p> <ul style="list-style-type: none"> • Patients should be monitored for vascular complications for at least 24 hour after haemostasis. • In the event of a haematoma, nurses should apply manual compression over the haematoma to prevent any further bleeding and continue to monitor the site for any reoccurrence. • For bleeding at groin site, apply pressure above insertion site with gauze to achieve haemostasis and notify physician immediately. • With pressure bleeding should stop in 5-10 minutes. • A haematoma can indicate internal bleeding into the thigh, pelvis, retroperitoneal space. Auscultate haematoma for presence of systolic bruit (indicates pseudoaneurysm). • Inspect for signs of infection at the groin site. • Neurovascular limb observations are included in the patient assessment. Notify the physician if an extremity is cold, discolored, and has a diminished or absent distal pulse. • BP, heart rate, groin site assessment and neurovascular limb assessment should be done 15 minutely x3, then 30 minutely x 3, then 4 hourly. • Patient assessment should also include assessment of ECG rhythm, assessment of pain/discomfort, assessment of intake and output. • Assessment of groin site includes assessing for bleeding, ecchymosis, haematoma, pseudoaneurysm and infection.
--	--	---

<p>Rezaei-Adaryani, M., Ahmadi, F., & Asghari-Jafarabadi, M. (2009). The effect of changing position and early ambulation after cardiac on patients' outcomes: a single-blind randomized controlled trial. <i>International Journal Of Nursing Studies</i>, 46(8), 1047- 1053.</p>	<p>II</p>	<p>The study investigated the effects of changing position while the patient is restricted to best rest post-cardiac catheter. It examined whether changing position had an effect on the level of comfort, satisfaction, fatigue and the amount of bleeding and haematoma formation.</p> <p>FINDINGS</p> <ul style="list-style-type: none"> • The patients in the experimental group (allowed to change positions from side to side while on bed rest) had significantly higher comfort and satisfaction and lower fatigue levels than the control group (strict lying on back for bed rest) after catheterisation (P < 0.01). • Changing patients' position, in accordance to the study's design, caused no significant increase in the amount of bleeding and haematoma when compared with the control group (P > 0.05). • By relieving pain, positioning improves haemodynamics after cardiac catheterisation.
<p>Pennsylvania Patient Safety Authority. (2007). Strategies to minimize vascular complications following a cardiac catheterization. <i>PA-PSRS Patient Safety Advisory</i>, 4(2), 1-6.</p>	<p>VI</p>	<p>The paper reviewed all cardiac catheter complications (n=700) reported to the Pennsylvania Patient Safety Reporting System and reviewed current literature to explore strategies to reduce vascular complications associated with cardiac catheterisation.</p> <p>FINDINGS</p> <ul style="list-style-type: none"> • 58% of cardiac catheter complications were vascular complications associated with the access site, including bleeding, haematoma formation, retroperitoneal bleed and pseudoaneurysm. The contributing factors of the 230 vascular complications reported were: medication errors, inconsistencies in patient assessments, unrecognized changes in patient condition and lack of appropriate interventions when complications occurred. • The incidence of all cardiac catheterisation complications is 1% for diagnostic and 3% for

		<p>interventional procedures. Early detection and management of vascular complications is key to minimizing complications. Signs and symptoms of haematoma formation at the groin site are swelling and pain at the site. Knowledge and assessment of these early signs and symptoms of bleeding at the access site are pivotal in minimizing vascular complications.</p> <ul style="list-style-type: none"> • Additional signs of haematoma include symptoms of blood loss and compromised vascular flow (e.g., weak or absent pedal pulses, tachycardia). If a patient is suspected of RPH nursing protocols should include obtaining a type and cross in anticipation of the need of blood products. • Assess vital signs and site every 15 minutes for 1-hour post procedure and then every hour until the patient is allowed to ambulate (3 to 6 hours). • Site assessment should include; palpation of site to assess temperature, assess used for access. • Assess for patient pain at the site. For interventional catheterisation ensure bed rest for six hours after haemostasis. Ensure head of bed is not elevated more than 30 degrees, color, and pulses in the extremity • Assess for a bruit, which indicates compromised vascular flow indicative of pseudoaneurysm.
<p>Karen, U. (2001). Therapeutic cardiac catheterization for congenital heart disease- a new era in pediatric care. <i>Journal of Pediatric Nursing</i>, 16 (5), 300-307.</p>	<p>VII</p>	<p>Report of multiple cardiac catheterisation procedures in the paediatric population. Describes the varying possible complications for the specific procedure and the implications this has on nursing practice.</p> <p>FINDINGS</p> <ul style="list-style-type: none"> • Interventional catheterisation is associated with significantly more complications compared to diagnostic catheterisation. • Complications are significantly higher in infants than older patients. • Knowledge of potential complications and vigilant

		<p>monitoring by the bedside nurse can reduce adverse consequences to the child after interventional cardiac catheterisation.</p> <ul style="list-style-type: none">• Hypotension may reflect blood loss or tamponade resulting from cardiac or great vessel perforation.• Vascular complications are the most common adverse events that follow therapeutic cardiac catheterisation.• Complications at the site of intervention include ruptures or tears, perforations, dissections, aneurysms or pseudoaneurysms, and fistulas.• Nursing assessment of limb perfusion is imperative and includes pedal and popliteal pulses, capillary refill, and skin temperature and color. Patients with occlusion of the artery will have a cold, pallid, pulseless leg.
--	--	---

Reference	Evidence Level	Methods, key findings, outcomes or recommendations
<p>Amoozgar, H; Naghshzan, A; Edraki, M.R; Jafari, H; Ajami, G.H; Mohammadi, H; Mehdizadegan, N; Borzouee, M & Kambiz, K (2019). Arterial and Venous Complications Early after Cardiac Catheterization in Children and Adolescents: A Prospective Study. <i>Iran Journal of Pediatrics</i>, 29(5); 1-9.</p>	<p>IV</p>	<p>The study evaluated the prevalence and risk factors of arterial and venous complications among children and adolescents, below the age of 18 years, during cardiac catheterization.</p> <p>FINDINGS</p> <ul style="list-style-type: none"> • Of the total 179 vascular access performed 70% of cases were interventional procedures. • 17 arterial and 16 venous events occurred, 4% and 5% of them respectively, were more serious. • The more serious arterial complications were dissection, pseudo-aneurysm and fistula, whereas in venous access they were pseudo-aneurysm and thrombosis. • The incidence of more serious complications was highest among patients younger than 1 year of age.
<p>Brotschi, B; Hug, M.I; Kretschmar, O; Rizzi, M & Albisetti, M. (2015). Incidence and predictors of cardiac catheterisation-related arterial thrombosis in children. <i>Heart</i>, 101: 948-953.</p>	<p>IV</p>	<p>The study evaluated the incidence and predictors of arterial thrombosis in 123 children, between 0 to 19 years, with cardiac diseases undergoing cardiac catheterisation of the femoral artery.</p> <p>FINDINGS</p> <ul style="list-style-type: none"> • Arterial thrombosis occurred in 14 children; 12 of the cases were in infants less than 12 months and 2 in older children. • Overall younger age ($p < 0.01$) and low body weight ($p < 0.004$) were significantly associated with an increased risk of arterial thrombosis. • Cyanotic cardiac disease ($p = 0.07$) showed a trend towards increased thrombotic risk.
<p>Harrar, D.B; Salussolia, C.L; Vittner, P; Danehy, A; Sen, S; Whitehill, R; Chao, J.H; Bernson-Leung, M.E & Rivkin, M.J (2019). Stroke after Cardiac Catheterization in Children. <i>Pediatric Neurology</i>, 100, 42-48.</p>	<p>V</p>	<p>The study reviewed medical records of patient's b/w 0 to 18 years with a new clinically-apparent arterial ischemic stroke after cardiac catheterization within a 10 year period.</p> <p>FINDINGS</p> <ul style="list-style-type: none"> • 20 children, with a median age of 1 year, had a new clinically-apparent post-catheterization arterial ischemic stroke. • Stroke commonly occurred after balloon dilation for pulmonary vein stenosis and systemic pulmonary collateral closure. • Most common presenting symptoms were are weakness and seizure.

<p>Krasemann, T. (2015). Complications of cardiac catheterisation in children. <i>Heart</i>, 101: 915</p>	<p>VII</p>	<p>An editorial discussing common complications of catheterisation in children and management. The following points are highlighted with reference to a study by Brotschi et al (2015):</p> <ul style="list-style-type: none"> • Interventional cardiac catheterisation seems to have higher complication rate than diagnostic procedures • Severe complications include death, cerebral infarction, and cardiac injury. Minor events include transient rhythm disturbance requiring no intervention. Most frequently adverse events are vascular, mainly arterial thrombosis. • Youngest patients have the highest risk of complications. • Guidelines for the diagnosis of post procedural arterial thrombosis should be established.
<p>Marques, J.S & Goncalves, C (2014). Post-catheterisation arterial thrombosis in children – pathophysiology, prevention and treatment. <i>Cardiology in the Young</i>, 24: 767-773.</p>	<p>V</p>	<p>A narrative review reporting the prevalence, mechanisms and therapy of lower limb ischemia.</p>