**Table 1:** Summary of included studies.

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| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Author (year)** | **Country** | **Study type** | **N** | **Mean age** | **STS score** | **Study period** | **Follow-up** | **Valve type** | **Approach** | **30-day Mortality** |
| Sinhal et al. (2008)(41) | Canada | Prospective | 106 | 83.5 | - | - | 6 months | BE valves (Cribier Edwards or Edwards-SAPIEN) | Percutaneous transarterial and open-chest direct left ventricular apical ventriculotomy | - |
| Hamdan et al. (2015)(42) | Israel | Prospective | 73 | 79.8 | - | - | 30 days after TAVR | CoreValve 91.8% Engager 8.2% | Transfemoral; Transaxillary; Transapical | 0% |
| Bagur et al. (2012)(30) | Canada | Prospective | 411 | 81 ± 11 | 9.2 ± 5.7 | January 2005 to August 2010 | 30 days | Cribier-Edwards 12%  Edwards-SAPIEN 84%  SAPIEN-XT 5% | Transfemoral 54% Transapical 46% | - |
| Urena et al. (2013)(20) | Canada | Prospective | 1556 | 81±5 | With PPM = 7.2 ± 4.9  Without PPM = 7.7 ± 5.4 | January 2005 to February 2013 | 22±17 months  (mean) | SE 74.5%  BE 25.5% | Transapical/transaortic 13.4%  Transfemoral/subclavian 86.6% | 6.7% |
| Ahmad et al. (2019) A(31) | USA | Retrospective | 382 | 80.5 | All: 6.9  With PPM: 7.5  Without PPM: 6.8 | December 2012 to April 2018 | - | Sapien: 11.5%; Sapien XT:18.1%; Sapien 3: 70.4% | Femoral: 86.6% Trans aortic: 6.0% Trans apical: 6.0% Trans-iliac: 0.8% Subclavian: 0.5% | - |
| Elchinova et al. (2021)(43) | Switzerland | Prospective | 1059 | 81.7 | All: 5.4 +/- 3.8  With PPM: 4.9 +/- 2.5  Without PPM: 5.4 +/- 3.8 | January 2012 to December 2017 | 30 days, 1 year, and 3 and 5 years | BE valve: 52.4% ME valve: 6.7%  SE valve: 40.9% | - | - |
| Kostopoulou et al. (2015)(44) | Greece | Prospective | 45 | 81 +/- 5 | - | January 2010 to February 2012 | 1, 6, 12, and 24 months | CoreValve | - | - |
| Leong et al. (2017)(45) | USA | Retrospective | 67 | 80.5 | - | January 01, 2013 to December 31, 2015 | 1 month, 6 months | MCV: 52.2%  ES: 34.3%;  Others: 13.4% | - | - |
| Mazzella et al. (2020)(46) | USA | Retrospective | 347 | 78.44 | 5.39 +/- 4.32 | November 2014 to August 2019 | - | SE and BE | - | - |
| Nishiyama et al. (2016)(47) | Japan | Prospective | 90 | 84 | - | October 2013 to January 2015 | 1 month, 3 months, and 6 months | BE valve (SAPIEN XT) | Transapical: 18%; Transfemoral: 82% | - |
| Urena et al. (2012)(48) | Canada | Prospective | 202 | 80 | 7.5 ± 3.7 | - | 30 days, 6 months, 1 year, and yearly thereafter | BE valve (Sapien or Sapien XT) | Transapical: 57.9%  Transfemoral: 42.1% | - |
| Akin et al. (2012)(32) | Germany | Retrospective | 45 | 81.5 | - | January 2007 to 2008 | 1 hour after TAVI and 7 days after TAVI | CoreValve (Medtronic Inc.) | Transfemoral 100% | - |
| Ferreira et al. (2021)(49) | France | Prospective | 74 | 82 | 4.7 +-3.5 | June 2018 to July 2019 | 3 and 6 months | BE (Edwards SAPIEN 3 prosthesis)  SE (Medtronic CoreValve Evolut (R or Pro) prosthesis) | Transfemoral 100% | - |
| Zhang et al. (2021)(50) | China | Retrospective | 39 | 75 | 3.18 +- 2.81 | 2019-2021 | - | Venus A Valve | Transfemoral 100% | - |
| Sharma et al. (2017)(51) | USA | Prospective | 226 | 81 | - | March 2012 to October 2016 | 10 days and 1 month | Edwards SAPIEN valve (SAPIEN, SAPIEN XT, and SAPIEN III) | - | - |
| Pollari et al. (2019)(52) | Germany | Retrospective | 342 | 81.2 | - | July 2009 to October 2016 | 21.2 +- 18 months | Sapien 3 and Sapien XT | Transfemoral and transapical | - |
| Marzahn et al. (2017)(53) | Germany | Retrospective | 856 | 80.5 | - | July 2008 to May 2015 | - | Medtronic CoreValve; Edward Sapien XT; Edward sapien 3; Medtronic evolut R | Transfemoral | - |
| Stamou et al. (2019)(54) | USA | Retrospective | 991 | Median 85 | TF-TAVR 6 (5-8)  AA-TAVR 7 (6-9) | April 2012 and February 2019 | - | Sapien 3  Evolut  Evolut PRO/R Sapien | Majority transfemoral | - |
| Denegri et al. (2021)(26) | Italy | Retrospective | 3821 | 82 | Female: 7.8% ± 7.1%  Male: 7.2 ± 7.5 | June 2007 to July 2019 | 1 month, 12 months and then yearly after TAVR | Corevalve 57%  Evolut pro 8% Evolut R 35% | Femoral 85% Subclavian 11% Aortic 4% | - |
| Cha et al. (2021)(29) | Korea | Prospective | 206 | 77.8±7.6 | 7.2 ± 9.4 | 2011-2018 | 1 month and 3 months | CoreValve 30% Evolut 19%  Lotus 11%  Sapien 3 27%  Sapien XT 11% | Transfemoral | - |
| Malebranche et al. (2021)(55) | Switzerland | Prospective | 1439 | 83 (79–86) | 3.72 (2.49–5.58) | January 2014 to December 2019 | 30 days and 1 year | Balloon-expandable valve: 51%;  Self-expandable valve: 42%;  Mechanically expandable valve: 7% | Transfemoral | - |
| Doshi et al. (2018)(56) | United States | Retrospective | 8210 | TA-TAVR80+/-9.1  TF-TAVR  81.3 +/-8.5 | - | January 2012 to December 2014 | - | - | Transfemoral | - |
| Shivamurthy et al. (2020)(57) | USA | Retrospective | 917 | 81.4 | - | November 2011 to February 2017 | - | - | Transfemoral Transapical | - |
| De Carlo et al. (2012)(58) | Italy | Prospective | 275 | 82.4 | - | September 2007 to July 2010 | 1 and 6 months and every 6 months afterward | Third-generation (18F) CoreValve | Transfemoral or subclavian | 1.6% for PPM group  3.4% for non-PPM group |
| Schewel et al. (2018)(59) | Germany | Retrospective | 563 | 81.2 | 5.0 3.4-8.0 | July 2008 to January 2016 | - | Edwards Sapien 4.4%,  Sapien XT 44.6% or Sapien 3 51% | Transapical 8.9% Transfemoral: 87.1%  Trans-axillary: 2.4%  Direct transaortic: 1.6% | - |
| Cresse et al. (2019)(60) | USA | Retrospective | 386 | 83 | - | April 2008 to June 2017 | - | Edwards transcatheter valve 6%  Medtronic 24% | - | - |
| Buellesfeld et al. (2012)(3) | Switzerland | Prospective | 353? | 82.6 | - | 2007 and 2010 | 30 days and 12 months | Edwards Sapien/Sapien XT prosthesis or the Medtronic CoreValve prosthesis | Transfemoral | - |
| Humphries et al. (2012)(36) | Canada | Prospective | 584 | F 83  M 82 | F 7.5 (5,10.2)  M 7.5 (4.8, 10.9) | January 2005 to September 2011 | 1,6,12 months and annually after | Cribier-Edwards, Edwards SAPIEN, Edwards SAPIEN XT  Core- Valve, CENTERA | Transfemoral | 8.7% |
| Chamandi et al. (2017)(2) | Canada, Italy, Spain | Prospective | 1629 | 81 | 7.4 +-5.3 | May 2007 - February 2015 | 2 years | Sapien 11% Sapien XT 31% Sapien 3 2% CoreValve 31% Evolut R 22.5% | Transfemoral 85% Transapical 11% Transaortic 2% Subclavian 2% | - |
| Bhardwaj et al. (2018)(1) | US | Prospective | 383 | 83 | 9.0 (6.3, 11.8) | January 2012 - July 2016 | 9 months | Edwards Sapien Valve; CoreValve Prosthesis | Transfemoral, Subclavian | - |
| De Torres-Alba (61)et al. (2018) | US | Prospective | 606 | 81.6 | - | January 2014 - January 2017 | 7 days | Edwards SAPIEN 3 Valve | Transfemoral 94.4%, Transapical | - |
| Mangieri et al. (2)(2018) | Italy | Retrospective | 611 | 84.4 | 6.9 +/- 5 | January 2009 - July 2015 | 1 year | BE 51.7%;  SE 33.7% | Transfemoral | - |
| Gonska et al. (62)(2016) | Germany | Prospective | 612 | 80.4 | 6.5 +/- 4.9 | February 2014 - September 2016 | 1 month 1 year | BE ES3, Lotus valve, CoreValve Evolut R | Transfemoral | 1.8% |
| Vejpongsa (63)et al. (2018) | US | Retrospective | 18400 | 81.6 | - | 2012-2013 | - | - | Transfemoral 75% Transapical 25% | - |
| Sannino et al. (2018)  (38) | US | Retrospective | 910 | F 82  M 80.9 | F 7.9 +-3.7  M 7.1 +- 4 | January 2012 - July 2016 | - | BE and SE | Transfemoral 88% Transapical 8% Transaortic 3% Subclavian 1% | Female 2.8%  Males 2.9% |
| Doshi (56)et al. (2017) | US | Retrospective | 6174 | 81.2 | - | January 2012 - December 2014 | - | - | transapical and transfemoral | - |
| Nadeem et al. (2018)  (64) | US | Retrospective | 672 | 81.6 | With PPM 7.1 Without PPM 7.7 | 2011-2017 | 1month 1 year | Medtronic CoreValve, Edwards SAPIEN Valves | - | - |
| Costa et al. (2019)  (65) | Italy | Prospective | 1116 | 82 | 4.4 | June 2007 - February 2018 | 72 months | 61.8% SE  27.2% BE  0.5% ME  10.5% others | Transfemoral 97% Others 3% | 4.7% |
| Dolci et al. (2019)  (66) | Netherlands | Retrospective | 266 | 80 | - | February 2014-February 2018 | 12 months | 100% BE | Transfemoral 84% Transapical 16% | - |
| Meduri (67) et al. (2019) | US | Prospective | 704 | 83 | No PPM 6.5 +-4.2 New PPM 6.8 +- 3.6 | - | 30 days and 1 year | 34% SE  66% ME | - | - |
| Husser et al. (2019)  (68) | Germany Switzerland | Prospective | 296 | 81 | - | January 2014-July 2017 | 1 | Sapien 3 ACURATE neo | - | 4% |
| Ahmad et al. (2019) B  (69) | US | Retrospective | 269 | 79.5 | 6.2 | December 2012-April 2018 | - | 100% Edward Sapien 3 | - | - |
| Wang et al. (2019)  (24) | US | Prospective | 298 | Men 79 F 81 | - | December 2015-June 2018 | - | Edwards Sapien 3 78% Medtronic Evolut 21.88 | Transfemoral 99.6%  Others: 0.4% | - |
| Maeno et al. (2019)  (70) | US | Retrospective | 659 | 83 | - | January 2013- December 2015 | 19.1 months | Edwards Sapien, Sapien XT, and Sapien 3 | - | 2.6% |
| Du et al. (2020)  (71) | China | Retrospective | 256 | 76.5 | 7.1 +- 5.9 | March 2013 - October 2018 | 12 | - | - | 3.3% |
| D’Ancona et al. (2011)  (72) | Germany | Prospective | 322 | 82.4 | Non PPM 18.8 +/- 16.3  PPM 13.4 +/- 8.2 | April 2008 to March 2011 | 36 months | BE | Transapical | 5% in the PPM group and  6.4% in the non-PPM group |
| Hayashida et al. (2012)  (37) | France | Prospective | 260 | 83.1 | - | October 2006 to December 2010 | 1,3,6, and 12 months post TAVI | BE 85.4% SE 14.6% | Transfemoral 65% Transapical 31.9% Subclavian 3.1% | 15% |
| Ledwoch (73)et al. (2013) | Germany | Prospective | 1147 | 82 | - | January 2009 to June 2010 | 1 month | 80% MCV 20% ES | Surgical 10% Transapical 10% Direct Aortic 0.6% Transfemoral 87% Transaxillary 3% Transarterial 89% | 6% for PPM group  8.1% for non-PPM group |
| Buja et al. (2013)  (74) | Italy | Retrospective | 659 | 81 | - | June 2007 to December 2009 | Median 13 months | 100% SE | Transfemoral 90% Subclavian 10% | - |
| Gensas et al. (2014)  (75) | Brazil | Retrospective | 353 | 82.86 | With PPM 14.48 +- 10.56  Without PPM 14.37+- 10.04 | January 2008 to December 2012 | - | CoreValve 82.9% Sapien XT 17% | - | - |
| Nazif et al. (2015)  (76) | US | Retrospective | 1973 | 84.3 | 11.3 +-4.0 | May 2007 to September 2011 | 12 months | ES | transfemoral 52% and transapical 48% | 7.5% for PPM group  5.8% for non-PPM group |
| Dizon et al. (2015)  (77) | US | Retrospective | 2531  (1785 final) | 84.5 | 11.5 +- 4.1 | March 2007-March 2009 | 12 months | ES | - | - |
| Mouillet et al. (2015)  (78) | France | Retrospective | 833 | 82.1 | 14.1 +- 11.2 | January 2010 to October 2011 | - | CoreValveVR or CoreValve AccutrakVR | - | 7.9% for PPM group  10% for non-PPM group |
| Giustino et al. (2016)  (79) | Rotterdam (Netherlands) Milan (Italy) Toulouse (France) | Retrospective | 947 | 82.2 | No PPM 8.7 +-6.8  New PPM 8.1 +-5.5 | November 2005 to December 2011 | 14 months | 47.9% BE 52.1% SE | Transfemoral 85.2% Transaxillary 7.4% Transaortic 1.5% Transapical 9.2% | 4.9% for PPM group  5.4% for non-PPM group |
| Rodriguez-Olivares et al. (2016)  (80) | Netherlands | Prospective | 302 | 81 | - | November 2005 to January 2015 | - | MCV  ES valve XT ES valve S3  Lotus | - | - |
| Van Gils et al. (2017)  (81) | Europe | Retrospective | 306 | 83 | 6.3 | May 2008 to February 2016 | 12 months | 38.2% SE  34.7% BE  27.1% ME | Transfemoral 86% Subclavian 8%  Transapical 6% | 7% |
| Raelson et al. (2017)  (82) | US | Retrospective | 549 | 87 | - | March 2009 to December 2014 | 1 month | 21% SE/ 79% BE | - | - |
| Monteiro et al. (2017)  (83) | Brazil | Retrospective | 670 | With PPI 82.5 Without PPI 81.1 | PPI 11.1 +-8.4  Without PPI 10.2 +-7.9 | January 2008 to January 2015 | - | 74% CoreValve/ 26% Sapien XT | 96% Transfemoral 4% Others | - |
| Gaede et al. (2017)  (19) | Germany | Prospective | 1025 | 81.9 | - | 2010 to 2015 | 2-3 months | ES valve 3  ES valve XT  Symetis Acurate TA  JenaValve, Engager TA | Transfemoral, Transapical | - |
| Gonska et al. (2016)  (62) | AMsterdam, the Netherlands | Retrospective | 283 | 79.9 | 6.7 +/- 4.8 | - | - | 100% SE | - | - |
| Pellegrini et al. (2018) A  (84) | Germany | Retrospective (3) | 709 | 81 | - | January 2014 to January 2016 | - | 100% BE | 100% Transfemoral | - |
| Pellegrini et al. (2018) B  (85) | Germany | Retrospective (3) | 283 | 80.8 | - | January 2014 to January 2016 | 12 months | 100% SE | 100% Transfemoral | - |
| Fadahunsi 2016  (86) | USA | Retrospective | 9785 | 84 | PPM 7.3  Without PPM 6.7 | November 21, 2011 to Sept 30, 2014 | 12 months | 88.7% BE  11.3% SE | Transfemoral=59.1%  Subclavian=0.5%  Trans-axillary=30.8% transapical=7.5% transaortic=2.1% | 5.6% |

**Abbreviations:** AA-TAVR=alternate access transcathter aortic valve replacement; BE=Ballon expandable; ES=Edwards Sapien; ME=mechanically expanding; MCV=Medtronic Corevalve; PM=Pacemaker; PPI=Permanent pacemaker implantation; PPM=Permanent pacemaker; PMI=Pacemaker implantations; SE=Self-expandable; STS-PROM=Society of Thoracic Surgeons-Predicted Risk of Mortality; TA=Trans-apical; TF-TAVR=transfemoral transcathter aortic valve replacement